




This slide has a blue header bar with the text 'Giant Mine Remediation Project' and the 'Northwest Territories' and 'Canada' logos. The main content area is white and contains a bulleted list of project milestones. A small number '2' is in the bottom right corner.

Giant Mine Remediation Project

Northwest Territories Canada

- Alternatives assessment 2000 – 2003
 - Three years of study involving teams of engineers working with Technical Advisor
 - Over 40 public consultation sessions including three major workshops
 - Findings reviewed by Independent Peer Review Panel


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Giant Mine Remediation Project

- Assessment process:
 - Initially reviewed 56 possible methods
 - Examples taken to first public workshop
 - Identified 12 alternatives for detailed assessment
 - One year of technical assessment
 - Then took two best option to second public workshop
 - Based on feedback, added a third option for final public workshop
 - Conclusions
 - IPRP Review in March 2003
 - Technical Advisor's final recommendation to INAC in August 2003


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Giant Mine Remediation Project

- Options considered:
 - A1 - Water treatment only
 - A2 - Water treatment with drawdown
 - A3 - Water treatment with seepage control
 - B2 - Frozen shell
 - B3 - Frozen block
 - C - Relocation to deeper in mine
 - D - Removal and off-site disposal
 - F - Removal and stabilization with autoclave
 - G - Removal and encapsulation in cement


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- Factors considered in assessments:
 - Short-term risks of arsenic release during implementation
 - Long-term risk of arsenic release after implementation
 - Risks to worker health and safety
 - Total life cycle costs

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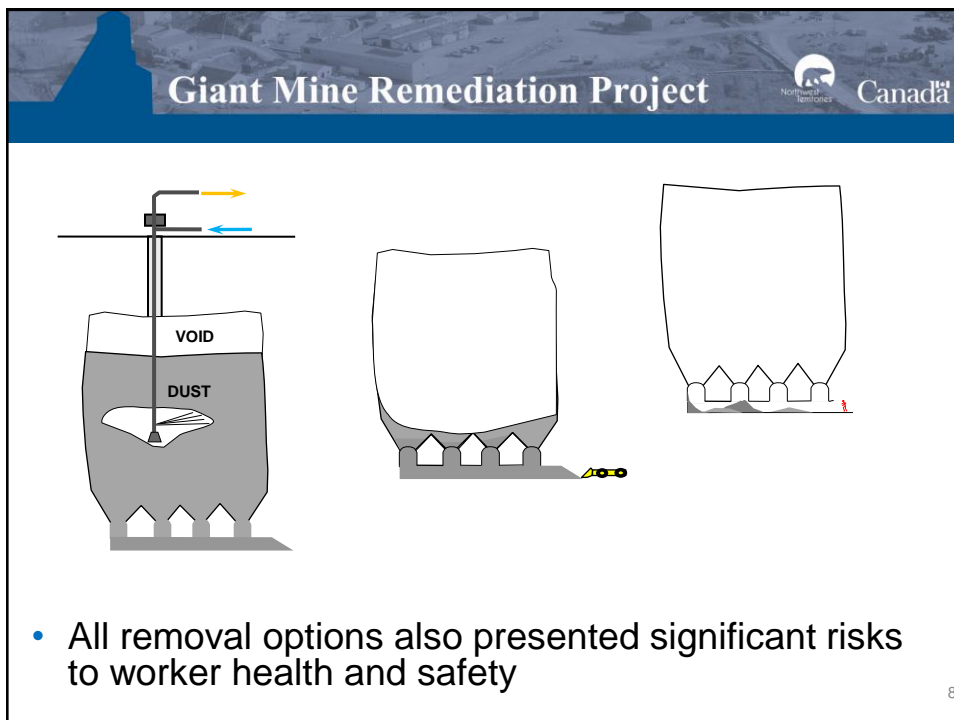
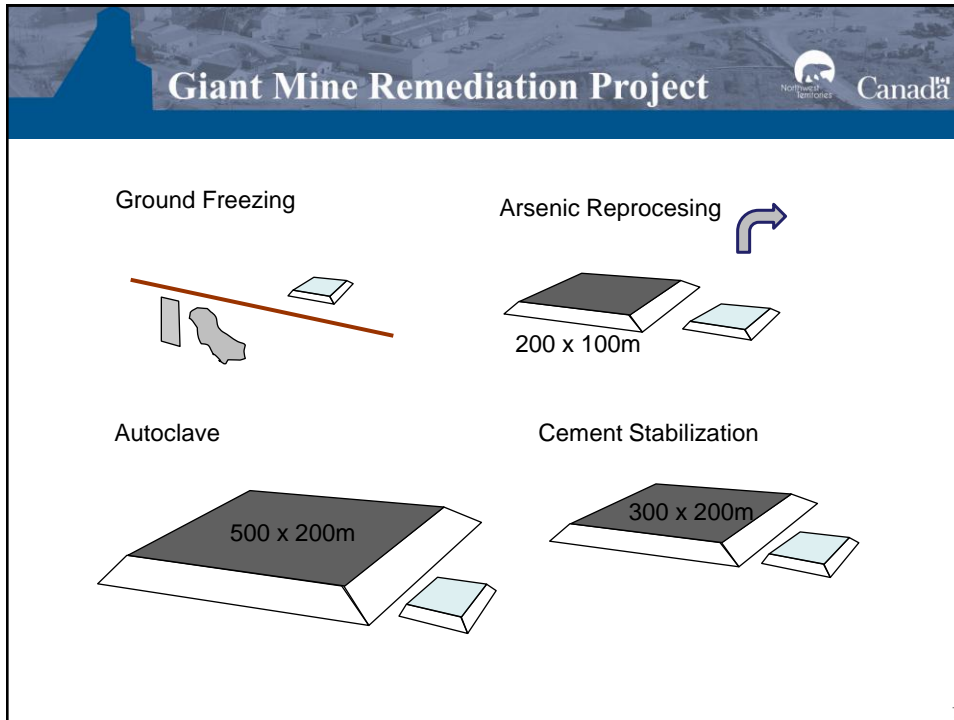



Giant Mine Remediation Project



- Total of 12,000 trucks
- Or 200 trucks per month

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Northwest Territories Canada

- Conclusion
 - Option B3 - Frozen Block
 - Low risk to workers
 - Very low risk of short-term arsenic release
 - Low or very low risk of long-term arsenic release

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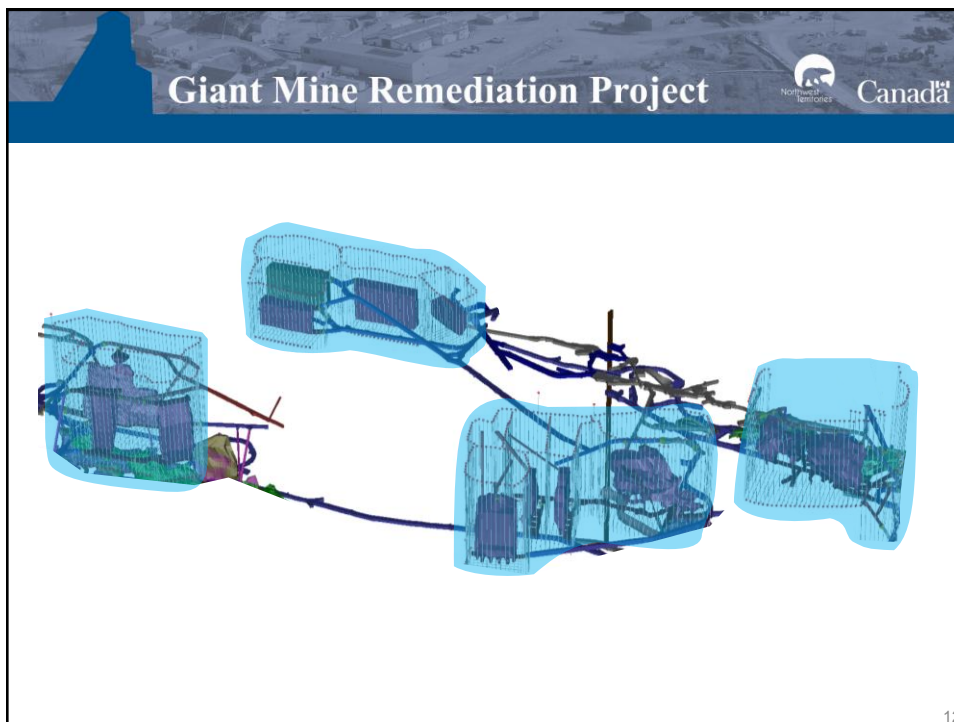
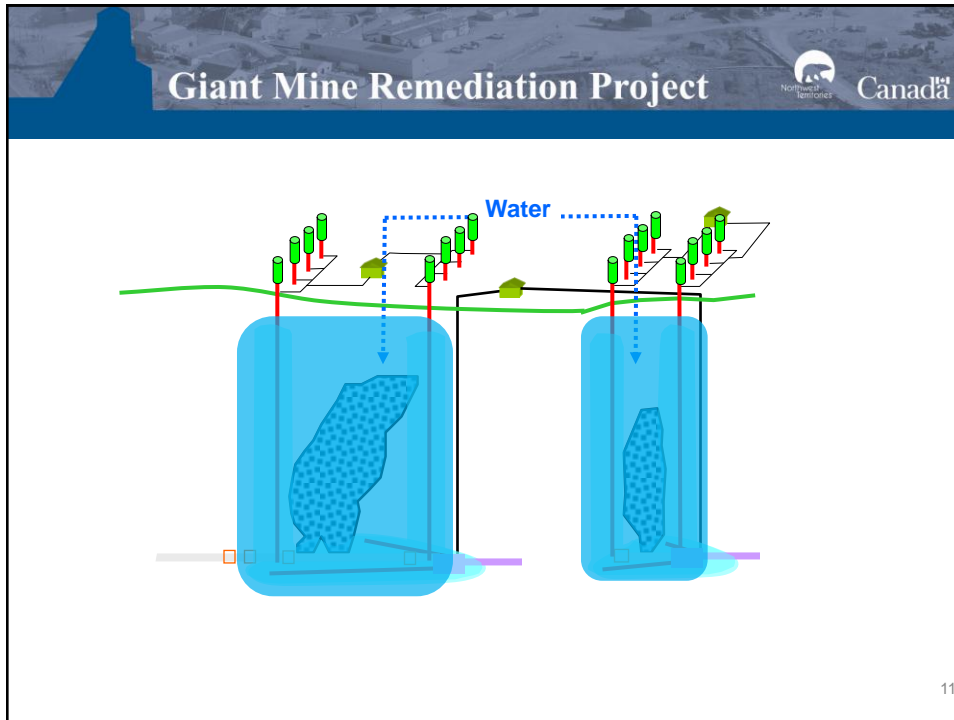


