Planning a Complex Mine Remediation

2016 RPIC Federal Contaminated Sites National Workshop
Objective

Discuss Giant Mine Remediation Project’s unique complexities

- Giant Mine Background
  - History
  - Jurisdictions
- Planning the Remediation
  - Site management & risk mitigation during planning
  - Overview of remediation components
  - Design interdependencies
  - Contracting
History of Giant Mine

- Giant Mine operated 1948 to 1999
- Many owners
- Royal Oak Mines Inc. declared bankruptcy in 1999
- 846-hectare property in custody of Indigenous and Northern Affairs Canada (INAC)
Jurisdictions

- Government of Canada
- Government of the Northwest Territories
- City of Yellowknife
- First Nations and Métis land claims
- Others
Site Management & Risk Mitigation During Planning

• Care and Maintenance
  – Water management and treatment
  – Inspection and maintenance of underground infrastructure (i.e. arsenic bulkheads)
  – Dust suppression
  – Site security

• Urgent Risk Mitigation
  – 2006 Baker Creek realignment
  – 2011 JoJo Lake Tailings Cap construction
  – 2013-15 Roaster Complex deconstruction
  – 2015 C1 Pit buttress construction
  – 2014 & 2015 underground stope backfilling
  – 2015 C-Shaft had frame deconstruction
Overview of Remediation Components

- Infrastructure Deconstruction and Disposal
- Surface Water Management
- Tailings Rehabilitation
- Openings to Surface
- Contaminated Soil
- Open Pits
- Borrow/Quarry Development
- Underground Stabilization
- Freeze Program
- Baker Creek Realignment
- New Effluent Treatment Plant
- Common Site Infrastructure
On-site waste streams:
- 60,000 m³ non-hazardous building waste
- 16,000 m³ arsenic trioxide waste
- 7,000 m³ hazardous (non-arsenic) waste

Waste Disposal:
- Non-hazardous waste – on-site landfill or recycled
- Arsenic trioxide waste – underground within the freeze zone
- Hazardous Waste – off-site at licensed facility
Surface Water Management

• Construction of drainage channels, storage ponds and spillways to direct surface water into Baker Creek

• Baker Creek discharge must meet site specific water quality objectives
Tailings Rehabilitation

- 95 hectares of tailings: variable depth; quality
- Tailings cap requirements: informed by engagement process
- Graded to promote drainage of clean surface water
Openings to Surface

- 37 mine openings to surface
- Adits, raises, shaft, portals, stope breakthroughs
- Capping achieved by engineered concrete caps or rock fill
Contaminated Soil

- Arsenic contaminated material: 900,000 m$^3$; waste rock; disturbed soils
- Petroleum hydrocarbon-contaminated soil: 3000 m$^3$
Open Pits

• Eight open pits

• B1 Pit will be backfilled to support freeze solution

• Open pit closure remediation under discussion after EA Report
Borrow/Quarry Development

- Borrow material needed for contaminated soil cover, tailings cap, and landfill cover
- Estimated fine-grained soil needed: 950,000 m³
- Estimated coarse-grained needed: 1,150,000 m³
Underground Stabilization

- Objectives:
  - Maintain ground surface
  - Maintain Baker Creek
  - Ensure stability around arsenic trioxide stopes and chambers

- Backfilling near surface stopes, voids: 400,000 m³

- Investigations on-going; confirming scope of stabilization activities

- Stabilization requirements highly dependent on final mine water level
Freeze Program

• Four freeze areas for 13 arsenic containing stopes and chambers

• 60,000 m of drilling to support thermosyphon installation

• Freeze Optimization Study (FOS) built in 2010 to better define design parameters
Arsenic trioxide storage areas to freeze
Yellowknife office building vs. frozen chamber
Baker Creek Realignment

- Poor hydraulic capacity; high seasonal flow variability
- Fish habitat
- Historic tailings and contaminated sediments
- Potential risk of flooding underground workings
- Realignment being reviewed after EA Report
New Effluent Treatment Plant

- Arsenic removed by iron co-precipitation and adsorptive technology; meets Canadian Drinking Water Quality guidelines

- Year-round operation; near-shore outfall into Yellowknife Bay

- Replaces existing seasonal plant treating to Metal Mining Effluent Regulations
Giant Mine Remediation Plan

#1 > Chamber Freezing & U/G Works
#2 > Pits, Baker Creek & Tailings Covers
#3 > Infrastructure Deconstruction
#4 > Long Term Water Treatment
Interdependent Remediation Components

Baker Creek

Surface Water Drainage

Open Pit Closure

Freeze Program
Interdependent Remediation Components

Underground Stabilization

Borrow Requirements

Contaminated Surface Material

Tailings Rehabilitation

Effluent Treatment

Surface Water Drainage
Interdependent Remediation Components

- As₂O₃ Waste Disposal
- Effluent Treatment
- Underground Stabilization
- Open Pit Closure
- Tailings Rehabilitation

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada
Canada
Government of Canada Contracting Priorities

- Open, fair, transparent procurement
- Establish a clear understanding of the government procurement process;
- Maximize competition and obtain value for money;
- Consult with Industry to solicit ideas and recommendations for consideration in the development of specific procurement strategies;
- Assess market capacity; and
- Maximize aboriginal participation in accordance with Land Claim obligations
Planning a Complex Mine Remediation

Questions?