



Indian and Northern  
Affairs Canada

Affaires indiennes  
et du Nord Canada

# Giant Mine Remediation Project

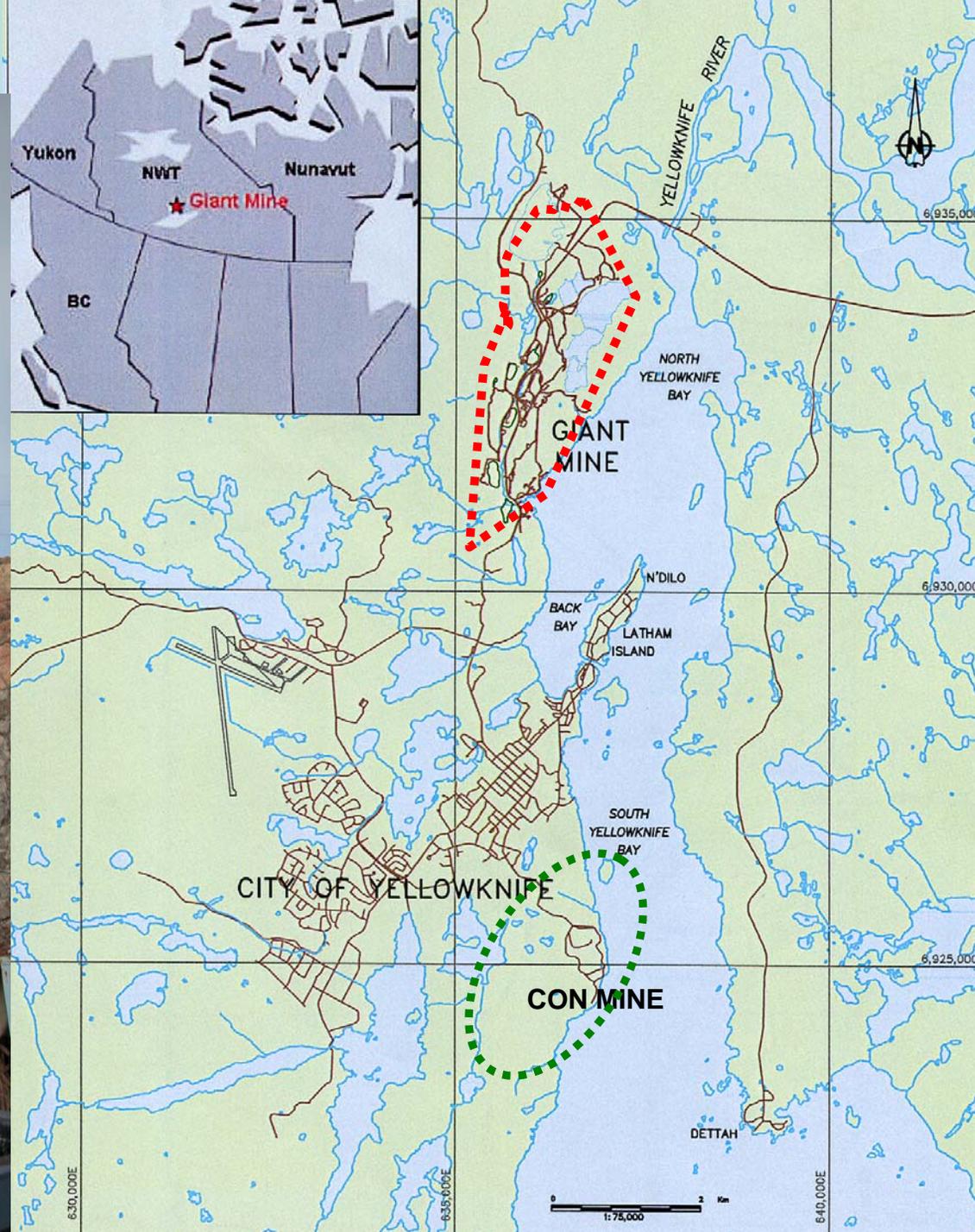
NATO/CCMS Pilot Study Meeting  
Ottawa June 2005



Canada

# Giant Mine Location

Original Giant Mine  
"A" Shaft (1945)



1935 – gold discovery! - 21 original claims staked by Burwash Yellowknife Mines Ltd.

From first production in 1948 until 2004 Giant Yellowknife Gold Mine produced over 7 million ounces of gold.



LOCATION PLAN  
GOLD SHOWINGS  
GOLD CLAIMS  
Baker Lake - Yellowknife Area



# Background

- Several companies owned and operated Giant Mine for 55 years
- Legacy of mining activity
  - Toxic arsenic trioxide dust in underground storage (237,000 tonnes)
  - Buildings with severe arsenic contamination, asbestos insulation
  - Decaying mine infrastructure
  - Tailings impoundments, sludge settling and polishing ponds
  - Contaminated surficial materials (arsenic and hydrocarbon)
  - Inadequate Abandonment and Restoration Plan
  - Negligible financial security in place for remediation
- 1999 - Royal Oak Mines forced into receivership