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- Frozen Block method
 - Four steps:
 - Freeze the surrounding ground
 - Add water to the dust
 - Freeze the water within the dust
 - Convert to long-term freeze maintenance and monitoring

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Giant Mine Remediation Project

- Implementation around 10 years
 - Design, procurement, construction
 - Create frozen shells
 - Create frozen blocks
- Transition to long-term
 - Thermosyphons remove any heat that enters the ground
 - Fully passive operation
 - Minimal maintenance
 - Very easy to monitor

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Giant Mine Remediation Project

- Very long term
 - Number of thermosyphons needed to keep Chamber 12 frozen

Climate Scenario	Mean Annual Air Temperature	Number of thermosyphons required
Current	-4.5°C	8
IPCC Best Estimate	-1.2°C	15
IPCC Worst Case	+1.35°C	32

- Actual number of thermosyphons = 66

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- Monitoring system
 - Thermistors in frozen blocks
 - Annual surveys of thermosyphons
 - Mine water collection system will monitor any changes in arsenic levels
 - Water treatment staff will be on site year-round

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- Contingency measures
 - Investigate causes
 - Replace defective components
 - Modify the ground surface to reduce heating
 - Install shallow thermosyphons
 - Install additional full-depth thermosyphons


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- Worst case scenario - all thermosyphons somehow became ineffective
 - Very unlikely chain of events before there is any risk of environmental impact
 - Nobody notices and no mitigation happens
 - Would take **twenty years** before dust begins to thaw!
 - Any released arsenic would go to minewater collection and treatment system
 - Increased arsenic would be very apparent
 - Complete failure of that system would also be needed before water could come to surface
 - The water would be evident in pits before it left site


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- Future Changes?
 - Information requests related to the possibility of future changes if a better method is found
 - Unlikely to be a markedly superior option in the near future
 - Current methods were thoroughly investigated
 - Over-arching risks will still apply
 - Threshold for any new options will be high
 - Sunk cost of freezing system
 - Low risk after freezing complete


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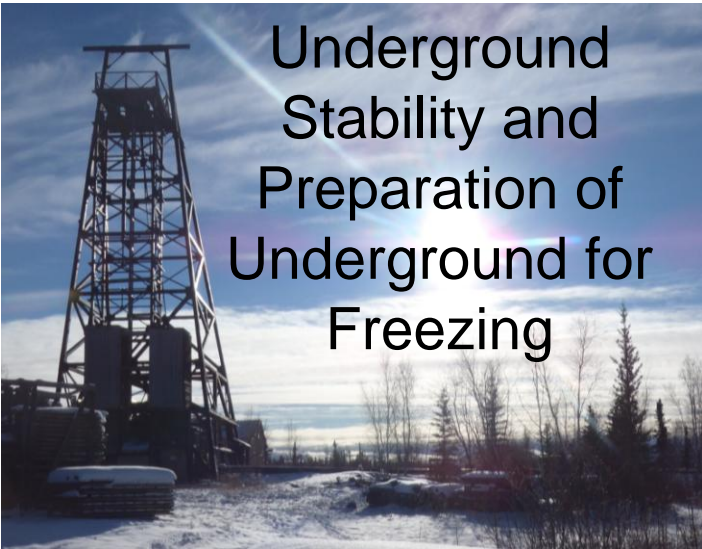
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- But the concerns were addressed:
 - Could we reverse the freezing?
 - Yes
 - Method would depend on the overall plan
 - Example in response to Review Board's IR#5
 - Will we continue to review new research?
 - Yes
 - 10-year time frame
 - Present findings in SOE reports
 - See response to Review Board's IR #19

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Giant Mine Remediation Project




Underground Stability and Preparation of Underground for Freezing

Darren Kennard,
M.Sc., P.Eng.

