Evaluating the effects of moving to a low maintenance ARD control strategy at the Victoria Junction coal tailings site

Paul Ziemkiewicz, PhD
Director, West Virginia Water Research Institute
Peckham, D. and Kehoe, A.
Enterprise Cape Breton Corporation

Pre-closeout surface water system

Pre-closeout acid base balance

<table>
<thead>
<tr>
<th>Acid-Balance Victoria Junction</th>
<th>net acid load (tonnes/yr)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Situation</td>
<td>Source</td>
</tr>
<tr>
<td>A System In**</td>
<td>VI ST 2017</td>
</tr>
<tr>
<td>B Smith Brook: SBU</td>
<td>WW</td>
</tr>
<tr>
<td>C Polishing pond: PP</td>
<td></td>
</tr>
<tr>
<td>D All AMD sources***</td>
<td>LCS</td>
</tr>
<tr>
<td></td>
<td>2 WW</td>
</tr>
<tr>
<td></td>
<td>3 PT</td>
</tr>
<tr>
<td></td>
<td>4 SBD</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

E System Out** VI ST 2016 -190.1
F net alkaline sources [A+B+C] -160.3
unaccounted alkalinity (E-F) -29.8

Shut-down schedule

<table>
<thead>
<tr>
<th>Monitoring Project</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1. Historic</td>
<td></td>
</tr>
<tr>
<td>Phase 2. Initial sampling</td>
<td></td>
</tr>
<tr>
<td>Phase 3. Implementation</td>
<td></td>
</tr>
<tr>
<td>Phase 4. Post-closure</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period List</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>Monitoring Project</td>
<td></td>
</tr>
<tr>
<td>Phase 1. Historic</td>
<td></td>
</tr>
<tr>
<td>Phase 2. Initial sampling</td>
<td></td>
</tr>
<tr>
<td>Phase 3. Implementation</td>
<td></td>
</tr>
<tr>
<td>Phase 4. Post-closure</td>
<td></td>
</tr>
</tbody>
</table>

© by Authors and IMWA
Key questions

- The monitoring program is meant to address six questions with respect to the environment adjacent to and down gradient of the CWRP. Three will be addressed during phase 1: historical analysis:
  1. The effect of capping the CWRP on water quality and aquatic life in Northwest Brook
  2. The effect of capping the CWRP on wetland vitality
  3. The effect of capping the CWRP on groundwater

- Three further questions will be addressed after implementation of the closure plan:
  1. The effect of closing the WTS on water quality and aquatic life in Northwest Brook
  2. The effect of closing the WTS on wetland vitality
  3. The effect of closing the WTS on groundwater

Criteria for success

- The success of the closure plan will be measured by whether the water quality of Northwest Brook, measured at VJ ST 2016 improves downstream of VJ ST 100 or deteriorates below MMER or CCME-FAL water quality standards.

- The distinction is made since the water leaving Grand Lake was measured by AMEC’s 2008 monitoring below a pH of 6.5 and in excess of mercury standards on several occasions.

Shut-down sequence

<table>
<thead>
<tr>
<th>Implementation Project</th>
<th>Project Month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>Phase 1</td>
<td></td>
</tr>
<tr>
<td>Turn off LCS/WW pumps</td>
<td>X</td>
</tr>
<tr>
<td>Phase 2</td>
<td></td>
</tr>
<tr>
<td>Reduce PT pumping 50%</td>
<td>X X X X X</td>
</tr>
<tr>
<td>Phase 3</td>
<td></td>
</tr>
<tr>
<td>Install ALD at WW</td>
<td>X</td>
</tr>
<tr>
<td>Phase 4</td>
<td></td>
</tr>
<tr>
<td>Install LLB @ SBU A^2</td>
<td>X</td>
</tr>
<tr>
<td>Phase 5</td>
<td></td>
</tr>
<tr>
<td>Install OLC @ SBD A^2</td>
<td>X</td>
</tr>
</tbody>
</table>

Shut-down sequence, Q1

<table>
<thead>
<tr>
<th>Acid-Base Balance Victoria Junction</th>
<th>Phased shutdown of WTS</th>
<th>Q1</th>
<th>not</th>
<th>acid load</th>
<th>Reduce D3 pumping by 50%/quarter (tonnes/yr)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A System In VJ ST 2017</td>
<td></td>
<td>-131.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Smith Brook SBU</td>
<td></td>
<td>-24.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Polishing pond PP</td>
<td></td>
<td>-2.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D All AMD sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 LCS</td>
<td>9.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 WW/ALD</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 PT</td>
<td>56.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 SBD-OLC</td>
<td>5.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71.2</td>
<td>71.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E System Out VJ ST 2016</td>
<td></td>
<td>-86.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Negative values represent alkalinity

Passive treatment will be installed as indicated by monitoring during shut-down

- The closeout plan involves installation of three passive treatment units:
  1. Limestone leachbed (LLB) immediately downstream of the railroad culvert at the head of the SBD channel
  2. Open limestone channel (OLC) in the SBD channel
  3. Anoxic Limestone Drain (ALD) at the wet well:
Scenario 3e: End of the evaluation period, assumes that all
ARD from the LCS and PT comes to the surface and is
partially addressed by passive treatment in SBD and WW

Acid/base balance

<table>
<thead>
<tr>
<th>sampling date</th>
<th>Grand Lk outlet</th>
<th>NWB US</th>
<th>upper Smith Rk</th>
<th>lower Smith Rk</th>
<th>NWB DS</th>
<th>Net from VJ site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Sep-09</td>
<td>-203</td>
<td>-158</td>
<td>-8</td>
<td>-17</td>
<td>-314</td>
<td>111</td>
</tr>
<tr>
<td>15-Oct-09</td>
<td>-240</td>
<td>-150</td>
<td>-33</td>
<td>-31</td>
<td>205</td>
<td>-36</td>
</tr>
<tr>
<td>1-Nov-09</td>
<td>-205</td>
<td>-175</td>
<td>-20</td>
<td>-6</td>
<td>340</td>
<td>135</td>
</tr>
<tr>
<td>9-Dec-09</td>
<td>0</td>
<td>-56</td>
<td>-19</td>
<td>-63</td>
<td>107</td>
<td>107</td>
</tr>
<tr>
<td>13-Jan-10</td>
<td>-93</td>
<td>-53</td>
<td>-19</td>
<td>-100</td>
<td>42</td>
<td>-51</td>
</tr>
<tr>
<td>10-Mar-10</td>
<td>-66</td>
<td>-49</td>
<td>-40</td>
<td>-64</td>
<td>-258</td>
<td>192</td>
</tr>
<tr>
<td>19-Apr-10</td>
<td>-92</td>
<td>-16</td>
<td>-123</td>
<td>-47</td>
<td>263</td>
<td>171</td>
</tr>
<tr>
<td>13-May-10</td>
<td>-251</td>
<td>-146</td>
<td>-10</td>
<td>-8</td>
<td>455</td>
<td>204</td>
</tr>
<tr>
<td>10-Jun-10</td>
<td>-316</td>
<td>-248</td>
<td>-33</td>
<td>-20</td>
<td>285</td>
<td>-31</td>
</tr>
<tr>
<td>14-Jul-10</td>
<td>-108</td>
<td>-57</td>
<td>-57</td>
<td>-41</td>
<td>-346</td>
<td>238</td>
</tr>
</tbody>
</table>

Net acid load (tpy) upstream and downstream of Victoria Junction

[Al] µg/L upstream and downstream of Victoria Junction

[Cd] µg/L upstream and downstream of Victoria Junction

Questions?