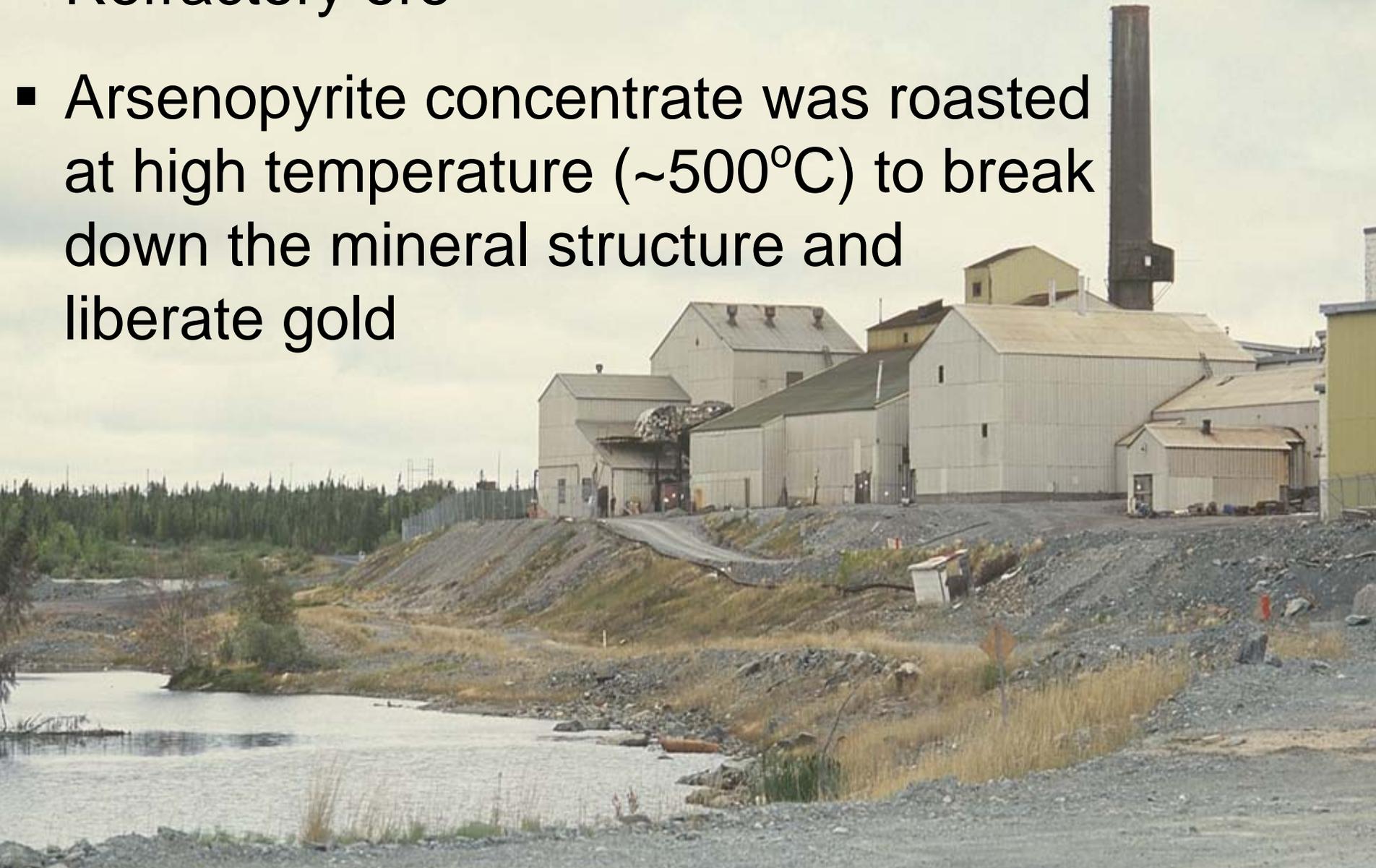


# Background

- **1999:** Indian and Northern Affairs Canada (INAC) entered into an agreement with Miramar to provide ongoing care and maintenance of Giant Mine – agreement also allowed Miramar to operate mine on reduced scale
- Miramar indemnified for existing condition of mine
- Agreement allowed INAC to:
  - Develop options with Technical Advisor for the management of the underground arsenic trioxide
  - Work with community to reach a preferred option
  - Secure funding - Federal Contaminated Sites Accelerated Action Plan
  - Negotiate cooperation agreement between Canada and Government of the NWT

# Ore Processing

- Refractory ore
- Arsenopyrite concentrate was roasted at high temperature ( $\sim 500^{\circ}\text{C}$ ) to break down the mineral structure and liberate gold





• Roasting process to extract gold produced 237,000 tonnes of arsenic dust as byproduct – now in underground storage

