Replacing an Active AMD Treatment System with Semi-Passive Techniques

- Background Information
- Site Characterization
- Conceptual Site Model
- Water Treatment Approach

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Active Mining - 1993

- Coal Refuse Area #5
- Coal Refuse Area #4
- Coal Refuse Area #6
- Treatment Plant
Existing ARD Treatment

- Hydrated Lime Feed Plant
  - Mix alkaline media to neutralize pH and precipitate metals
  - 25+ yrs old
  - Weak structural integrity
  - Inadequate pump system
  - Remote – Power Outages
  - Single stage treatment
    - Insufficient Mn/Al removal

- Treatment Alternatives Analysis
  - Identify and Characterize the source
Site Characterization

- Review Historical Data
- Inventory ARD Sources
- Establish Monitoring and Gaging Stations
- Evaluate Water Chemistry and Contaminant Loadings
- Identify Treatment Alternatives
Data Analysis – Surface Water Flow

- Upper creek base flow is due primarily to Seeps 1 & 2 (at SG-A) and Seep 3 (at SG-B)

- Flow increases at SG-C much greater than Seep 5 input.

  Suggests groundwater influx
Groundwater Influence

- Pumping tests: low K (0.07-0.14 f/d) in upper reaches; higher K (0.6-1.8 f/d) in lower
- Strong GW-SW interaction in lower valley (MW-13-04)

<table>
<thead>
<tr>
<th>WELL</th>
<th>METHOD OF ANALYSIS</th>
<th>TRANSMISSIVITY (ft²/day)</th>
<th>LENGTH OF SATURATED SCREEN INTERVAL (ft)</th>
<th>HYDRAULIC CONDUCTIVITY (ft/day)</th>
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<tbody>
<tr>
<td>MW-13-05</td>
<td>Neuman</td>
<td>4.17</td>
<td>7.35</td>
<td>0.57</td>
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<td>Theis - Recovery</td>
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<td>MW-13-04</td>
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<td>7.89</td>
<td>58.4*</td>
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<td>Theis - Recovery</td>
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<td>46.5*</td>
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<td>4.9</td>
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<td>MW-13-02</td>
<td>Theis - Recovery</td>
<td>0.446</td>
<td>6.65</td>
<td>0.07</td>
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* Hydraulic conductivity is not considered highly accurate due to insufficient pumping rate and length of test.
Groundwater Influence

- GW Flow rate 0.02 f/d (upper) and 0.4 f/d (lower)

- GW quality is generally good
  - Neutral pH
  - Iron < 10 ppm
- Flow increase and WQ improvement downstream due to GW influx
Data Analyses – Acidity Loadings

- Conceptual Site Model –
  - Acidity Loadings (pH, Fe, Al, Mn, flow rate)

- Compare acidity loadings from each source to the total acidity load observed at the treatment plant (as a percentage of the total loading at the site)
  - Identify data gaps
  - Prioritize treatment areas
Acidity Loadings Comparison

Seeps 1 + 2
Seep 3
Seep 4
Seep 5

Outfall
Active Treatment Plant
CCC

Acidity Load Contributions

Total Avg Acidity Load = 2700 lbs/day
Water Treatment Alternatives

- **Active Treatment**
  - Uses chemicals, energy, labor, and infrastructure (high O&M)
  - Shortest HRT and smallest possible footprint

- **Passive Treatment**
  - Low-energy dynamics employed in natural biological and geochemical processes at ambient temperatures
  - No moving parts or power requirements
  - Low O&M
  - Long HRT and large footprint

- **Semi-Passive Treatment**
  - Utilizes moving parts and chemicals WITHOUT continuous power and labor required for active systems.
  - Treat at the source
Pebble Quicklime at ARD Source

- Aquafix – water wheel driven chemical feed system
Pebble Quicklime at ARD Source
Pond 14 Lime Dosing Footprint

400 sf
Passive Mixing/Aeration – BioMost, Inc

MixWell

A-Mixer

MixWell

A-Mixer

BioMost, Inc

BioMost, Inc
Passive Aeration - Trompe

- Water-powered air compressor

- For every 4’ TDH, = 1 cfm/25 gpm

- Pond 14 Outfall = 13’

- 3 Trompes in series = 4 CFM at base flow
Seep 3 Lime Dosing
Seep 5 Passive Treatment

- Added alkalinity from upper lime dosing systems
- “Clean” groundwater influx
- Controlled releases of stormwater ponds above the site
  - Currently piped to below permitted outfall
- Constructed Wetlands
Semi-Passive Treatment

- Capital costs << Completely Passive System
- Annual O&M costs << Active System
- No power = reliable treatment
- Treating at the source allows passive polishing systems to be installed downstream
  - Manganese removal beds
  - Open Limestone Channels
- Cost-effective bandage approach
  - Buys time to explore source control efforts
Questions?

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