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Introduction

- Stabilize the arsenic chambers/stopes
- Prepare the underground for freezing

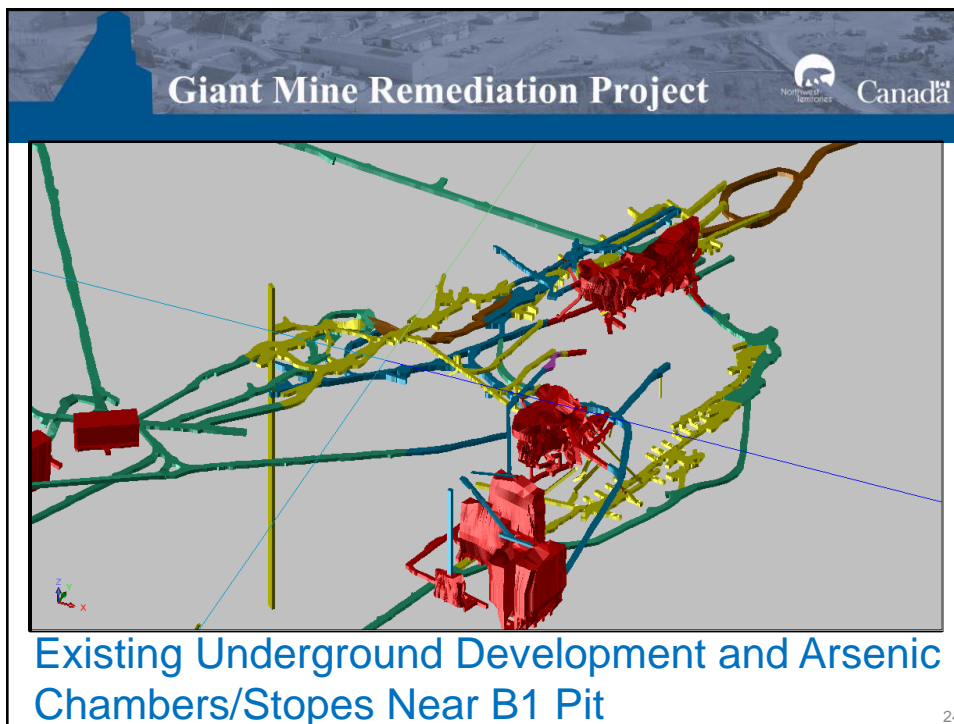
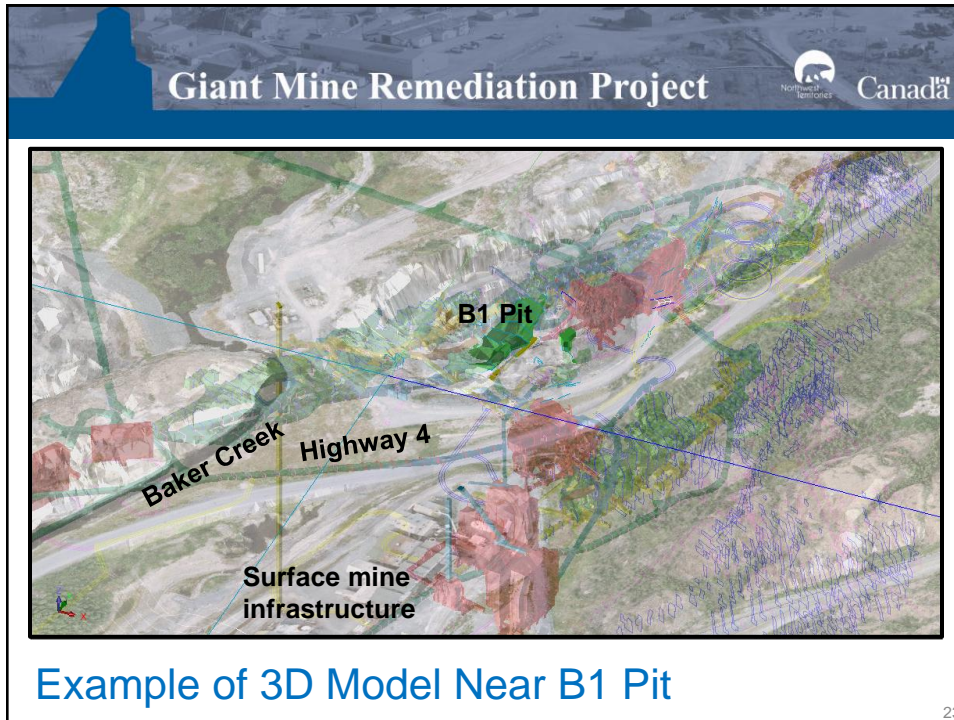
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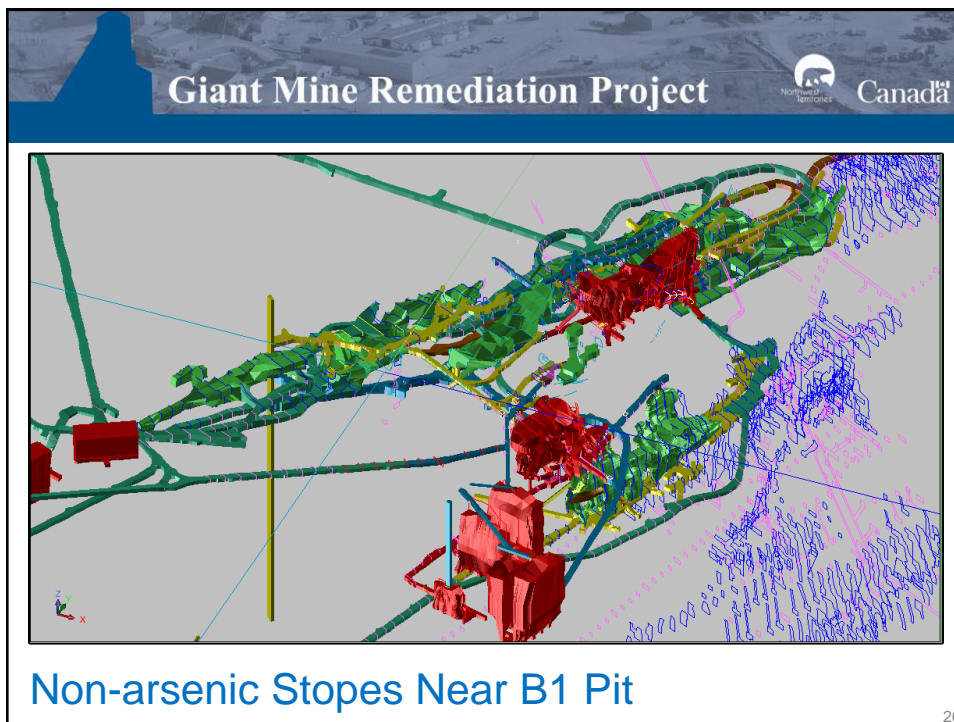
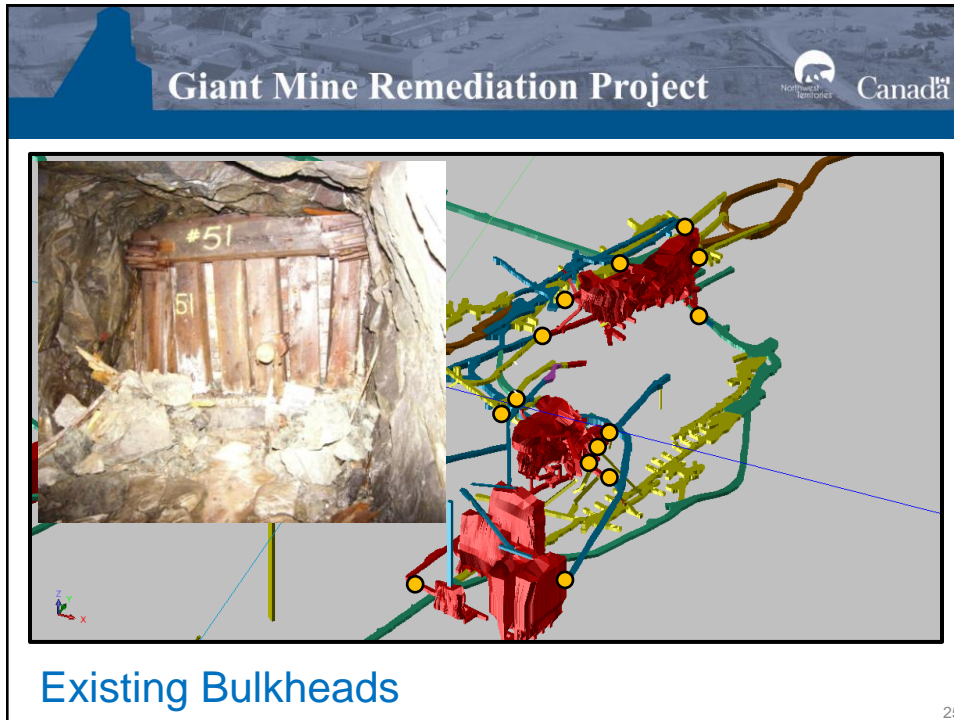
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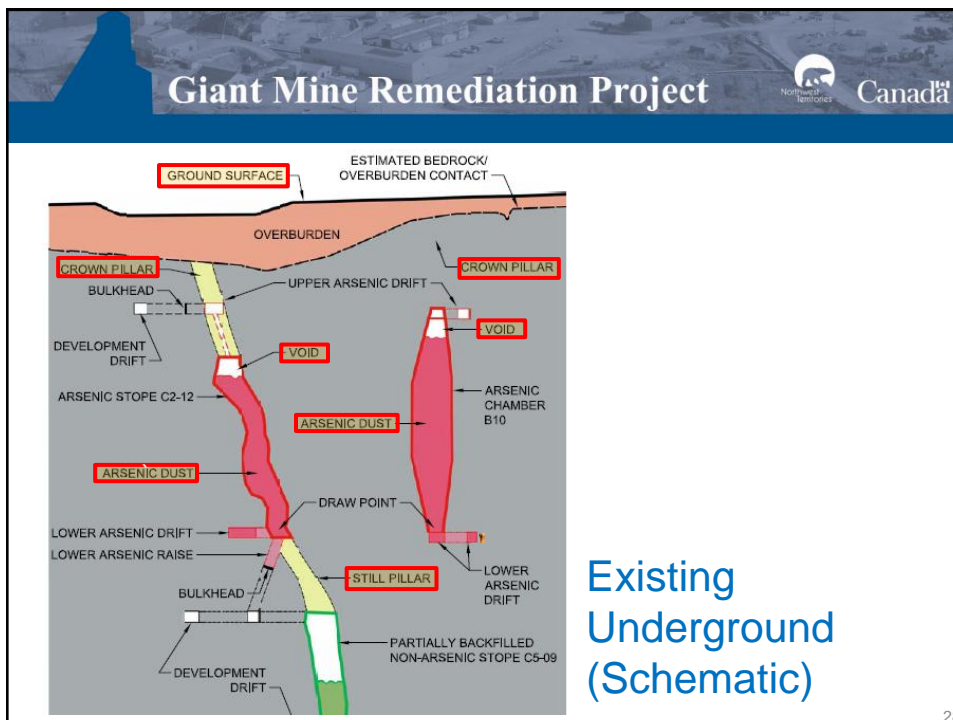
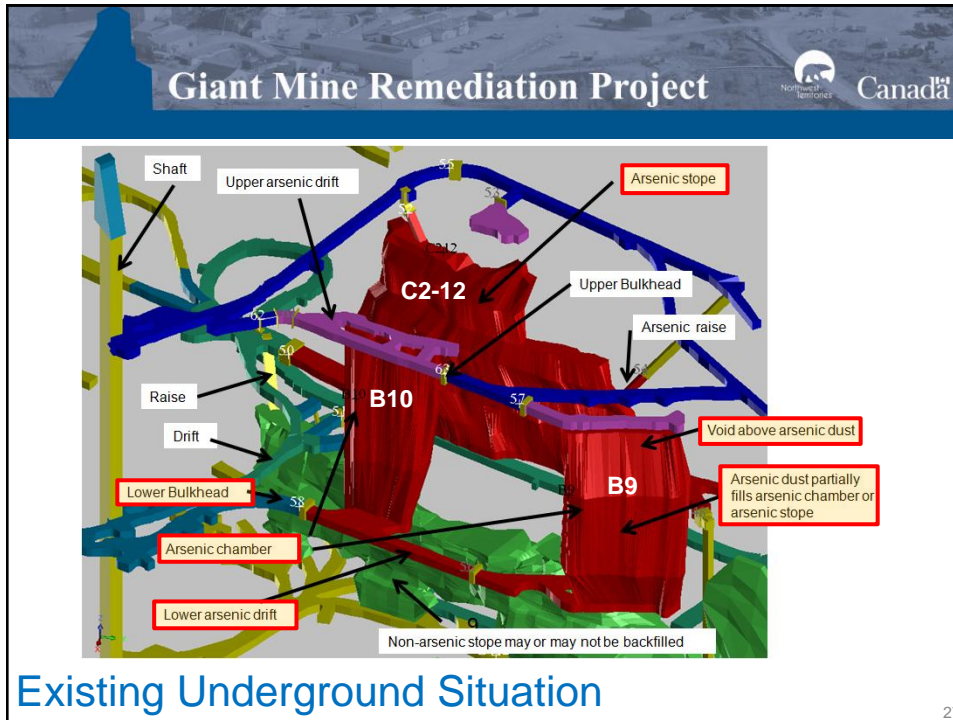


