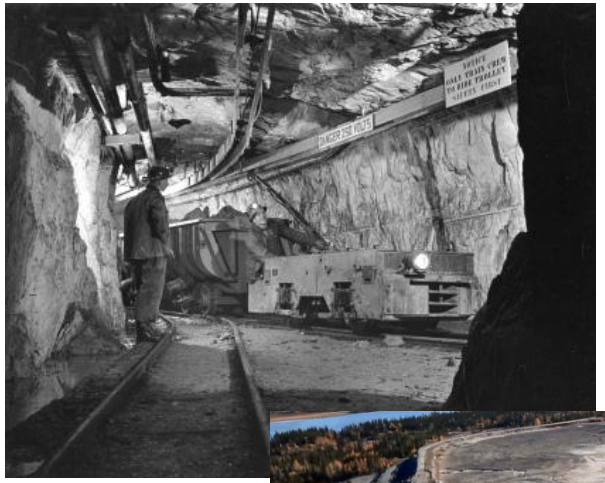
Planning a Complex Mine Remediation

Objective

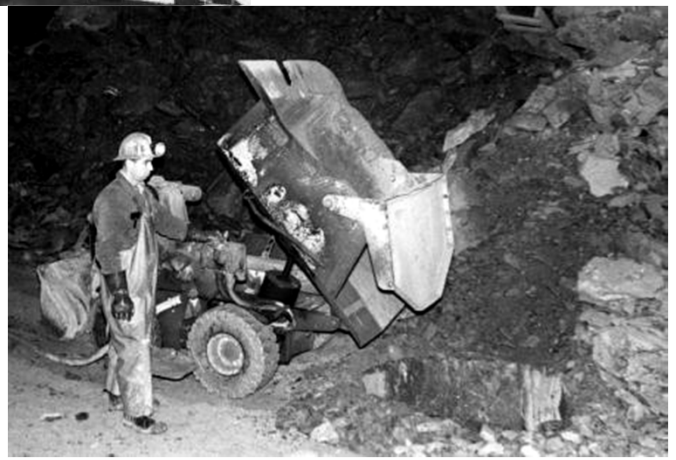
Discuss Giant Mine Remediation Project's unique complexities

- History of Giant Mine
  - Jurisdictions
  - Stakeholders; interests
- Planning the Remediation
  - Care & Maintenance
  - Urgent Risk Mitigation
  - Interdependent Components
  - 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 Aboriginal Affairs and Northern Development Canada

