Equity Mine – 25 Years of Closure

Cody Meints – Site Supervisor, Equity Mine
Mining History
Production Statistics

• Production from 1980 to 1993
• Silver 72.3 million oz
• Gold 498,000 oz
• Copper 189.6 million lbs
• 21,500 tonnes/day mined
• 9,000 tonnes/day milled
• Averaged 158 employees
Mine Plan
Milling
Milling
Decommissioning - 1994
Plant Site – Before and After
Acid Rock Drainage
ARD Generation

Equity first learned that the waste rock and ore would oxidize and produce ARD in 1982 after a year and a half of construction and two years of production.
## Baseline Sampling

<table>
<thead>
<tr>
<th>Hole</th>
<th>Depth (m)</th>
<th>Date</th>
<th>Neutralizing Potential</th>
<th>Paste pH</th>
<th>Max Potential Acidity</th>
<th>Net Neutralizing Potential</th>
<th>NPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>23-26</td>
<td>08/29/73</td>
<td>31.40</td>
<td>6.20</td>
<td>271.00</td>
<td>-239.60</td>
<td>0.12</td>
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<td>72</td>
<td>52-56</td>
<td>08/29/73</td>
<td>24.50</td>
<td>8.10</td>
<td>292.00</td>
<td>-267.50</td>
<td>0.08</td>
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<td>75</td>
<td>28-32</td>
<td>08/29/73</td>
<td>19.60</td>
<td>6.90</td>
<td>101.00</td>
<td>-81.40</td>
<td>0.19</td>
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</tbody>
</table>
Baseline Sampling

A total of three samples were collected prior to mining for ABA analysis
• Samples collected from drill core and only represented the ore deposit not the waste rock
• No kinetic testing, only static ABA tests

A lack of knowledge about ARD within the industry at the time allowed this statement from the environmental consultant in charge of the base line studies at Equity:
• “Drill core samples of ore were tested by BC Research to study the rock’s acid producing potential. These tests indicated that under acidic conditions the rock has the potential of producing acid water. Because the rock will not be artificially acidified and the climate is not hot and humid, acid production from the dumps is not anticipated.”

The company and government accepted this statement since it is what they wanted to hear. As a result no consideration was given at the design or construction stage to include any mitigation for the potential of ARD in the future.
Baseline Sampling

• Consultants assumed that the cold weather in Northern Canada would inhibit oxidation

• The opposite is true – the cold weather might initially slow the oxidation, but once oxidation begins the cooler ambient temperatures in the winter set up venting conditions that ‘pump’ oxygen through the waste rock dumps
Mine Plan

With no thought of ARD mitigation the mine plan was developed strictly to economically mine the deposit:

- Initial waste rock was used for the plantsite backfill, a tailings starter dam, and road construction
- The mining started with the Southern Tail pit as it had the highest metal values and could pay down the debt quicker
- The waste rock dumps were constructed close to the open pits, in an area that sloped down towards Bessemer Creek
ARD Sources

ARD Storage and Treatment

#1 Dam Seepage
20% volume
4% acidity

Waste Rock Stockpiles
65% volume
94% acidity

Reclaimed Plantsite
15% volume
2% acidity
ARD Cycle

ARD Collection → ARD Storage → ARD Treatment → Treated Water Storage → Treated Water Discharge
Waste Rock Dumps
Waste Rock Dump Cover

Original waste dump cover was 1 metre of uncompacted till
- 40% infiltration

Final cover started in 1990 to reduce water infiltration
- 0.5 m compacted till
- 0.3 m uncompacted till
- expected 2 to 5% water infiltration & decreased oxygen infiltration
Waste Rock Dump Cover
Waste Rock Dump Monitoring
Cover Moisture Content

Neutron probe measures moisture content within the cover.
Main ARD Pond Acidity

Acidity (mg/L)

0 5000 10000 15000 20000 25000

Tailings Facility
Tailings Facility

- 35 million tonnes PAG tailings in a 120 Ha pond
- Water cover 1.5 m to 8 m (5.6 Mm³)
- Decant/pump excess water to Diversion Pond or Main Zone pit for discharge
- Periodic lime slurry addition to raise pH
- Potential for reprocessing to remove Au, Ag, S
- Annual geotechnical review, daily inspection by staff, automated monitoring system
Tailings Dams Remote Monitoring