# Gold Extraction by Roasting

Arsenopyrite  $\text{Fe}^{3+} \text{As S}$



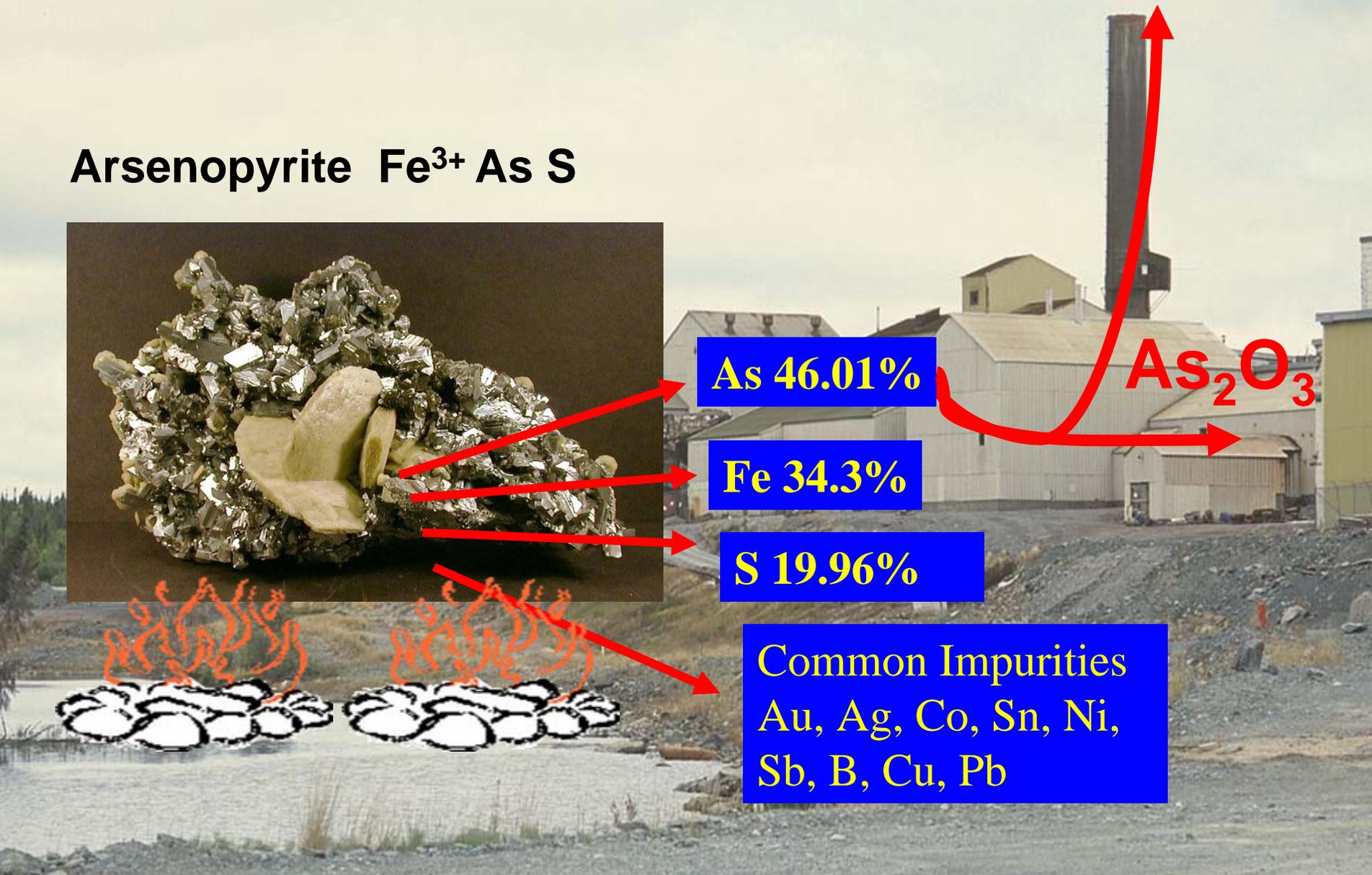
As 46.01%

Fe 34.3%

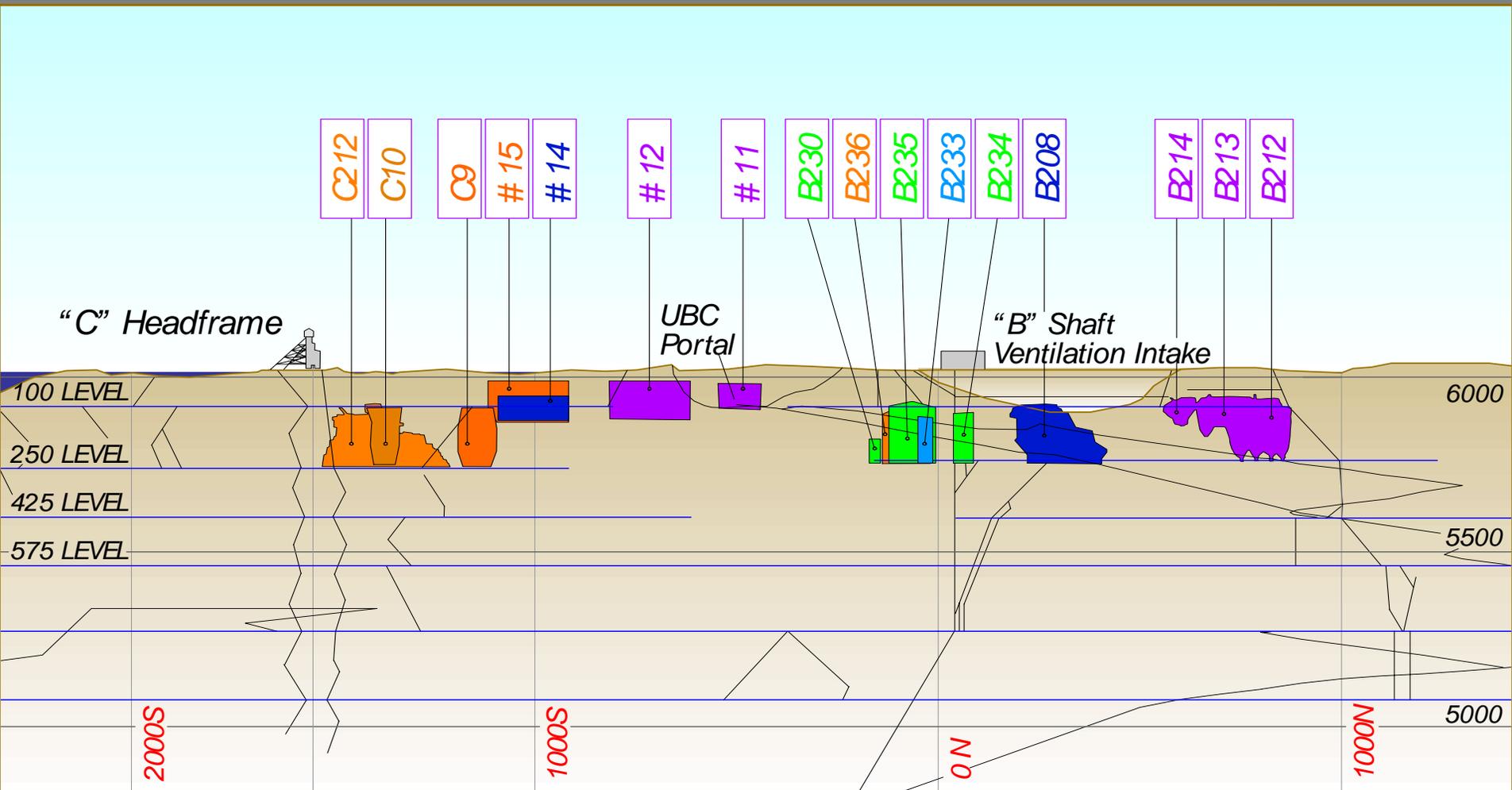
S 19.96%

Common Impurities  
Au, Ag, Co, Sn, Ni,  
Sb, B, Cu, Pb

$\text{As}_2\text{O}_3$

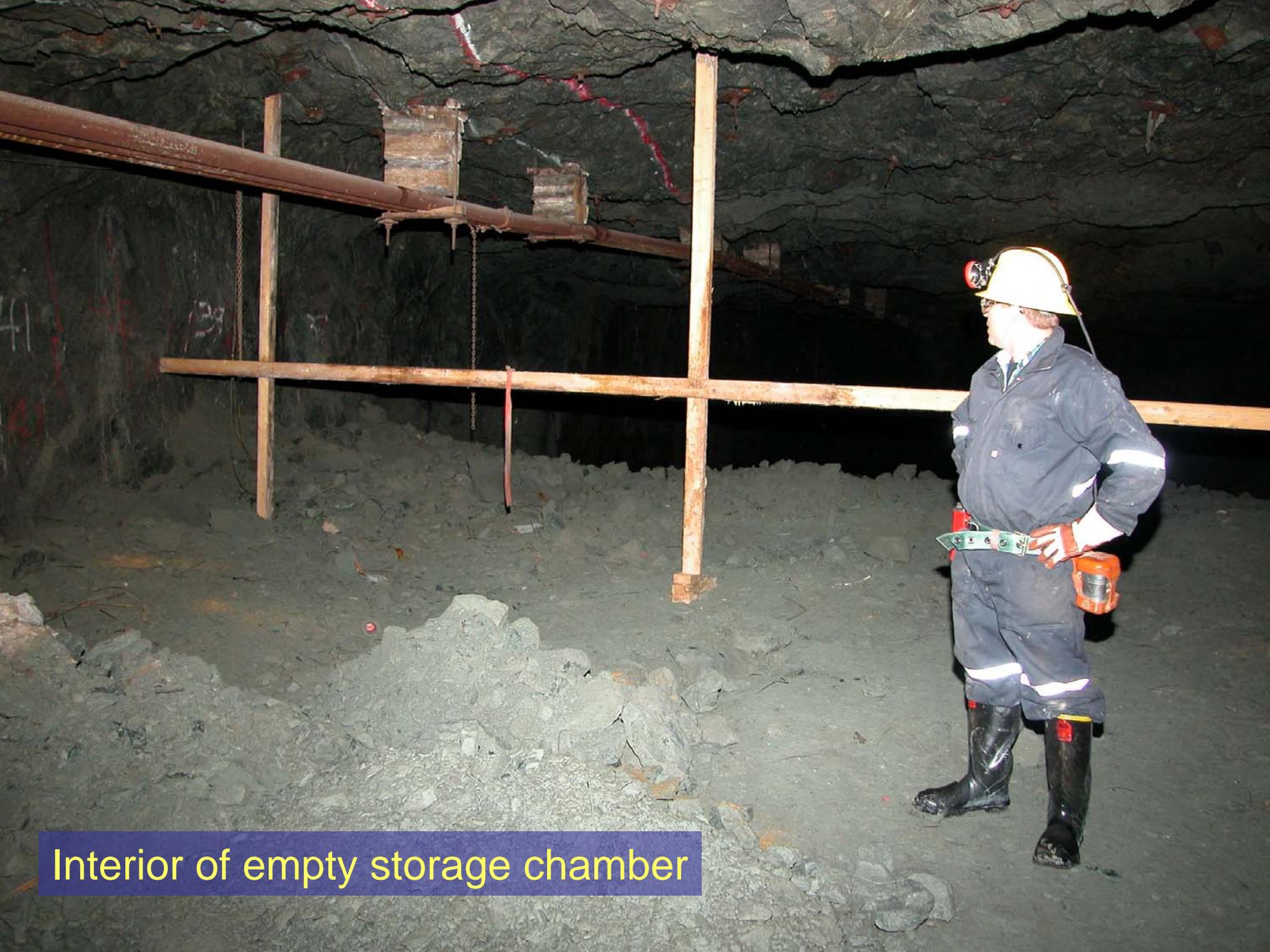


Arsenic trioxide dust in storage underground is enclosed completely in rock – all access drifts sealed by thick cement bulkheads