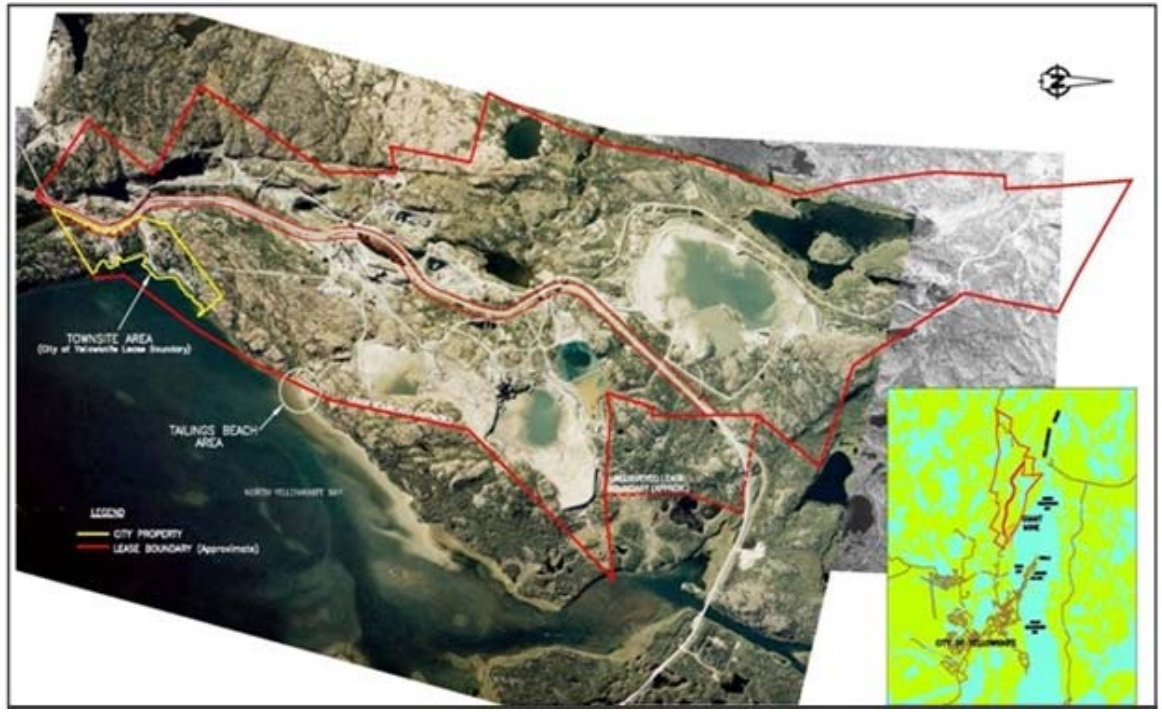


Underground Storage of Arsenic Trioxide

Roasting process to extract gold produced 237,000 tonnes of arsenic dust as byproduct

Jurisdictions

- Government of Canada
- Government of the Northwest Territories
- City of Yellowknife
- First Nations and Métis land claims
- Others



Giant Mine Stakeholders

Interests: varied;
may be in competition;
opposition

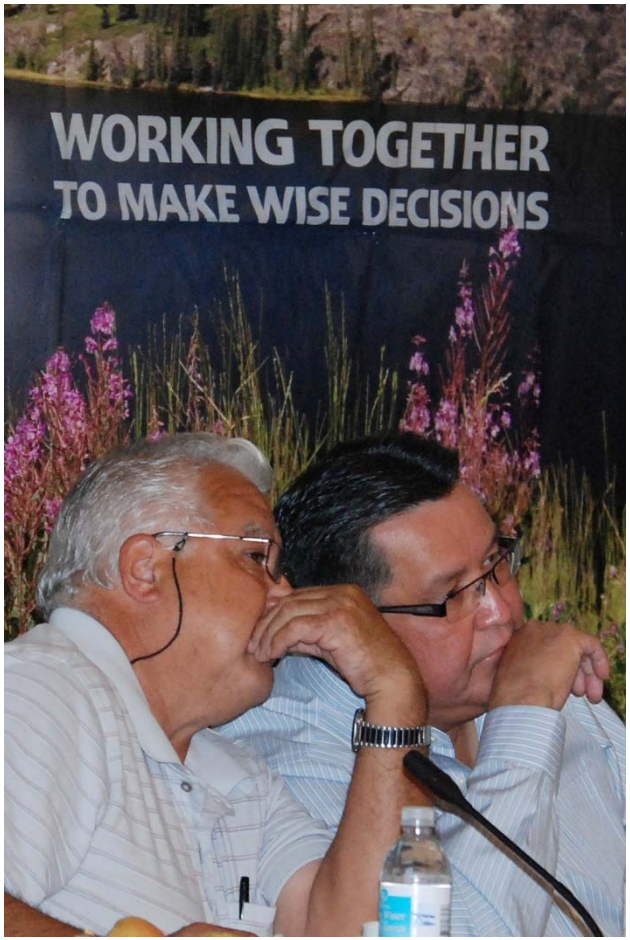
Engagement: constant;
balances opposing views;
keeps all informed

Managing Site and Planning Remediation

- Government of Canada's priorities:
  - Ensure site safety/integrity
  - Maintain regulatory compliance
  - Maintain engagement with First Nation stakeholders
- Care and Maintenance:
  - Water management and treatment
  - Inspection and maintenance of underground infrastructure, notably arsenic bulkheads
  - Dust suppression
  - Site security

Managing Site and Planning Remediation

- December 2007: Type A Water License application to Mackenzie Valley Land and Water Board to start remediation
- March 2008: Project referred to Environmental Assessment (EA)
- August 2014: EA completed; final Report of EA accepted by Ministers
- 2007-2014: Remediation Plan activities suspended
  - Significant challenges: deteriorating infrastructure; emerging risks; public safety