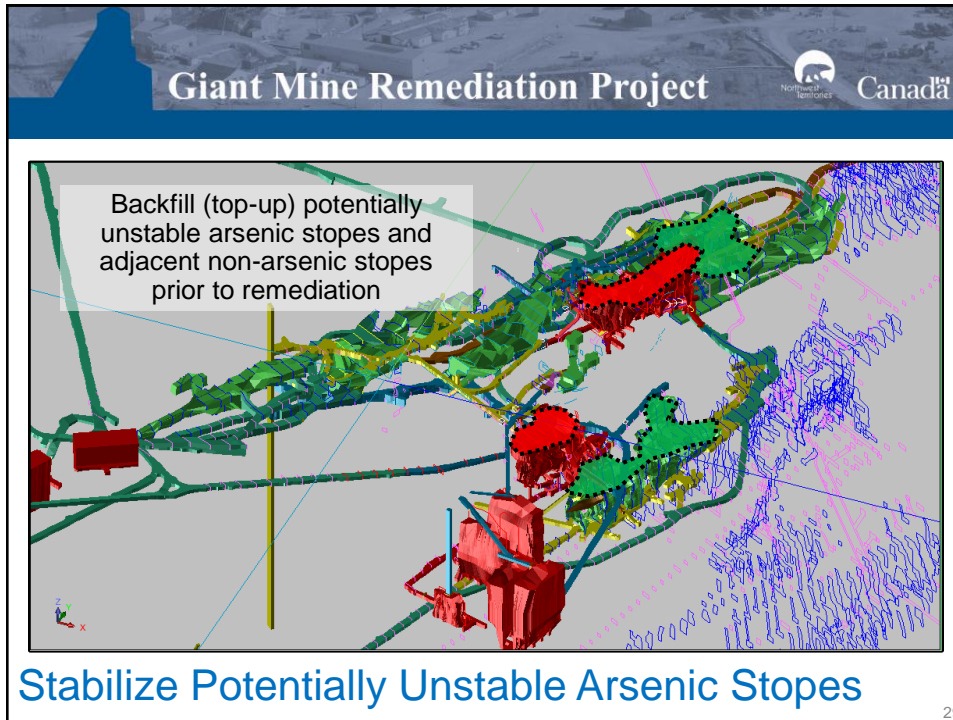
Surface Elements Near B1 Pit

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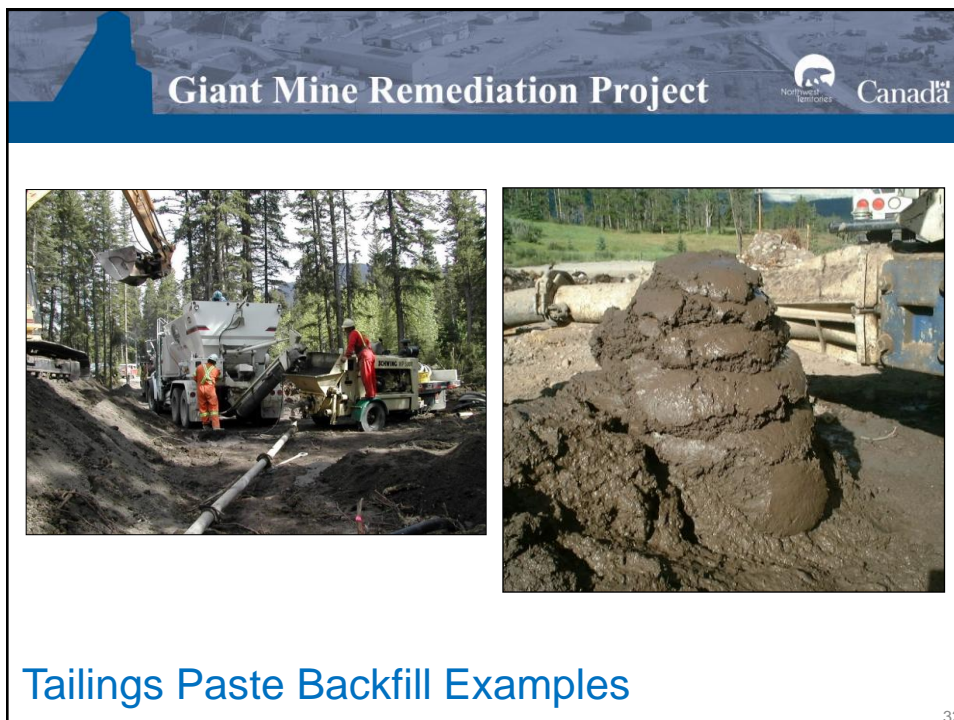
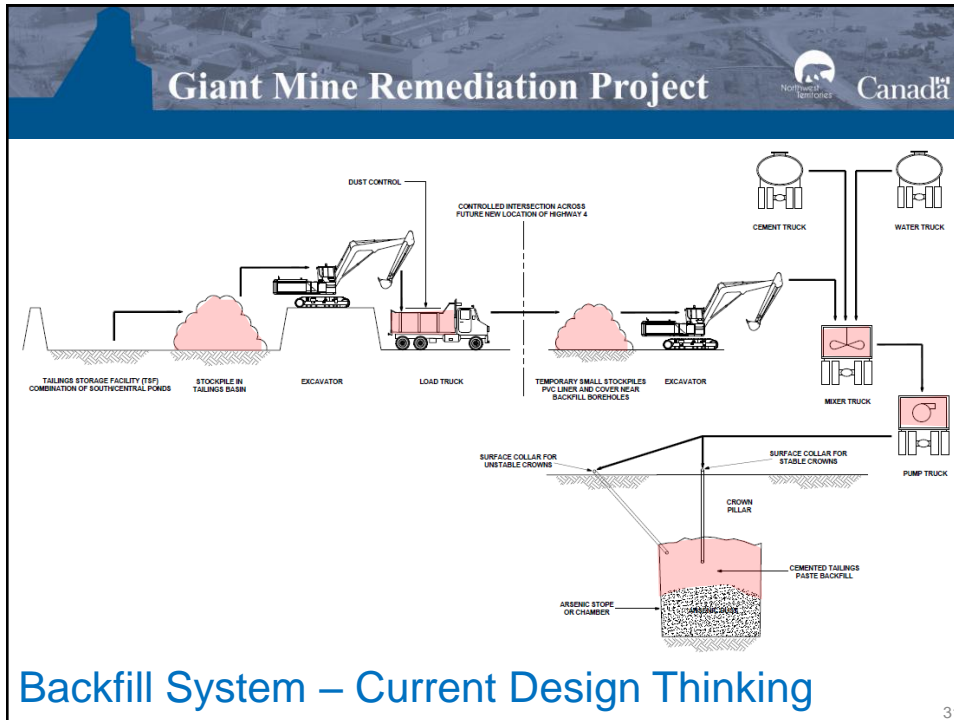



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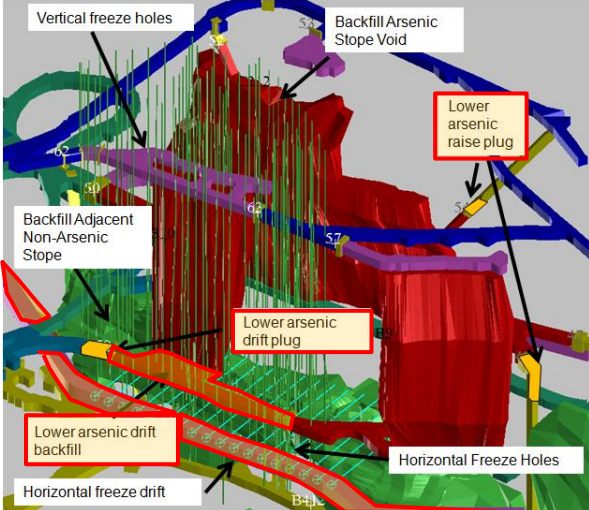
- Void backfill material will consist of lightly cemented tailings paste backfill.
- Tailings will be sourced from the south and central tailings ponds.
- It will be placed primarily through vertical holes drilled from surface.
- Existing roadways and pads, new pads for freeze drilling will be utilized.
- Ground support rehabilitation and barricading with waste rock is required to control paste backfilling.

Backfill Requirements – Current Design Thinking

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- Excavate new development
- Install lower arsenic drift and raise plugs
- Backfill lower arsenic drifts.

Preparation of Underground

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Construct new drift plugs adjacent to existing bulkheads

Preparation - Drift Plugs

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- Drift plugs are required to reinforce existing bulkheads to block of the movement of arsenic dust and to limit leakage from the arsenic stopes and chambers during wetting.
- Plugs will be built adjacent to existing bulkheads where possible.
- Remote plugs are avoided where possible but some may be required.
- The freeze system will be designed to freeze the plugs prior to wetting and freezing to reduce the potential for frost pressure to impact them.
- The plugs will be designed to withstand the anticipated conditions imparted during wetting and freezing but details are still being defined.

Drift Plugs – Current Design Thinking

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- Current design thinking include 33 new drift plugs:
 - some will require new development
 - some remote plugs may be required