Instrumentation includes:
• 10 GNSS (GPS) receivers
• automatic total station (6 prisms)
• 18 piezometers
• 5 cameras
• 1 weather station
• 2 pond water level stations
Tailings Dams Remote Monitoring

- GPS
- Solar Panel
- Battery Box
- Data Logger
- Vibrating Wire Piezometer & Inclinometer
- Radio Antenna
Remote Monitoring – GNSS
Remote Monitoring – Prisms
Remote Monitoring – Vibrating Wire Piezometers
Remote Monitoring – Camera Views

Dam #1 Pumphouse Camera 2018-04-10 13:42:18

Dam #2 Office Camera 2018-04-10 13:31:49

Diversion Dam Splitter Dike Camera 2018-04-04 18:53:20
Remote Monitoring – Weather Station

Graphs showing Air Temperature, Air Pressure, Wind Speed, Temperatures, and Wind conditions over the last 96 hours.
Remote Monitoring – Water Level Indicators
Tailings Dams Remote Monitoring – Alarms

View Alarm (Alarm Enabled) - OK

Name: Pond Water Level
Revision: 0
Owner: System Administrator
Description: Alarm to determine if pond water elevation has changed dramatically.

Conditions

<table>
<thead>
<tr>
<th>Merge Operator</th>
<th>Data Type</th>
<th>Sensor Link Mode</th>
<th>Evaluation</th>
<th>Condition Type</th>
<th>Reference Date</th>
<th>Attention Threshold</th>
<th>Warning Threshold</th>
<th>Alarm Threshold</th>
<th>No Data Threshold</th>
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<tbody>
<tr>
<td>1</td>
<td>Where</td>
<td>Length</td>
<td>Specific Sensor(s)</td>
<td>Avg of (3)</td>
<td>Relative Measurement (m)</td>
<td>7 Days</td>
<td></td>
<td></td>
<td>1 Day</td>
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<td></td>
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</tr>
<tr>
<td>Dam No. 1 Pond Elevation (Water Above Sensor)</td>
<td>1,291.784 m (04/04/2018 13:46:20)</td>
<td>1,291.784 m (28/03/2018 13:46:20)</td>
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<tr>
<td>2</td>
<td>And</td>
<td>Length</td>
<td>Specific Sensor(s)</td>
<td>Avg of (3)</td>
<td>Relative Measurement (m)</td>
<td>7 Days</td>
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<td></td>
<td>1 Day</td>
</tr>
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<tr>
<td>Dam No. 2 Pond Elevation (Water Above Sensor)</td>
<td>1,291.785 m (04/04/2018 12:30:00)</td>
<td>1,291.766 m (28/03/2018 12:30:00)</td>
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</table>
ARD Treatment
High Density Sludge (HDS) Treatment Plant

- 2,500 USG/min normal operating flow rate
- Capable of 5,000 USG/min emergency flow rate in “low density mode”
- 2 high volume paste slakers
- Lime addition to pH 8.5 for metals removal
- 25 m diameter clarifier, flocculant addition
- Sludge recycle to create high density sludge which quickly settles
- Treated water and sludge to Main Zone Pit
ARD Treatment and Statistics

1985 to 2017 Averages:
• Treated ARD volume: 970,000 m³
• Lime consumption: 4628T

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>Acidity (mg/L CaCO3 eq)</th>
<th>Copper (mg/L)</th>
<th>Iron (mg/L)</th>
<th>Zinc (mg/L)</th>
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</thead>
<tbody>
<tr>
<td>ARD Avg</td>
<td>2.6</td>
<td>7585</td>
<td>54</td>
<td>817</td>
<td>117</td>
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<tr>
<td>ARD Min</td>
<td>2.0</td>
<td>2290</td>
<td>17</td>
<td>176</td>
<td>39</td>
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<tr>
<td>ARD Max</td>
<td>3.2</td>
<td>17200</td>
<td>120</td>
<td>1941</td>
<td>240</td>
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<tr>
<td>Treated Avg</td>
<td>8.6</td>
<td>0</td>
<td>0.0096</td>
<td>0.104</td>
<td>0.017</td>
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</tbody>
</table>
- 700 T lime storage
- 4628 T annual usage
- 970,000 m$^3$ ARD treated
- Average acidity 7585 mg/L
Hydrology
Consequences of Getting the Hydrology Wrong