Managing Site and Planning Remediation

Managing onsite emerging risks within Regulatory Framework

- During EA:
  - onsite conditions continued to worsen
  - risks to public safety and to the environment apparent
- Emergency water license to mitigate risks:
  - Roaster complex deconstruction
  - Underground stability

2006 Baker Creek Realignment

2011 JoJo Lake Tailings Cap

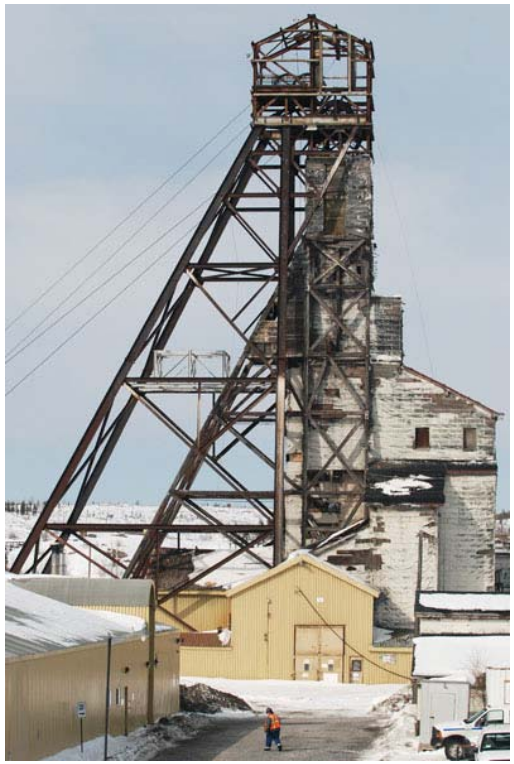
2013-2015 Roaster Complex Deconstruction

Baker Creek Flood Risk: C1 Pit Buttress

Effluent Treatment Plant Tank Improvements

Underground Stability: Stope Backfilling

C-Shaft Head Frame Deconstruction



Managing Site and Planning Remediation

- Giant Mine Team continues to manage risks: underground; surface
- EA report: 26 measures to address as part of the remediation process
- Measures affecting remediation project:
  - Realignment of Baker Creek
  - Tailings rehabilitation
  - Effluent treatment
  - Surface water quality
  - Freeze Program

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

Infrastructure Deconstruction and Disposal

On-site waste streams:

- 60,000 m^3 non-hazardous building waste
- 16,000 m^3 arsenic trioxide waste
- 7,000 m^3 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 m^3
- Estimated coarse-grained needed: 1,150,000 m^3

