Brunswick Mine

Environmental Management

MEND Workshop
May 24th, 2006
Site Overview

~ One of World’s Largest Zinc Lead Mines
~ Operating Since 1964
~ Underground Produces 10,000 Tonnes/day of Ore
~ 804 Hectares in Headwater of Little River
Issues Faced Today

~ Mine Developed 42 Years Ago
~ Water Management - Ground & Surface
~ Waste Management - Tailings, Sludge & Hazardous Wastes
~ Mine Closure
Water Management

~ All Contaminated Water Is Collected
~ No. 6 Open Pit
  ~ Surface Run Off Directed to Pit
  ~ Pit Water Pumped to No. 12 for Treatment
~ No. 12 Mine
  ~ All Surface Flows Directed To ETP
  ~ Tailings Seepage & Groundwater Emerge in Lower Ponds
No. 6 Mine Water Management
- Benthic Communities in Knights and Austin Brooks Similar to Reference
- Evidence of Transition from ARD Impacted Streams
- Loadings in Austin Brook at Design
- Loadings in Knights Brook Slightly Above Design
2005 Water Treatment

~ ETP Designed in 1992
~ MMER 2002
~ DFO Warning Letter 2004
~ Secondary Clarification By-pass Pump
Effluent Treatment Plant (ETP)

- Lime slurry
- Recycled sludge
- Water
- Air
- Flocculant
- Treated water
- Sludge disposal
- Recycled sludge

- Lime/Sludge Mixing Tank
- Rapid Mix Tank
- Reactor Tank
- Clarifier
- Flocculant Mix Tank
pH at Mouth of South Little River

- Median > 6
- LSL

- 2001
- 2002
Thiosalt Management

- pH Barrier to Rehabilitate in South Branch LR
- 2000 Government Imposed
- 2002 Optimize Natural Oxidation
- 2003 Chemical Treatment Design
- 2004 Implemented Thiosalt Treatment
- 2005 Water Management to Reduce Cost
Thiosalt 2005 – Quarry Reclaim
Thiosalt 2005 – Quarry Reclaim
Thiosalt 2005 - EEM Study

~ South Branch Little River (immediate receiver)
~ Upper near-field area and a lower far-field area on the (Main Branch) Little River
~ North Branch Little River, un-impacted reference.
The Presence and Density of Fish Was Higher than Expected at the Upper (Near-field) Area.

The Abundance and Diversity of Fish Found in the South Branch Little River Exceeded Expectations.
The Fish Community Were Predominantly White Suckers, Minnow Species, Sticklebacks, Brook Trout

“Overall, the fish community assessment results were very positive, especially relative to historical surveys which found no or very few fish in both the South Branch Little River and the (Main Branch) Little River, respectively”
Closure Plan
Sludge Management Closure Plan
Closure Plan – Dam Cover
**Historical Loadings**

- **Early 1980’s** - Zn was ~ 30 mg/l at Mouth of South Little River and 10 to 14 mg/l at Basin.
- **Mid 1980 - 1993** - Lime neutralization and sludge settlement in ponds - Zn averaged 1.5 mg/l at Mouth of LR South and 0.5 to 0.7 mg/l at Basin.
- **1993** - High density sludge - Zn averages 0.2 mg/l at the Basin.

**Figure 6.2: Typical Current and Historic Zinc Loadings to the Little River, 1980 to Present**

- Early 1980s
- Pre-ETP (1989-92)
- Current condition (1995-98)

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<td>Stn 1109</td>
<td>1,163</td>
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<td>793</td>
<td>28</td>
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<td>Stn 1114</td>
<td>73</td>
<td>14.9</td>
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~ ETP - 2.6 tonnes
~ Buffer Pond - 1.4 tonnes
~ Unexplained - 2.7 tonnes
~ Unnamed Brk - 0.4 tonnes
~ Total 7.1 tonnes
~ Runoff to Main Branch
~ 7.8 tonnes
~ Total Mouth Little River
~ 14.9 tonnes
FIGURE 9.2: MEAN ANNUAL ZINC CONCENTRATIONS IN THE LITTLE RIVER UNDER THE NO. 12 MINE CLOSURE SCENARIO

- Current condition (1995-98)
- Short-term transition
- Long-term closure

Mean annual zinc concentrations for different stations under the No. 12 mine closure scenario.
Conclusions - Impacts of Closure

- Stable pH Conditions Acceptable to Aquatic Life
- Zn Loadings Will Decrease by ~1.3 tonnes/yr Short Term and an Additional ~ 0.5 tonnes/yr Long Term
- Zn Will Be Unaffected in LR Remaining at 0.2 mg/l
- The 2.7 tonnes/yr Unexplained Is ~ 20% of Total Projected Loadings, If Reduced Still Minimal Change in Zn Concentration in LR
- Zn Conc. Will Increase in SLR Due to Less Dilution
Conclusions - Impacts of Closure

~ Biological Conditions in Main Branch LR Will Improve Mainly Due to Stable pH

~ Based on Mesocosm Study, LR Adverse Effects Will Not Occur

~ Zn of 0.2 mg/l in LR Will Allow Some Level of Salmon Productivity

~ Zn Levels in SLR (0.5-0.6 mg/l) Will Prevent the Establishment of a Permanent Fish Community
FIGURE B.17
DETAIL OF TOE DRAIN MODEL RESULTS

ACCESS RAMP
TOE DRAIN
TILL BUND
The Hydraulic Conductivity Of The Fractured Bedrock (1.5 - 3 M) Most Pronounced Effect

85-95 % of Seepage Reports to SBLR Within 120 M of Dam

This Seepage Combined with ETP Discharge is the majority of the SBLR’s 7.1 t/a

No Indications of a Significant Deep Groundwater Plume

Possibility to Reduce Loadings with Collection System (0 to 50% ?)
Questions?