Arsenic Chambers Long Section: 10 chambers & 5 stopes





Interior of empty storage chamber

11 story office tower  
in Yellowknife

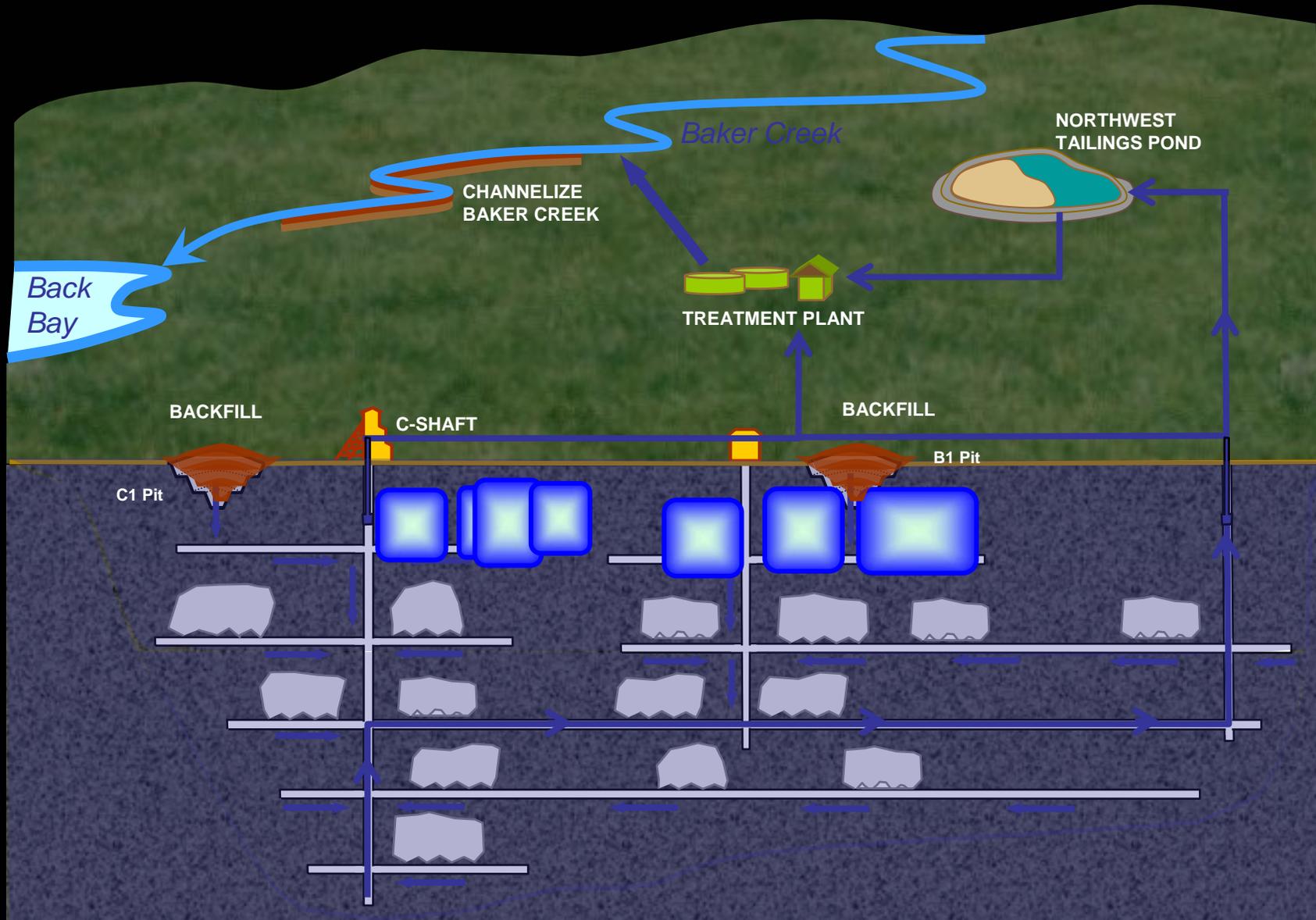




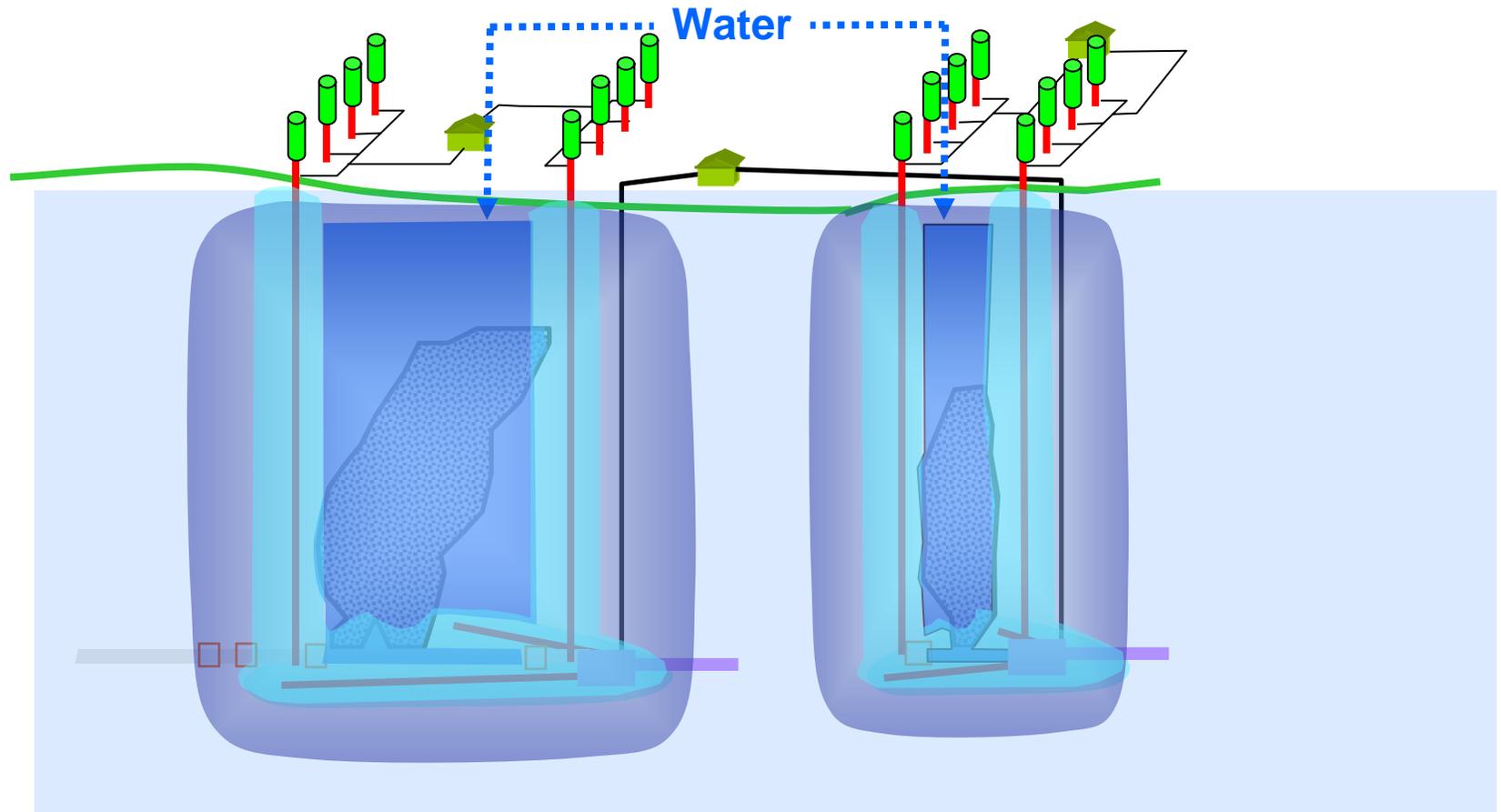
# Giant Mine Remediation

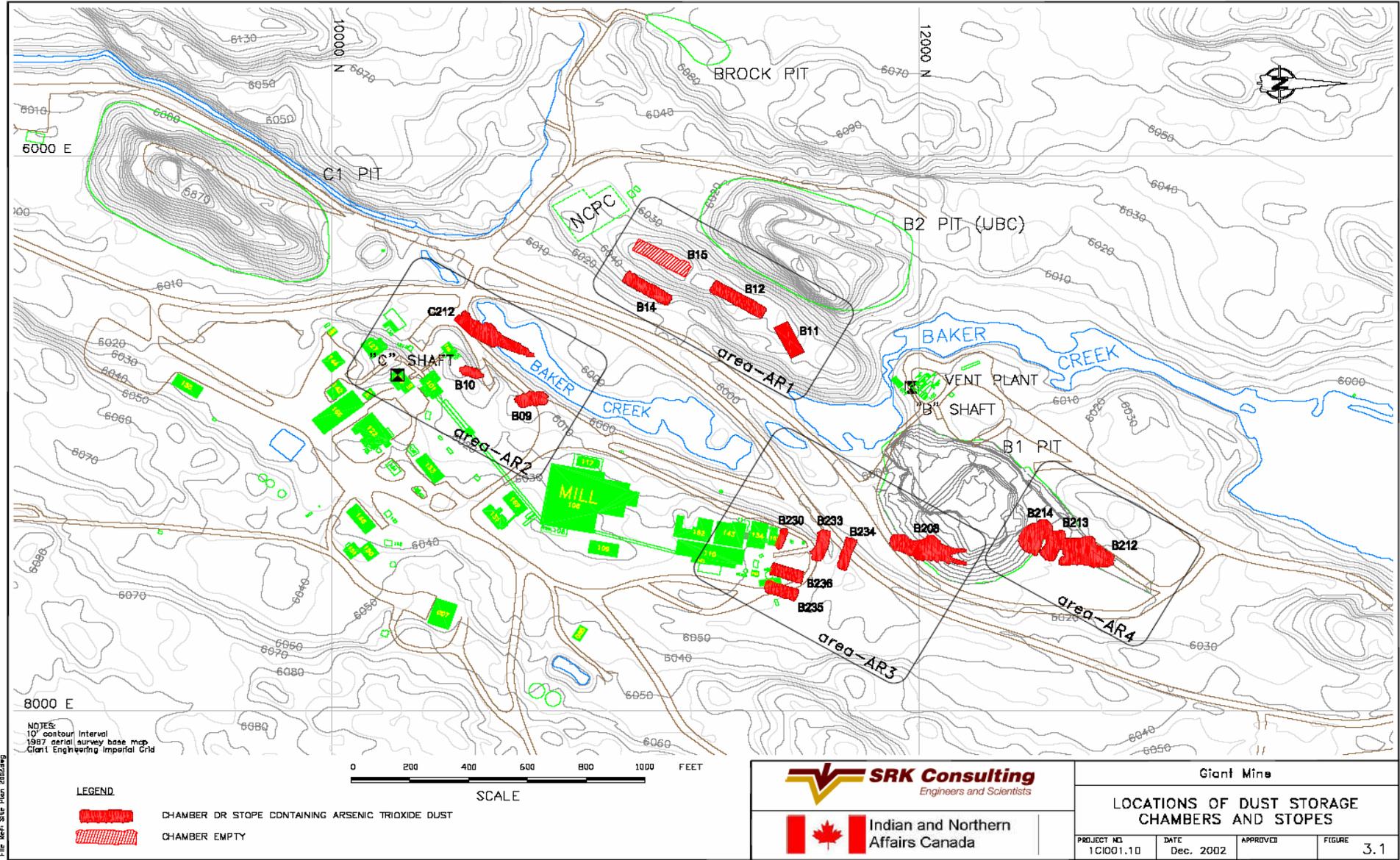
- Surface
  - Buildings and other infrastructure
    - Hazardous waste removal and demolition of contaminated structures
  - Contaminated soils (arsenic and hydrocarbon)
  - Pits and mine openings
  - 4 tailings impoundments
  - Effluent treatment, settling and polishing ponds
  - Baker Creek
  - Junk equipment/scrap lay down areas
- Underground
  - Arsenic trioxide dust storage chambers
- Requirement for indefinite period of effluent treatment