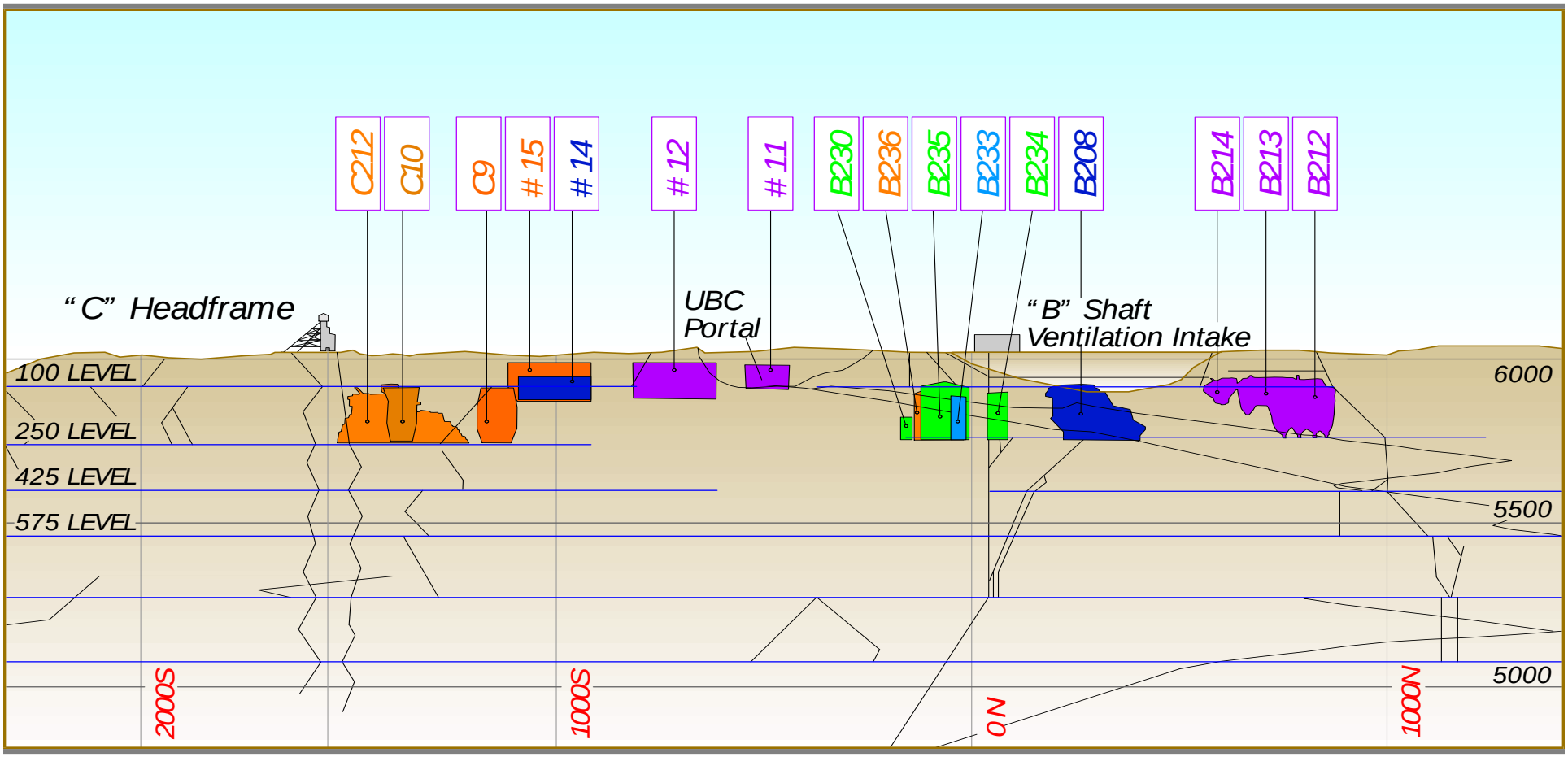
Underground Stabilization

- Objectives:
  - Maintain ground surface
  - Maintain Baker Creek
  - Ensure stability around arsenic trioxide stopes and chambers
- Backfilling near surface stopes, voids: 400,000 m^3
- Investigations on-going; confirming scope of stabilization activities
- Stabilization requirements highly dependent on final mine water level