Drift Plugs – Current Design Thinking

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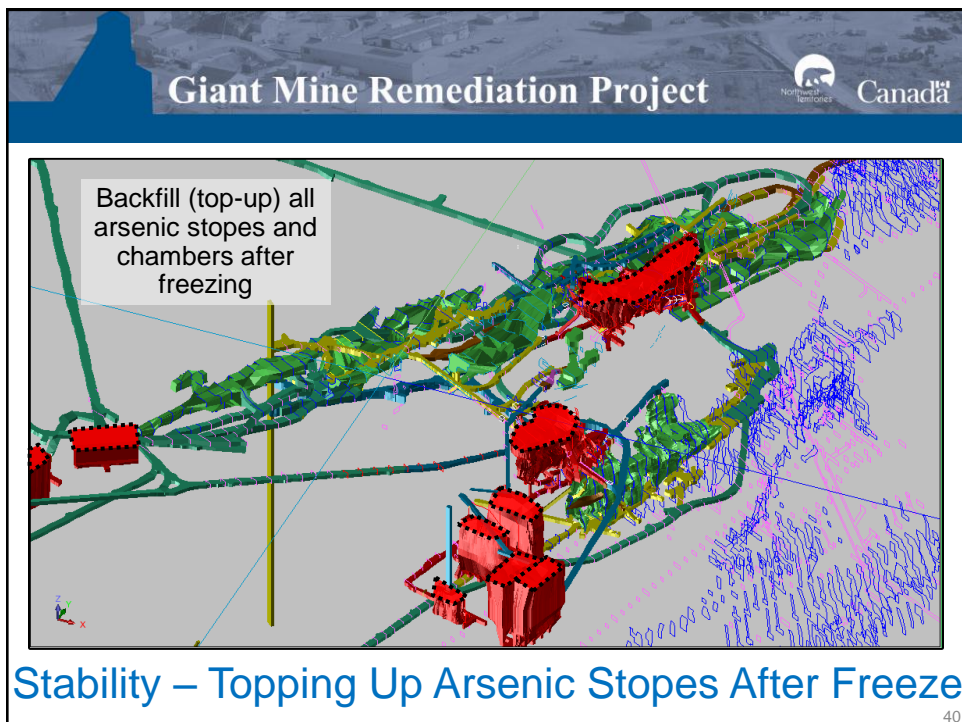
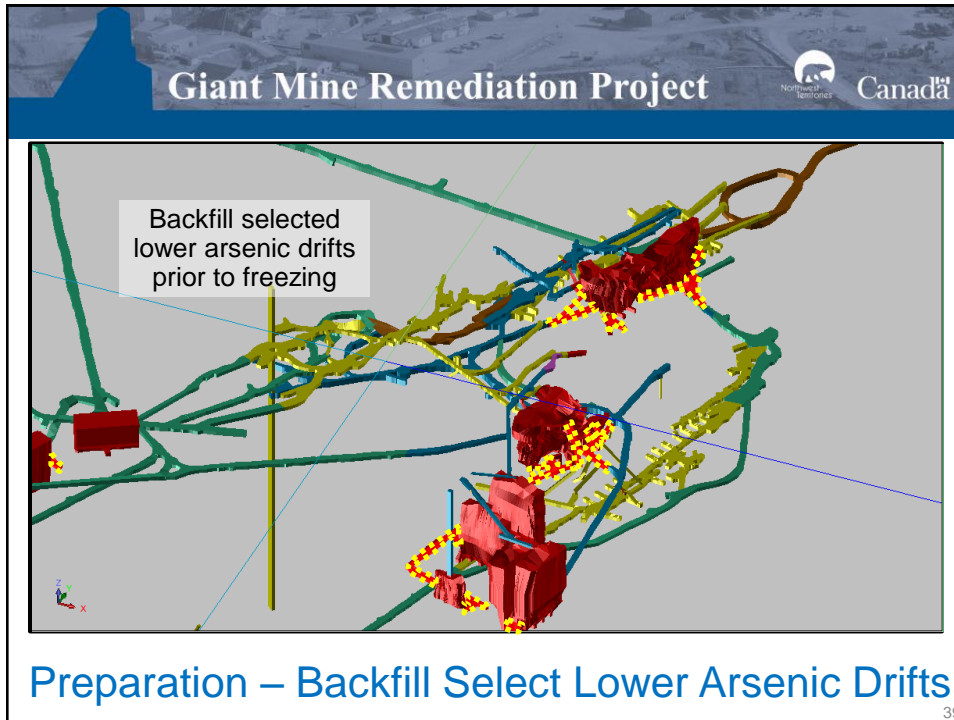



Preparation - New Underground Development 37

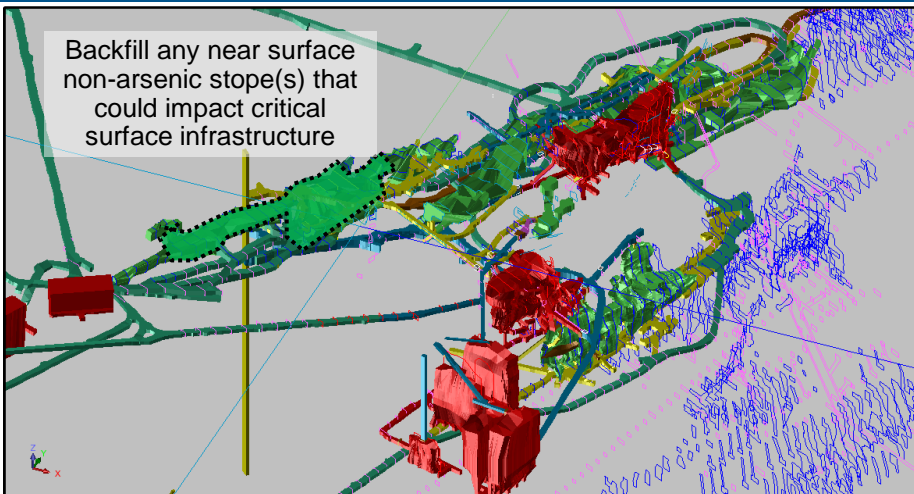
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- New underground development openings and rehabilitation of existing underground development is required to:
 - Replace existing underground development that is no longer safe to use.
 - Re-establish access to currently inaccessible bulkheads for monitoring and plug construction.
 - Provide access for drilling of horizontal freeze holes.
 - Existing surface portal may become un-useable.
- Waste rock from new development will result.

Preparation - New Underground Development 38




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Backfill any near surface non-arsenic stope(s) that could impact critical surface infrastructure

Stability – Backfill Select Non-arsenic Stopes


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- Developing new underground openings to the currently inaccessible bulkheads will reduce the need for remote plugs.
- The new drift plugs will be built adjacent to the existing bulkheads where possible.
- Select lower arsenic drifts will be backfilled to limit movement of dust.
- Upper arsenic drift plugs may not be required.
- Select non-arsenic stopes under critical surface elements (e.g. Baker Creek) may be backfilled subject to ongoing geotechnical assessment.

Current Design Thinking

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- Address remaining design issues:
 - Continue to incorporate more of the existing historical mine geometry information into digital mine design tools.
 - Continue geotechnical investigations to refine stability assessments.
 - Continue to investigate geotechnical aspects of wetting the dust.
 - Continue to investigate geotechnical aspects of seasonal fluctuations in mine water levels associated with equalization storage required for mine water treatment plant operations.
 - Continue to investigate geotechnical aspects of unexpected flood events.
 - Continue to investigate geotechnical aspects of near surface stable mine water level scenarios.

Next Steps in Ongoing Design

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David Knapik,
P.Eng.



Freeze System Design Update

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- Overview of current design thinking
- Location of Drift Plugs / Backfill
- Chamber / Stope Geometry
- Monitoring
- Next Steps in Design Process

Introduction

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- Focused on major components such as drilling, mechanical, and civil / underground.
- Electrical and instrumentation are a much smaller part of the total project.

Focus of Current Design Thinking

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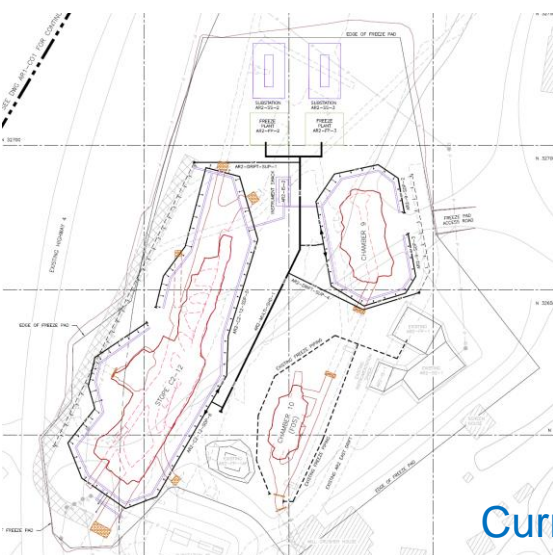
- Initial thinking was based on concept outlined in the DAR
- FOS constructed and data is still being collected and evaluation is ongoing
- Current design thinking incorporates experience gained from FOS design, construction, and initial operation

Current Design Thinking

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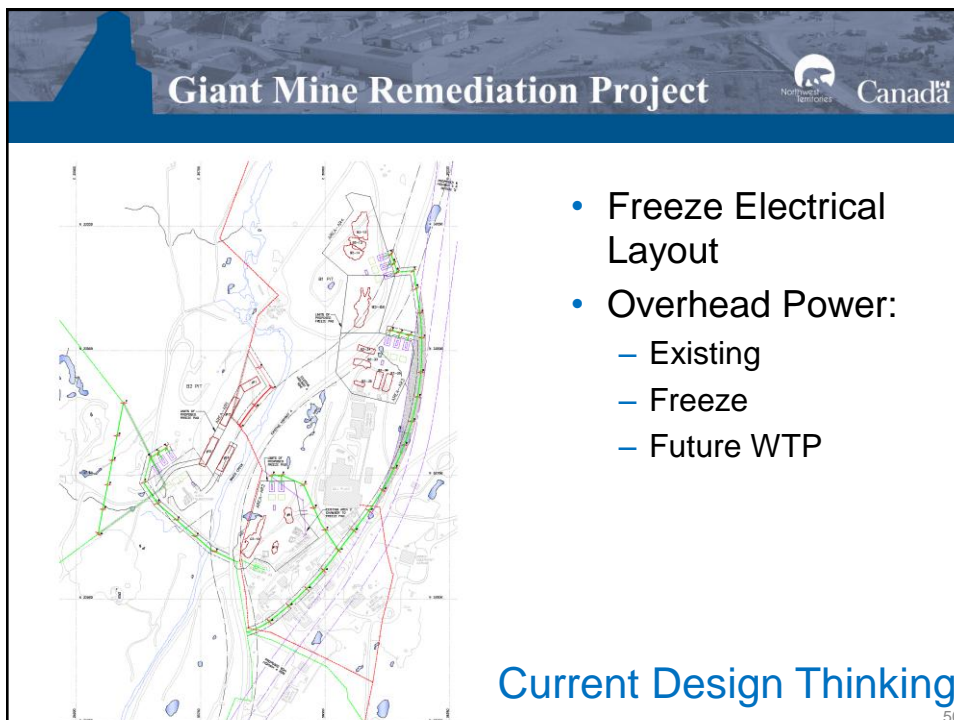
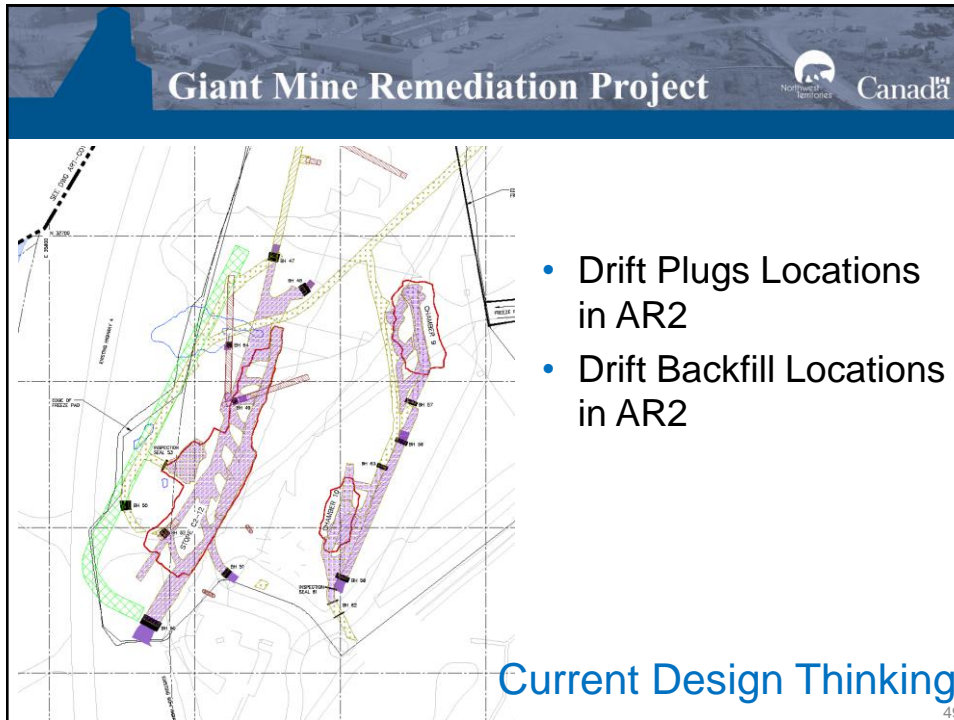