# Frozen Block Conceptual Design



# Freezing and Water Management Sequence





Four separate areas of freezing

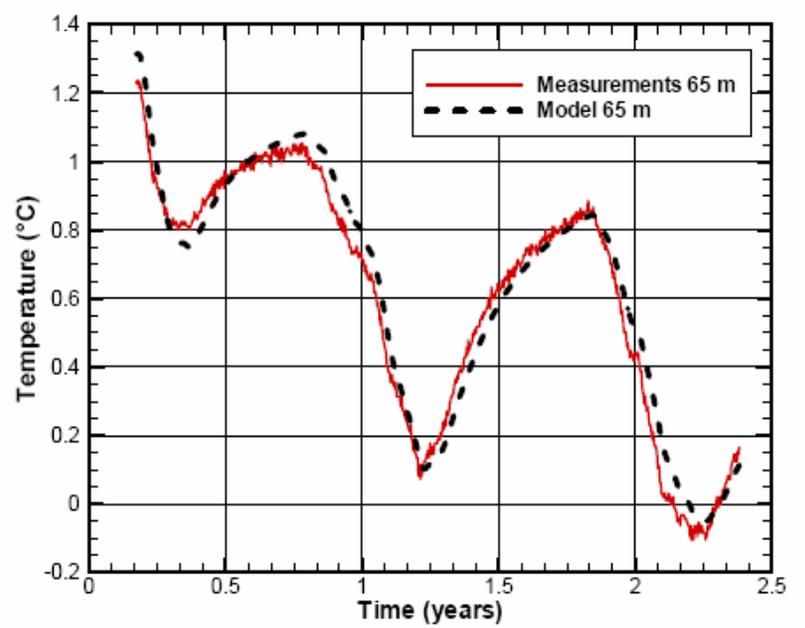
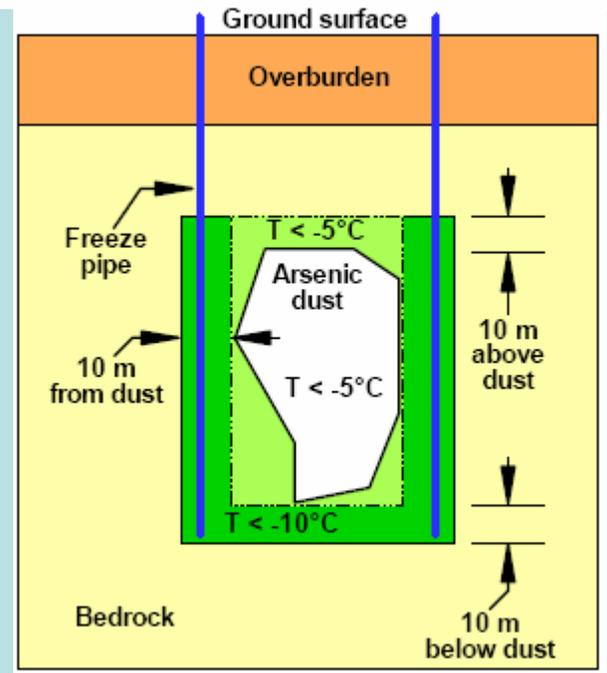
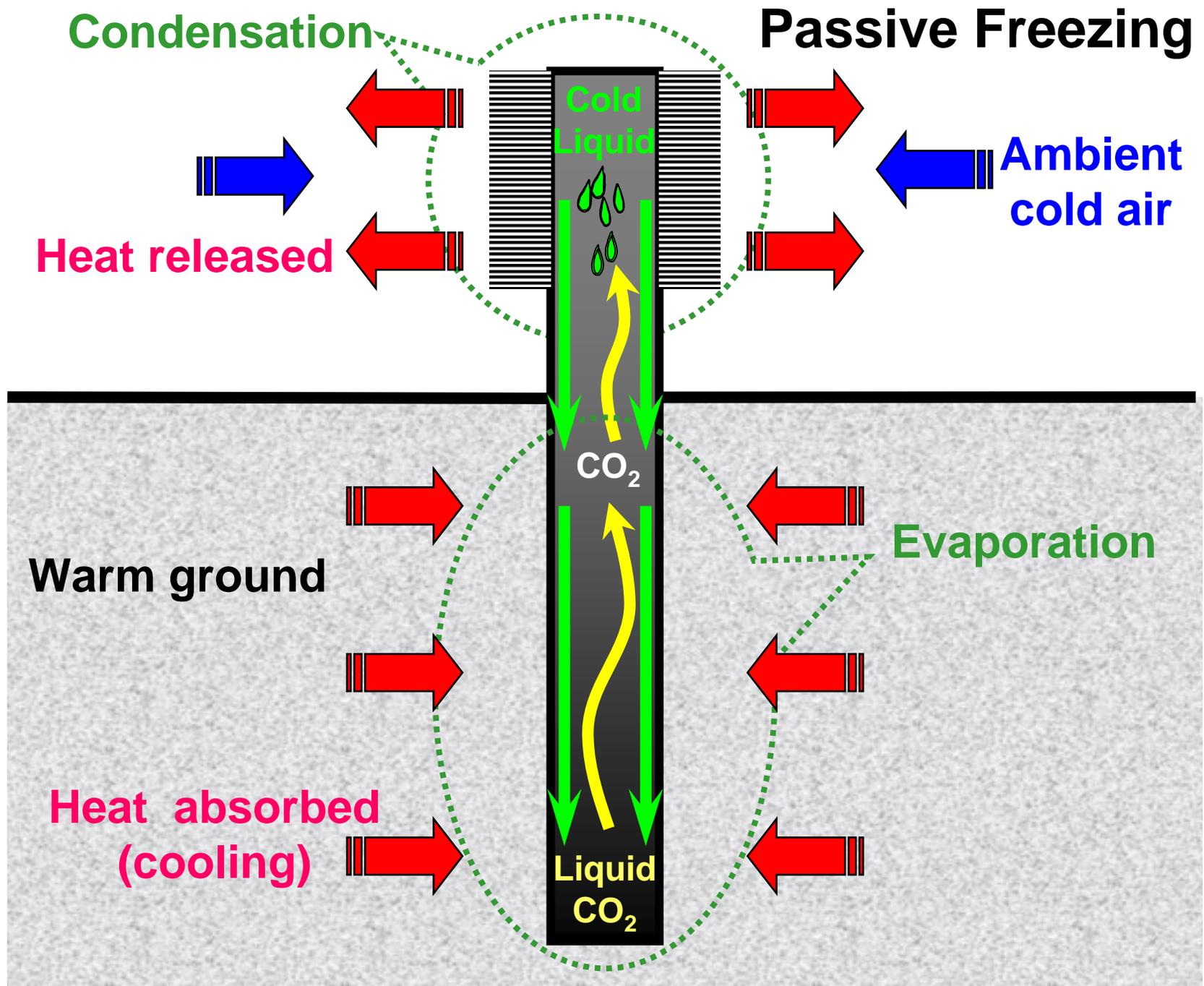


