Integrating ARD Prevention into the Mt. Milligan Project

December 2008
Project Information

- Project is 155 km northwest of Prince George, BC
- Proven and Probable Mineral Reserve - 334 Mt averaging 0.22% copper and 0.43 grams per tonne gold
- Large scale open pit mining from two pits
- 60,000 tonnes per day processing plant
- Peak mine production of 44 Mt/a @ 0.82 waste:ore strip ratio
- Conventional copper-gold concentrator with flotation
- Two tailing streams:
  - cleaner tailing (7,200 tpd)
  - scavenger tailing (52,800 tpd)
- Capital cost of $917 million
- 700 direct jobs during construction and 400 jobs during operations
Over 1000 drill holes!
• Mineralogical studies of fresh and weathered rock
• over 1800 Acid Base Accounting (ABA) assays
• over 5000 multi-element scans
• 59 shake flask extractions
• 56 Net Acid Generation tests
• 23 tailing solution assays from metallurgical studies
• 7 column tests
• 16 humidity cell tests.
Results from ABA
Block Model Results – NP and S

Southern Star

NP (t CaCO₃ / 1000 t)

66

MBX

0.00 <= 40.000
40.000 <= 60.000
60.000 <= 80.000
80.000 <= 100.000
100.000 <= 1000.000

0.001 <= 0.500
0.500 <= 1.000
1.000 <= 2.000
2.000 <= 3.000
3.000 <= 1000.000

S (%)
• Two types of tailing:
  – Scavenger tailing is low sulphur – NAG
  – Cleaner tailing is high sulphur (HCT generated ARD in 2.6 years) – PAG
• From the block model, about 37% of the waste rock (25% of the total waste including overburden) has a NPR less than one
• PAG and NAG waste rock blocks tend to cluster
• Acidic drainage has not been produced from laboratory testing of waste rock.
  – High sulphur/low carbonate (NPR = 0.5) HCT ran for 9.5 years generated neutral pH leachate with low metal concentrations.
  – NAG test results are consistent with ABA
  – Humidity cells and sequential NAG suggest NPR cutoff between one and two
  – Nevertheless chose a NPR segregation criteria of 2.0
• Oxide/weathered waste rock somewhat higher metal leaching compared to non-oxidized waste rock
Waste Management Principles

- Segregate and submerge PAG waste rock and cleaner tailing
- Segregate and submerge oxide/weathered waste rock
- Use NAG waste rock and overburden for construction
- Use scavenger tailing for TSF cover material
# Annual Waste Material Production

<table>
<thead>
<tr>
<th>Year</th>
<th>Overburden (kt)</th>
<th>Weathered Rock (kt)</th>
<th>Oxide (kt)</th>
<th>VH NAG (kt)</th>
<th>High NAG (kt)</th>
<th>Low NAG (kt)</th>
<th>Low PAG (kt)</th>
<th>High PAG (kt)</th>
<th>Total (kt)</th>
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<tbody>
<tr>
<td>2010</td>
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<td>1,669</td>
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<td>745</td>
<td>2,021</td>
<td>497</td>
<td>22,100</td>
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<td>127</td>
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<td>43</td>
<td>488</td>
<td>3,339</td>
<td>1,292</td>
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<td>2,537</td>
<td>954</td>
<td>1,170</td>
<td>346</td>
<td>2,147</td>
<td>3,291</td>
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<td>7,208</td>
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<td>5,907</td>
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<td>12,326</td>
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<td>579</td>
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<tr>
<td>Total</td>
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<td>26,771</td>
<td>15,242</td>
<td>30,555</td>
<td>8,673</td>
<td>37,027</td>
<td>56,442</td>
<td>13,074</td>
<td>275,007</td>
</tr>
</tbody>
</table>
**Pit Material**

- PAG Waste Rock
- Overburden
  - Sand & Gravel
  - Till
- Oxide/Weathered Waste Rock
- NAG Waste Rock
- Esker Borrow

**Transfers**

- Pit Material Transfer
- PAG Waste Rock to Pit Disposal
- Overburden Sand & Gravel to Dam Core/Liners
- Oxide/Weathered Waste Rock to TSF Dam – Shell
- NAG Waste Rock to TSF Causeway
- Esker Borrow to Dam – Filters

**Destination**

- Pit Disposal
- TSF Disposal
- Dam Core/Liners
- West Separator Berm
- TSF Dam – Shell
- TSF Causeway
- Dam – Filters
## Waste Distribution by Final Destination (kt)

<table>
<thead>
<tr>
<th>Location</th>
<th>Overburden</th>
<th>Weathered Rock</th>
<th>Oxide</th>
<th>VH NAG</th>
<th>High NAG</th>
<th>Low NAG</th>
<th>Low PAG</th>
<th>High PAG</th>
<th>Total</th>
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<tbody>
<tr>
<td>TSF Core Zones</td>
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<tr>
<td>Downstream Fill</td>
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<td>0</td>
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<td>5,200</td>
<td>40</td>
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<td>63,523</td>
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<td>TSF Upstream Fill</td>
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<td></td>
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<td>WSB – Core Zone</td>
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<td>1,388</td>
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<tr>
<td>West Separator Berm</td>
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<td>P C Causeway</td>
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<td>27</td>
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<td>18</td>
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<tr>
<td>PAG Separator Dyke</td>
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<td>MBX-66 Backfill</td>
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<td>5,210</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>87,222</strong></td>
<td><strong>26,771</strong></td>
<td><strong>15,242</strong></td>
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<td><strong>56,442</strong></td>
<td><strong>13,074</strong></td>
<td><strong>275,006</strong></td>
</tr>
</tbody>
</table>
Implementation Plan Elements

- maintain and develop the ARD block model
- test blast hole samples to verify the accuracy of the ARD block model and make adjustments as necessary
- implement the segregation plan using geological and engineering controls and a dispatch system
- maintain and check records to ensure that the management plan is followed as planned
Dispatch System

• Every piece of production equipment (e.g., shovels, haul trucks, track dozer) will have GPS
• Dispatcher located in a look-out above the open pit will operate the system.
• Engineering department will transmit bench plans to the shovel and track dozer operators.
• Operators will see on screens plans with ore/waste and ARD boundaries and the location of their equipment relative to the bench plans in real time.
• The shovel and/or track dozer will segregate waste units according to the bench plan.
• Dispatch system will transmit the nature of the material and the required dump location for each load to screens in the truck driver cabs.
# Site Analytical Methods

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>No. Samples/Year</th>
<th>Analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxide/Weathered</td>
<td>30</td>
<td>Visual with occasional samples tested for acid soluble copper</td>
</tr>
<tr>
<td>NAG/PAG waste rock</td>
<td>400</td>
<td>Leco S and CO2 (surrogate for NP) and ICP Ca (additional surrogate)</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>External lab ABA</td>
</tr>
</tbody>
</table>
“WASTE IS MORE IMPORTANT THAN ORE”