- AR2 Typical Mechanical Layout


Current Design Thinking

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- Chambers:
 - Generally regular in shape
 - Narrow
- Stopes:
 - Generally irregular in shape
 - Some are narrow and some are wide

Chamber/Stope Geometry

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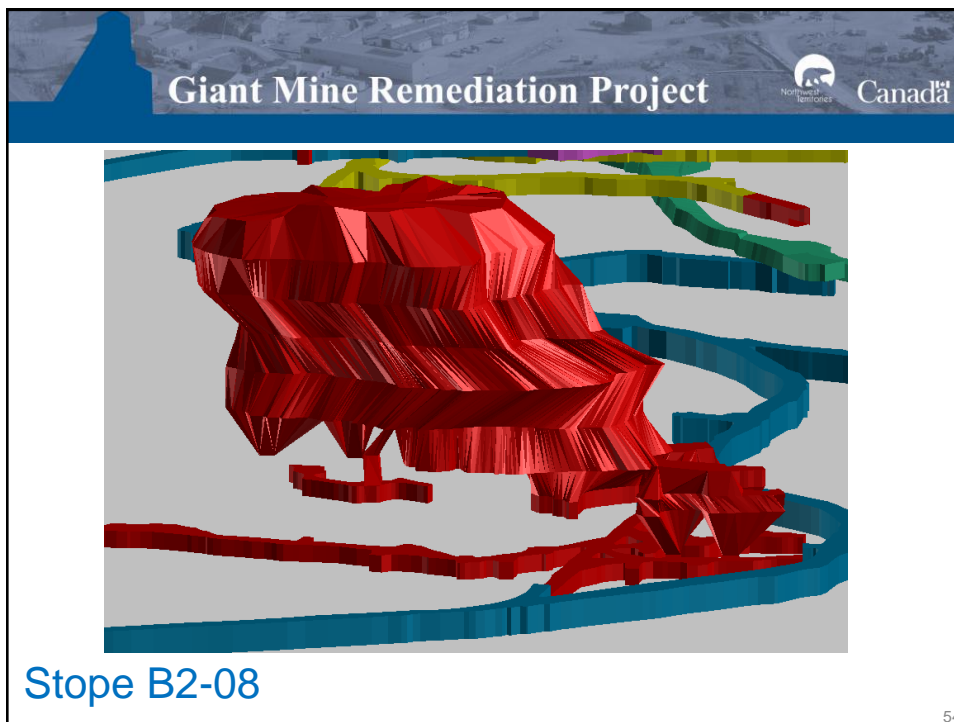
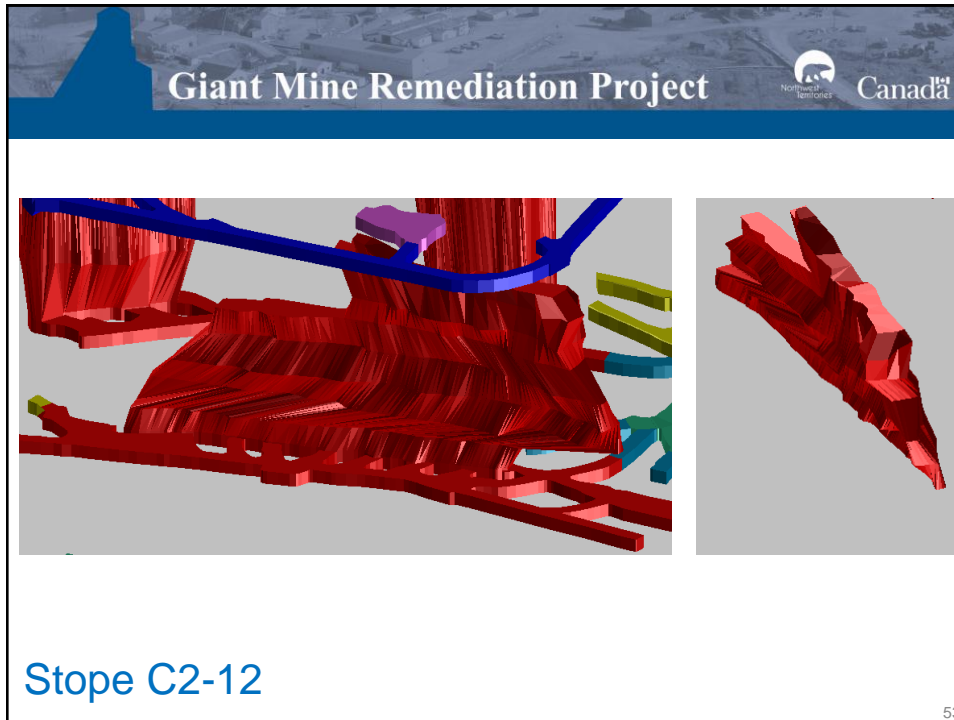
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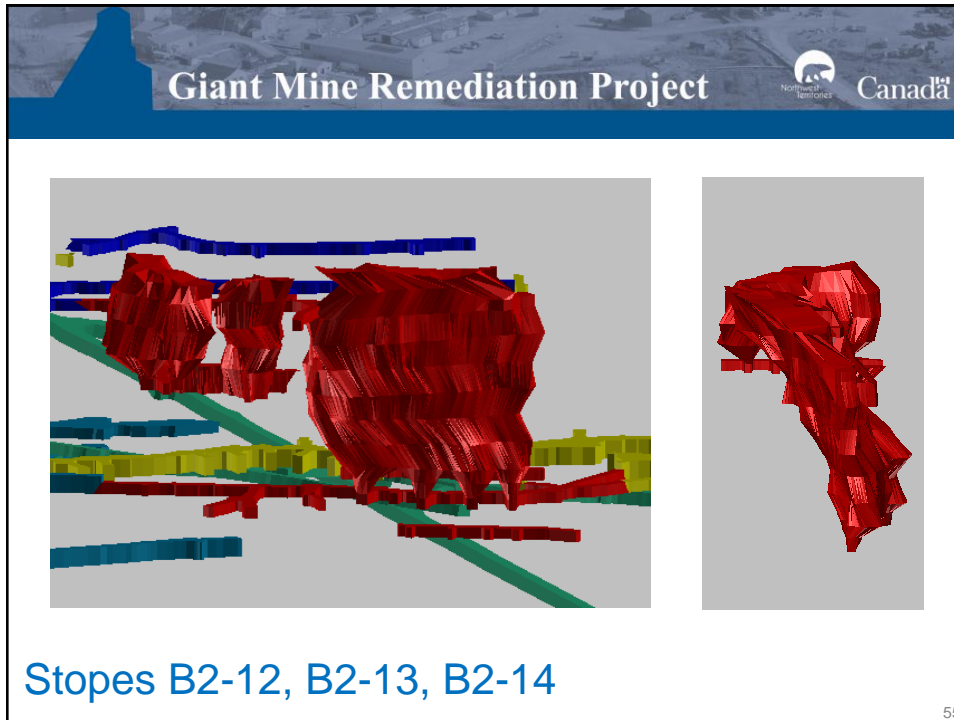




Chamber 12

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- Chamber and stope geometry is incorporated into design:
 - Thermal modeling
 - Freeze pipe placement and orientation
 - Instrumentation placement
 - Wetting

Chamber/Stope Geometry

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- Monitor progress of frozen shell
- Monitor progress of wetting
- Monitor performance of frozen block
- Monitor performance of drift plugs