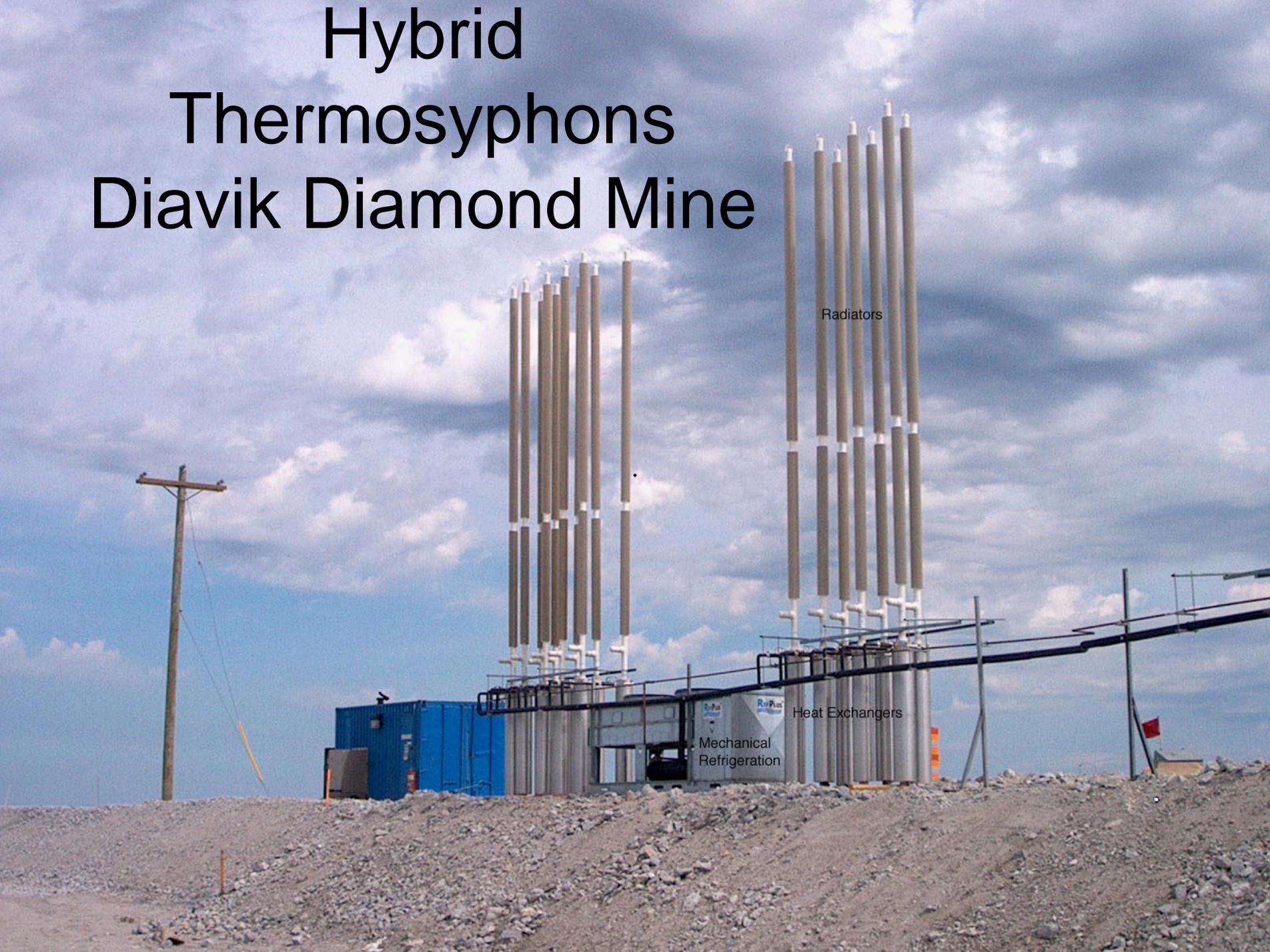
Figure 13. Calibrated thermal model, measured and predicted ground temperatures at 2.69 m from the thermosyphon and 65 m deep.







# Hybrid Thermosyphons Diavik Diamond Mine



Radiators

Heat Exchangers

Mechanical  
Refrigeration

## Frozen Soil Barrier

Subsurface Contaminants  
Focus Area



Prepared for  
**U.S. Department of Energy**  
Office of Environmental Management  
Office of Science and Technology