Freeze Program

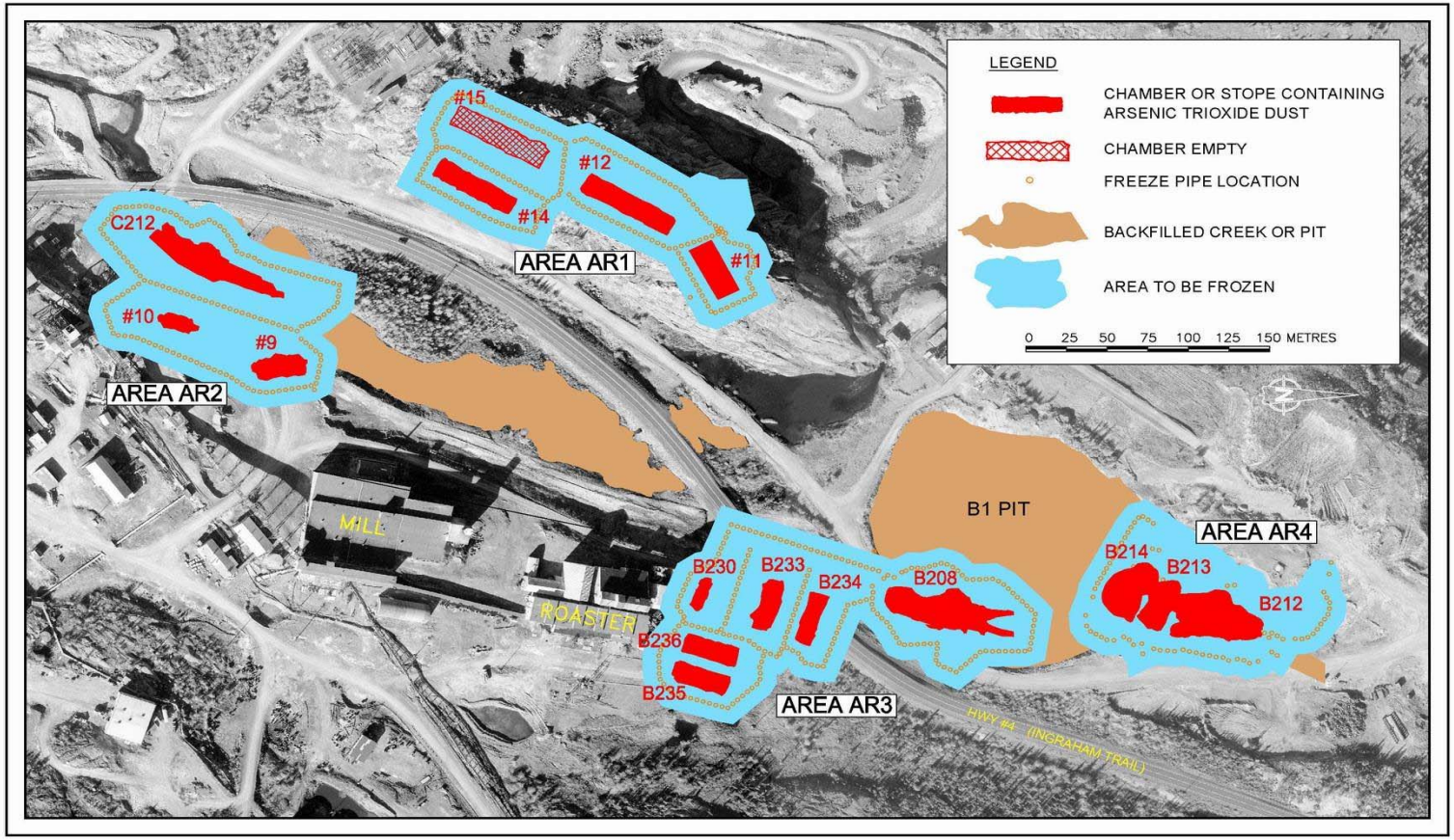
- Four freeze areas for 13 arsenic containing stopes and chambers
- 60,000 m of drilling to support thermosyphon installation
- Freeze Optimization Study (FOS) built in 2010 to better define design parameters

