Controlling Surface Water at One of Canada’s Largest Base Metals Operations: From Legacy Challenges to Environmental Award Winner

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Presentation Overview

• INTRODUCTION
• BACKGROUND / HISTORICAL CONTEXT
• PROBLEM STATEMENT
• CONCEPTUAL OPTIONS REVIEW
• PREFERRED OPTION
• PREFERRED OPTION COMPONENTS
• CLOSING REMARKS / QUESTIONS

INTRODUCTION: Water Management

• Hydraulic overload
• Dependence on water recycling
• Plant upset or power supply interruption
• Legal change, legacy and compatibility with closure

Hydraulic Overload

Vale Canada Limited
(INCO) employs “Collect and Treat” strategy for the Sudbury Central Area operations:

\[ \text{~} \sim 48 \text{ km}^2 \text{ drain directly} \]
\[ \sim 52 \text{ km}^2 \text{ including pumped inputs} \]
Hydraulic Overload

Q: What does about 52,000,000 m² look like?
A: About 80% of the land base of Manhattan NY.

Hydraulic Overload

Dependence on Water Recycling

Problem Statement Continued...

- Need a way to capture and return non-compliant effluent

Legal Change and Compatibility with Closure
- Need a modular or “expandable” solution
Step 1 - Conceptual Options Review: 1998-1999

Conceptual options for whole basin included:

1. Pumping and storage in inactive underground workings
2. Pumping and storage in new surface reservoirs
3. Reservoir augmentation upstream of the Plant
4. Reservoir storage downstream of the Plant
5. Combination of upstream and downstream reservoirs
6. Plant capacity upgrades and smaller attenuating reservoirs
7. Plant capacity upgrades and no attenuating reservoirs

Step 2 - Central Tailings Seepage Stations: 1999-2000

Pumping and storage station improvements included:

- Whissel Dam North Seepage Pond
- Whissel Dam South Seepage Pond
- Rock Dam Seepage Pond
- Mikkola Dam Seepage Pond
- Pistol Dam Seepage Pond

Step 2 - Seepage Stations Improvements: 1999-2000

- Whissel Dam (North) Seepage Pond
- Rock Dam Seepage Pond
- Mikkola Dam Seepage Pond
- Pistol Dam Seepage Pond

Step 3 - Tailings Pond Operational Changes: 2002

OM&S Manual and filling plan allow 27km² to be controlled with minimal capital improvements:

- Incorporate sufficient freeboard
- Define operating water levels and levels that trigger water release to manage overtopping risk

Step 3 - Tailings Pond Operational Changes: 2002

- OM&S Manual and filling plan
- Active Areas (R1, R2, R3 and R4)
- Incorporate sufficient freeboard
- Define operating water levels and levels that trigger water release to manage overtopping risk

Step 4 - Uncontrolled Area Improvements: 2002

- 8 km² catchment area
- Finland Creek
- Common Creek
- Town of Copper Cliff
- South part of Smelter Complex
**Step 4 – Bypass Collection Pond: 2002**

- Operating characteristics constrained by:
  - Freestand fall height at start of 2002 season
  - Firebreak for Regional Flood without inundation boundary at the Town of Copper Cliff

**Step 4- Bypass Collection Pond: 2001-2002**

- Earth fill dam
- Remote controlled pump station
- Wave break
- Emergency spillway
- Fibre optic links
- OMS defined
  - N.O.W.L.
  - EDF H.W.L.
  - IDF H.W.L.

**Step 5 - North Mine Lake Improvements: 2004-2008**

- Pump Lake, Clarabelle Lake and Lady MacDonald Lake
- New dams, remote controlled decants and emergency spillways
- Decants are monitored/manipulated at CCWWTP by fibre optic links
- OMS defines N.O.W.L., EDF H.W.L., IDF H.W.L. to manage overtopping risk

**Step 5 - North Mine Lake Improvements: 2004-2008**

- Lady MacDonald Dam
  - Was originally a fresh water supply dam for Copper Cliff in the early 1900’s
  - Was rehabilitated and raised in the 1960’s to improve control of mine water flows and discharge to the CCWWTP

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Old Stack – A Area Dam - Background
• Originally built in the 1930s as a pipeline support embankment
• Subsequently used for tailings storage in 1937-1958
• About 40 years later, the need to store water and increased seismic criteria in Ontario led to a Stability & Emergency Spillway Improvement Project.


A Area Seismic Upgrade:
• Buttressed dam primarily with rock fill, but new core of compacted tailings
• Buttress was founded on bedrock near (involved removal of saturated tailings and replacement with dumped rockfills)
• Included under-drainage measures in the downstream bench


New low flow decant
Fibre optic links
Tunnel widening to safely pass a PMF
Stilling basin improvement

Step 7 - Common Creek Improvements: 2006-2007

• Sheet pile cut-off to prevent rail line subsidence
• Remote controlled desilting
• Remote controlled decant
• Remote controlled discharge
• Remote controlled water level
• Remote controlled waste level
• Remote controlled emergency spillway

Step 8 - CCWWTP Control Panel

Human Interface
• Touch screen menu
• Graphical user interface
• Remote monitoring
• Remote manipulation
• Fully upto-date data on site

Additional features in case of potential operational problems

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Step 8 - CCWWTP Control Panel

Human Interface
- Water level
- Reservoir
- Weather
- Gate control
- Gate motor status
- Building temperature
- Trending
- Integrated with CCWWTP control system

WMS Project: System Performance to Date
- Eliminated seasonal bypasses for more than a decade
- Prevented plant overload during a flash flood in July 2009
- Won an environmental award in 2009 from Consulting Engineers Ontario

Closing Remarks
- Remote controlled reservoir network may seem elaborate
- Operationally superior
- Makes clear economic sense for closure (200 years)
- Modern solution to a legacy challenge

Thank you for your attention