• 1997 – Diverted low strength ARD to environment
  ➢ Insufficient ARD pumping capacity at Main Pond
  ➢ Decreased ARD collection catchment, but only minor pumping improvements – see if ARD could be decreased

• 2002 – Diverted low strength ARD, under-treated ARD
  ➢ Insufficient ARD pumping capacity at Main Pond
  ➢ Insufficient treatment capacity
  ➢ Insufficient ARD storage capacity

• Extensive upgrades to the ARD collection and treatment system completed
  ➢ New pumphouse and pipelines for Main Pond (2002)
  ➢ Increased ARD storage and treated water capacity (2002)
  ➢ Significant increase in ARD storage (2003 - 2008)
Main Pond Pumphouse (Upper)

- Three 250 HP pumps each capable of 2,000 USG/min
- Two 16” pipelines to Storage Pond with connection to HDS plant
- Can be operated using with emergency backup power
- 10,000 USG/min pumping capacity from Main Pond with old and new pumphouses
Emergency ARD Storage

- Capacity of 700,000 m³
- Can store approximately three quarters of annual year
- Extra storage for large flow events or significant breakdown in treatment plant
Emergency ARD Storage – Sludge Removal

Sludge removal to MZP

- Thick sludge could be hauled
- Wetter sludge could be pumped
HDS Plant Construction
2007 Freshet – Highest on record

- 2007 freshet started with 100 cm snowfall in October 2006
- Highest snow pack on record for site and region
- Rapid melt after mid May
- Regional flooding
- No issues at Equity site
2011 Freshet

- Average Snow pack until mid April
- Significant precipitation in April and May (rain and snow)
- Regional flooding
- Emergency ARD Pond used for 20,000 m³ of ARD
- 161,000 m³ collected from Main Pond during peak week
Environmental Monitoring
Site Discharge

- 2002 to 2017 average 2,190,000 m³ water discharged off site
- 2/3 discharged to Buck Creek
- 1/3 discharged to Foxy Creek
- 3:1 Dilution Required by MoE Permit
Environmental Effects Monitoring

Every 4 years as per MoE permit PE-4475

- Environmental health of Foxy Creek, Buck Creek, and Goosly Lake
- Fish, Benthic Invertebrates, Periphyton, Sediment
- Ceriodaphnia and rainbow trout bioassays
Security Bond
Security Bond Review

- Long term security bond held as letter of credit - currently $87.722 M
- Components of the security calculation are fixed costs, variable costs, lime costs, periodic costs.
- Triggers used between five year bond review intervals to minimize risk of under-funding (lime unit cost, lime use, power)
- Uncertainty lies mainly in lime consumption, but also in unit costs and interest rates
- MEMPR, MoE, NRCan, Local Landowner, Goldcorp attend meetings (First Nations, DoH, EC invited)
Security Bond Review

- Actual Lime Use
- 1991 Com. $32 M
- 1995 Com. $21.6 M
- 1995 Com. $24 M
- 2000 Com. $23.55 M
- 2005 Com. $51.059 M
- 2010 Com. $56.291 M
- 2015 Com. $82.467 M
## Bond Components

<table>
<thead>
<tr>
<th>Fixed Costs</th>
<th>Variable Costs</th>
<th>Periodic Costs</th>
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</thead>
<tbody>
<tr>
<td>Salaries (op/r&amp;m)</td>
<td>Power</td>
<td>Major equipment repair</td>
</tr>
<tr>
<td>Benefits</td>
<td>Supplies</td>
<td>Cover repairs (major and minor)</td>
</tr>
<tr>
<td>Services Purchased</td>
<td>Pumps &amp; piping</td>
<td>EEM studies</td>
</tr>
<tr>
<td>Road Maintenance</td>
<td></td>
<td>Major infrastructure maintenance</td>
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<tr>
<td>Equipment maintenance</td>
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<td>Geotech Reviews</td>
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Knowledge Sharing
Wildlife
360° Virtual Tour by VRify
360° Virtual Tour by VRify

www.goldcorp.com > Portfolio > Closed Sites > Equity