Monitoring

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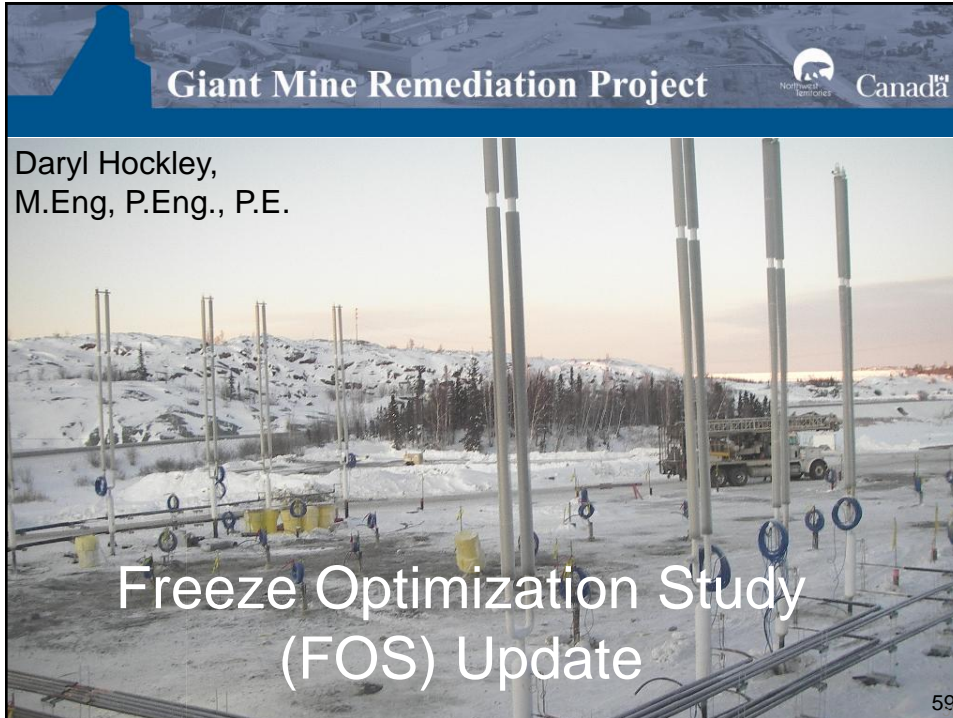


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- Continue design development and optimization
- Develop monitoring plan
 - Instrumentation maintenance
 - Data collection
 - Data management
 - Reporting
- Develop wetting plan
- Final design
- Develop construction sequence

Next Steps in Ongoing Design

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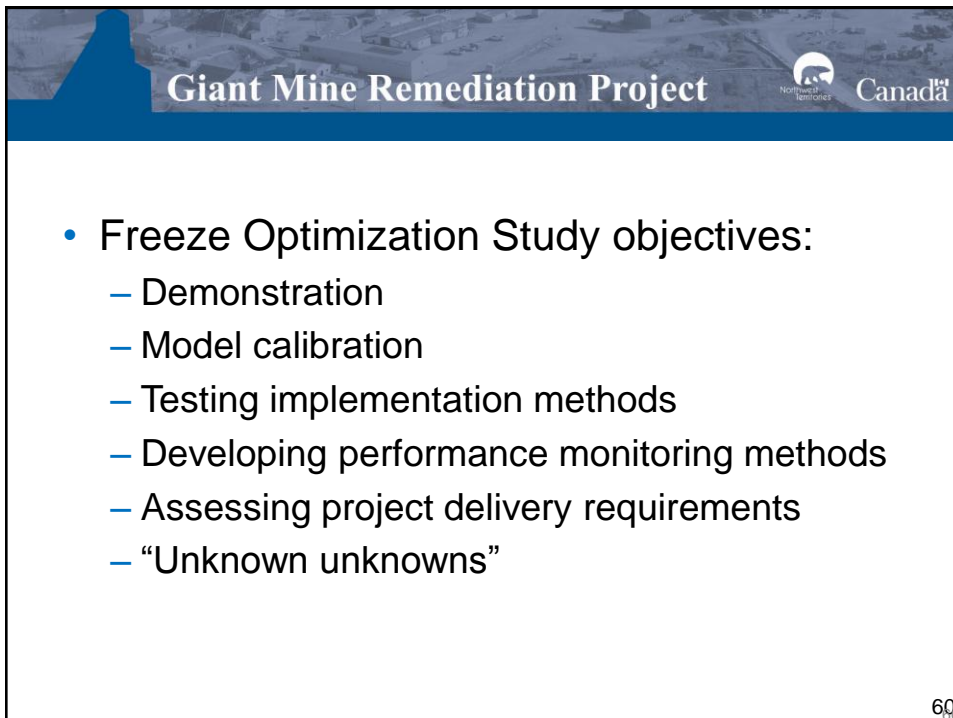
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Daryl Hockley,
M.Eng, P.Eng., P.E.

Freeze Optimization Study
(FOS) Update

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- Freeze Optimization Study objectives:
 - Demonstration
 - Model calibration
 - Testing implementation methods
 - Developing performance monitoring methods
 - Assessing project delivery requirements
 - “Unknown unknowns”

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- Update will cover:
 - Construction
 - Operations
 - Freezing result to September 2011
 - Preliminary findings
 - Next steps

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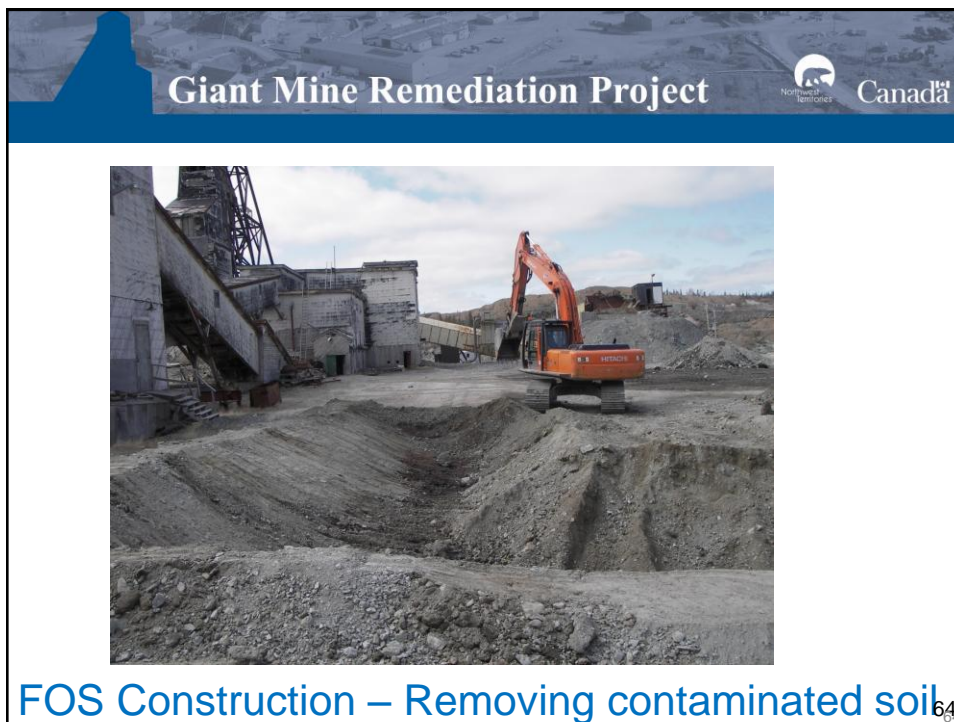
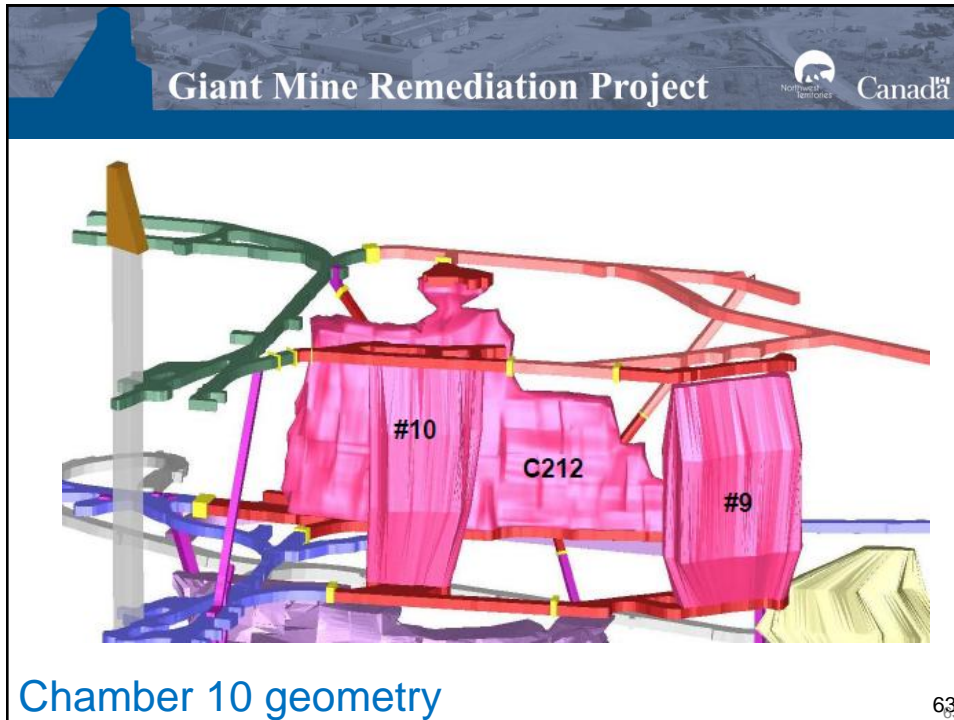
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Chamber 10 location

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Clean rock fill

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Preparing working area

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Canada



Rotary drilling rig

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Canada



Installing J-55 pipe

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Crane installing thermosyphons

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Installing freeze pipe and grout pipe


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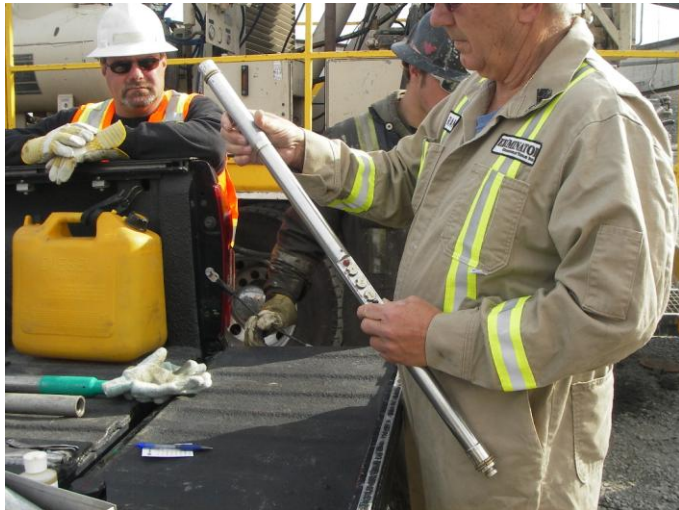
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Testing pipe welds