Figure 1. Frozen Soil Barrier system at Oak Ridge National Laboratory



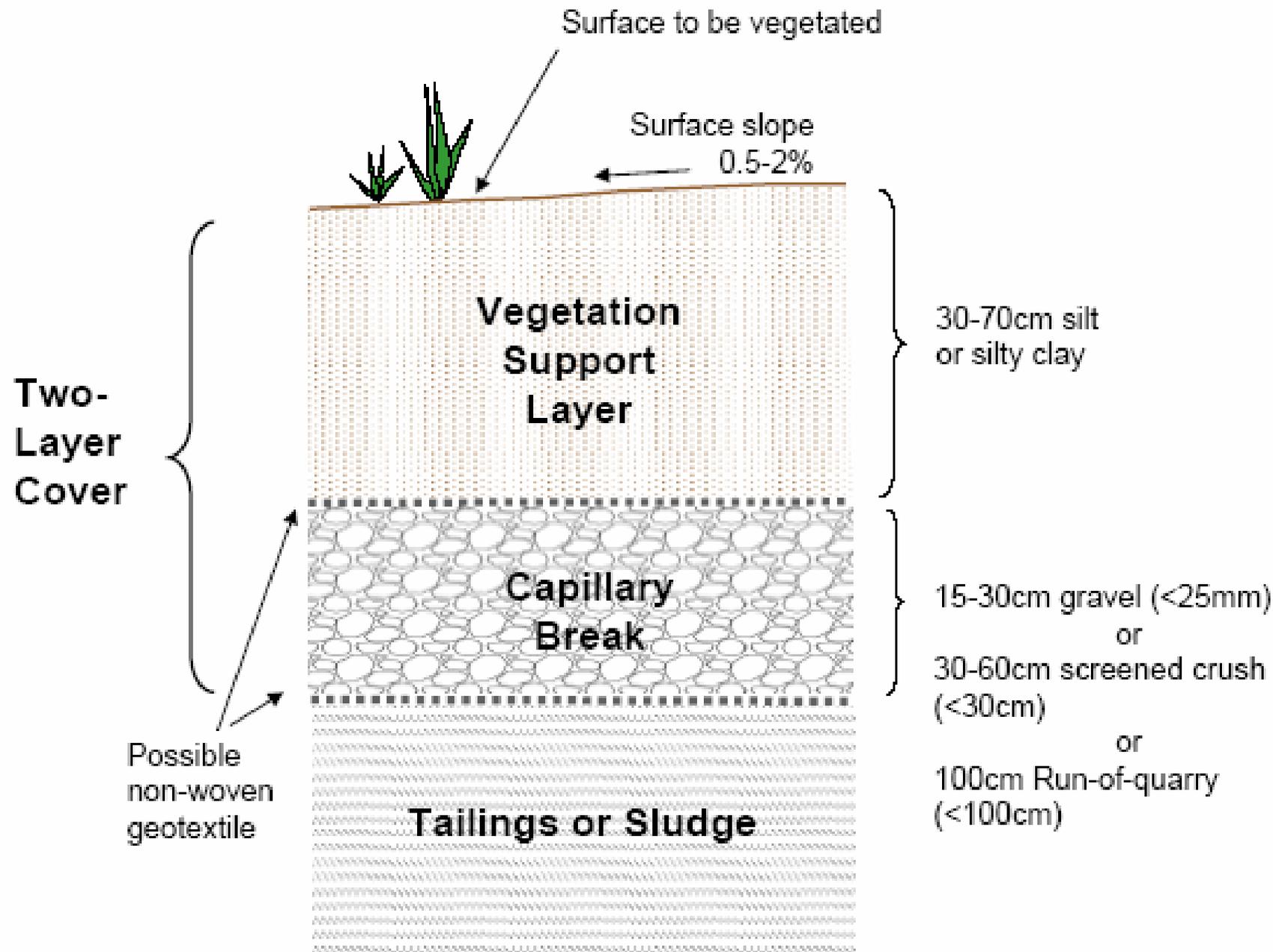
Demolition of hazardous buildings prior to contaminated soils removal





Tailings graded, covered  
natural drainage established

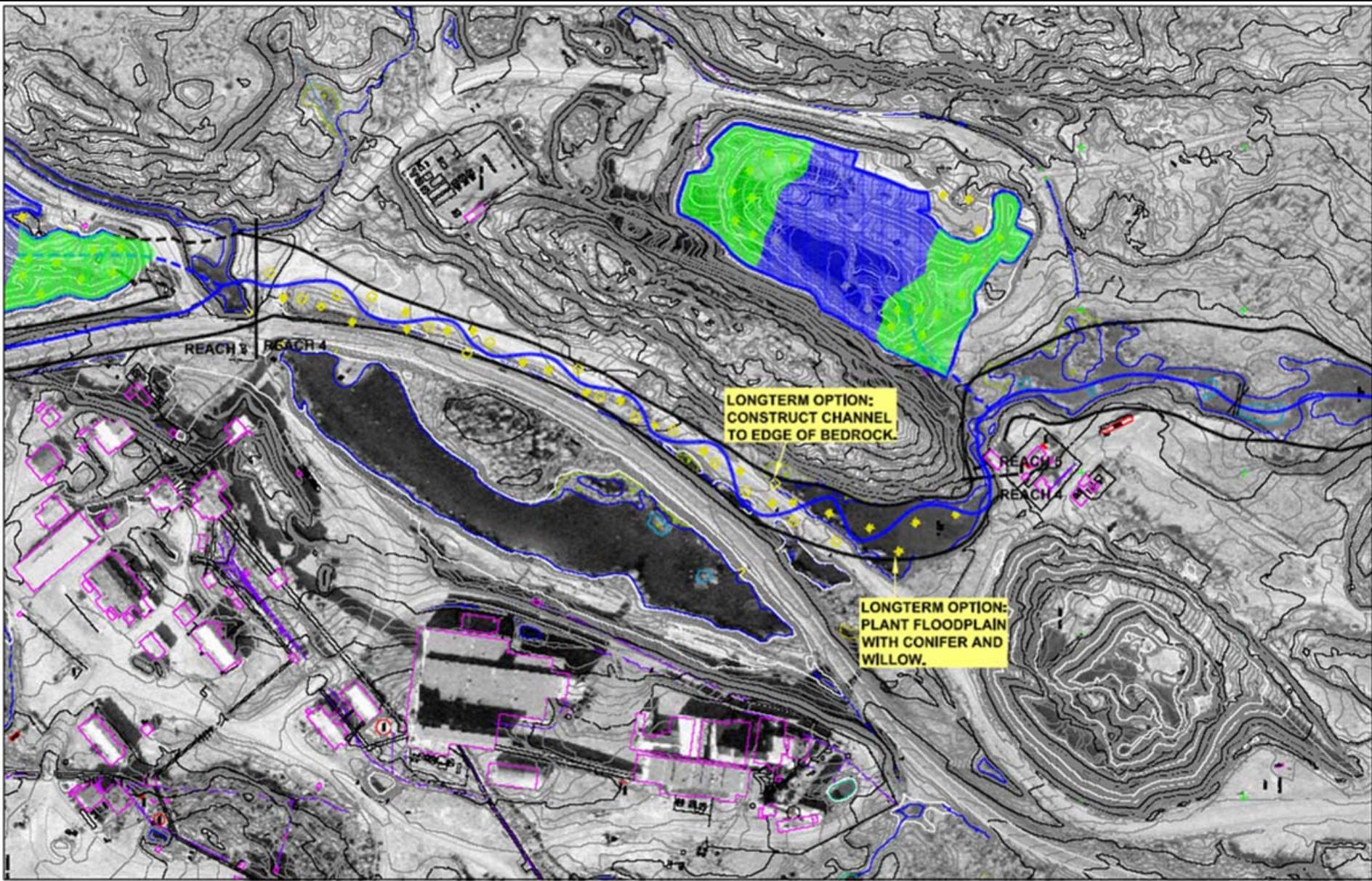
**NWT Region**



Effluent Treatment Plant and Settling Pond  
will be covered using design similar to tailings cover



# Baker Creek Rehabilitation



# Remediation Plan

- **Review by expert federal departments**
  - Environment Canada
  - Fisheries
  - Health Canada
- **Regulatory Board Review ( 2 years )**
  - Additional public input
  - Possible Full Environmental Assessment



# Giant Mine Remediation Project

**For more detailed information:**  
<http://giant.gc.ca>



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