Freeze Program – Cut Away View



Yellowknife office building vs. frozen chamber

Arsenic trioxide storage areas to freeze



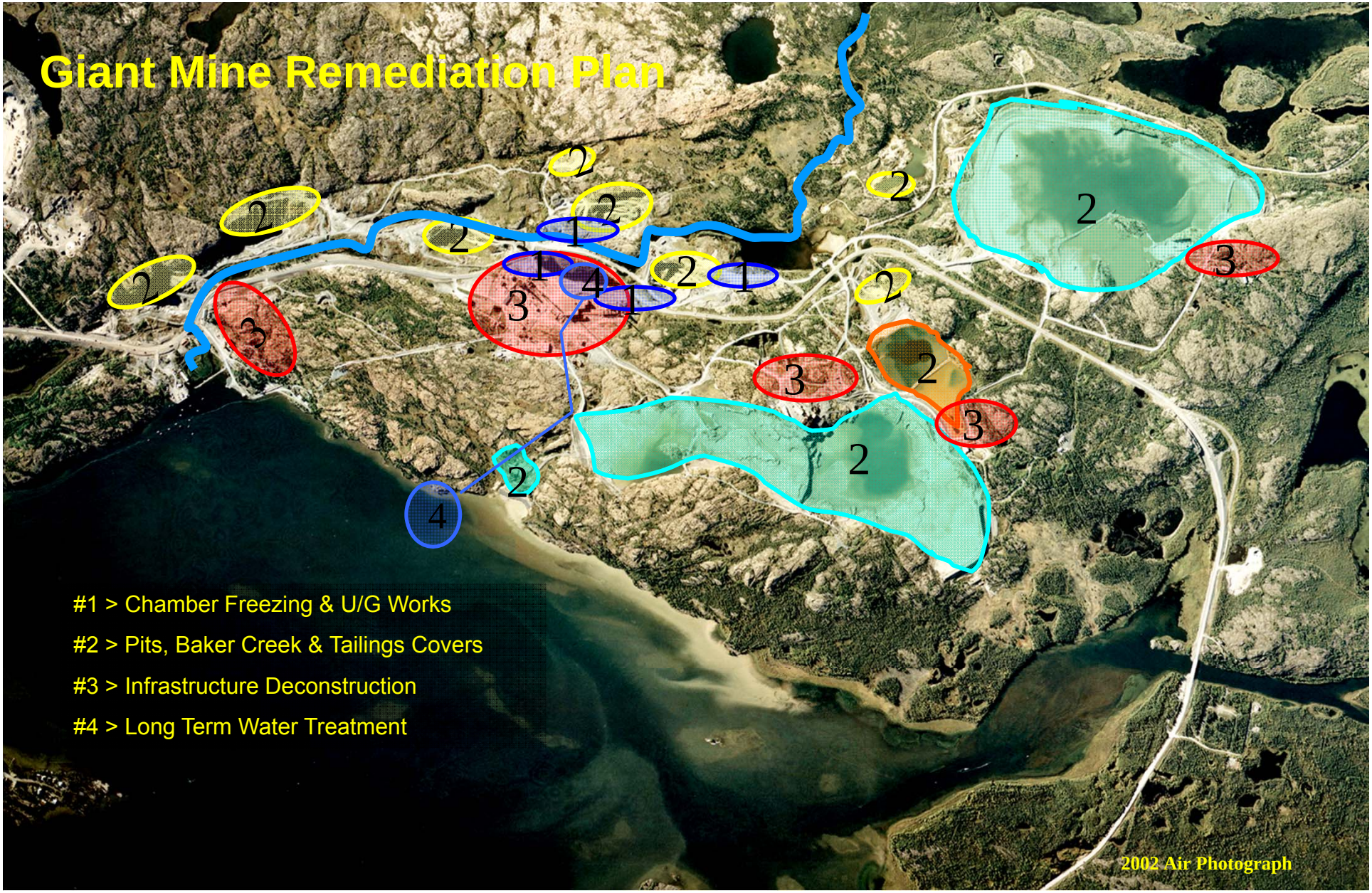
Baker Creek Realignment

- 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

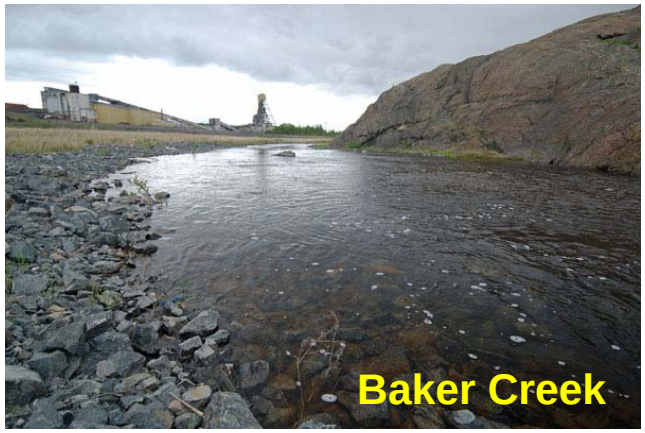
New Effluent Treatment Plant

- 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



Interdependent Remediation Components



Interdependent Remediation Components

Interdependent Remediation Components

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

Government of Canada Contracting

- Treasury Board Contracting Policy
  - Approval Thresholds
- Trade Agreements
  - 44 Trade Agreements with 39 countries
- Aboriginal Land Claims
  - Tlicho Comprehensive Land Claim Agreement; the *Môwhì Gogha Dè Nîîtåèè area,* extends into the Giant Mine lease boundary
  - Asserted claim by Yellowknives Dene First Nation
- Other Considerations
  - Established Real Property contracting tools

Planning A Complex Mine Remediation - Summary

- Multiple stakeholders and jurisdictional interests
- Remediation planning with deteriorating site conditions
- Interdependent remediation elements
- Federal government procurement policies

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