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Downhole survey tool

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Borehole logging

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Downhole thermistor cables

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Thermosyphons in place

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Thermosyphon cooling system

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Hybrid thermosyphons

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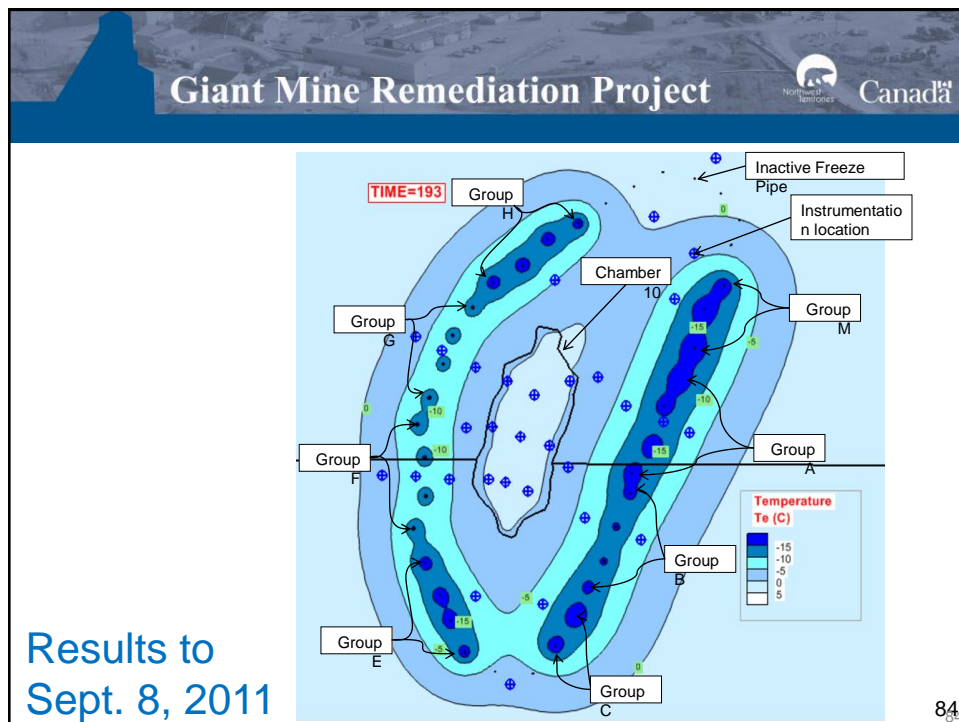
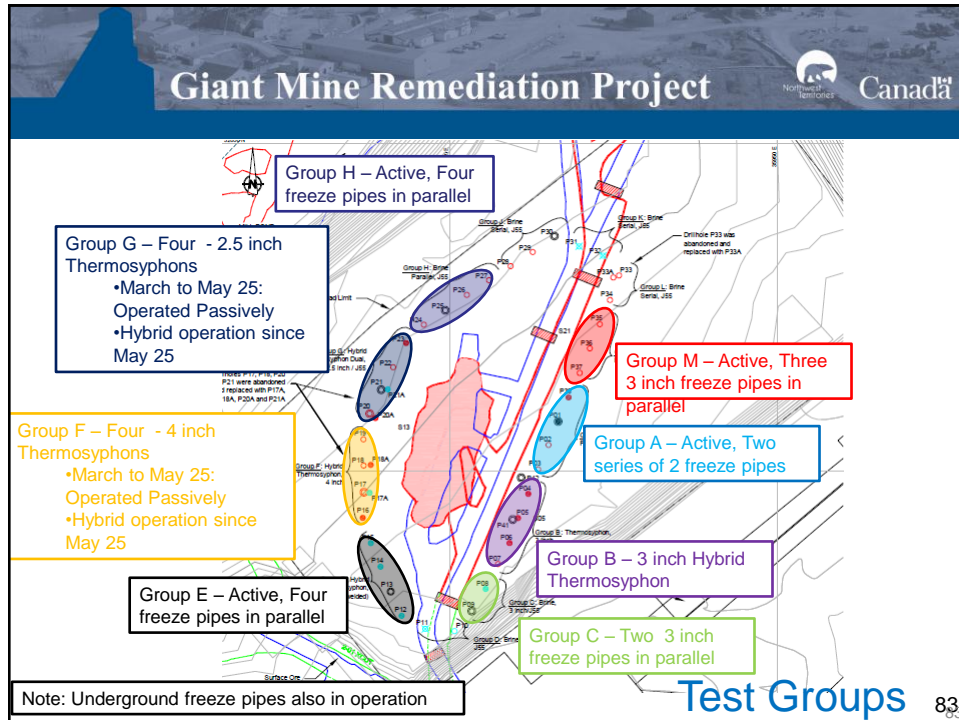
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Refrigeration unit

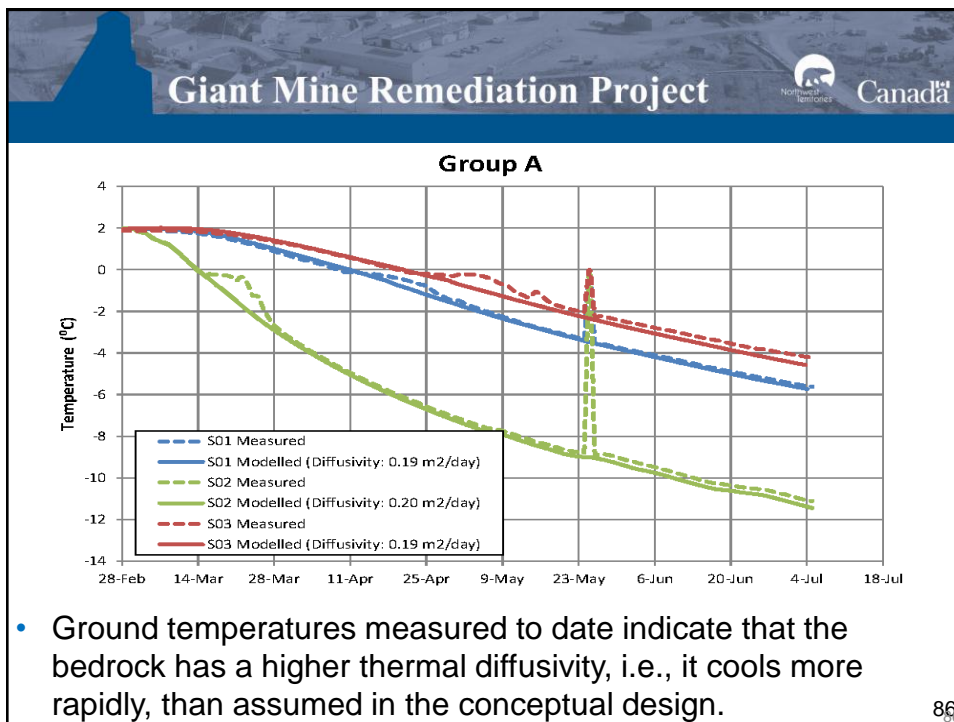
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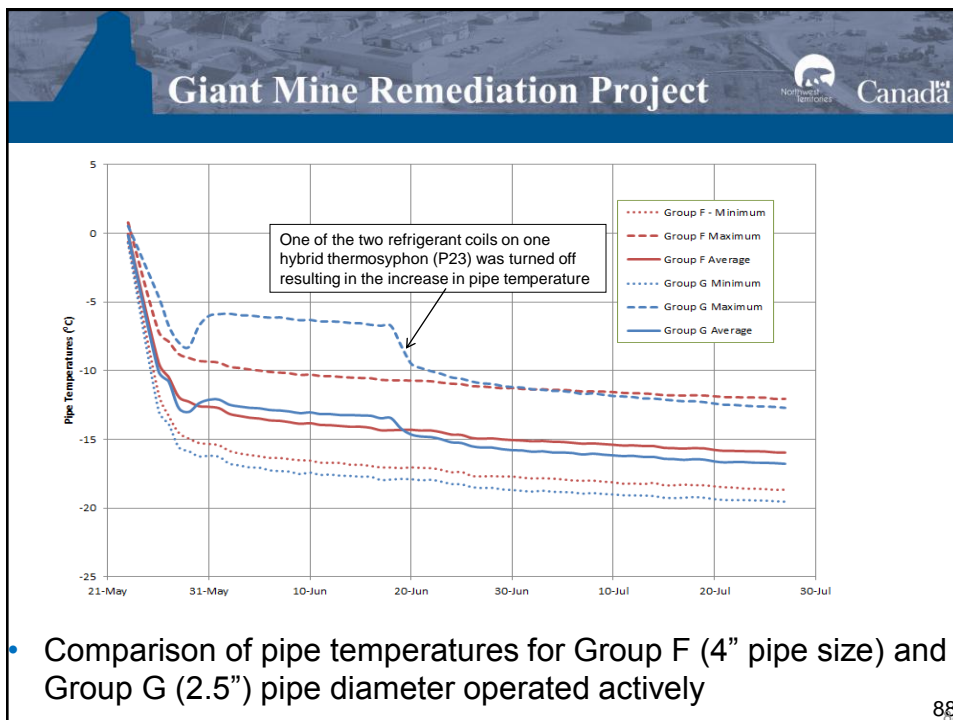
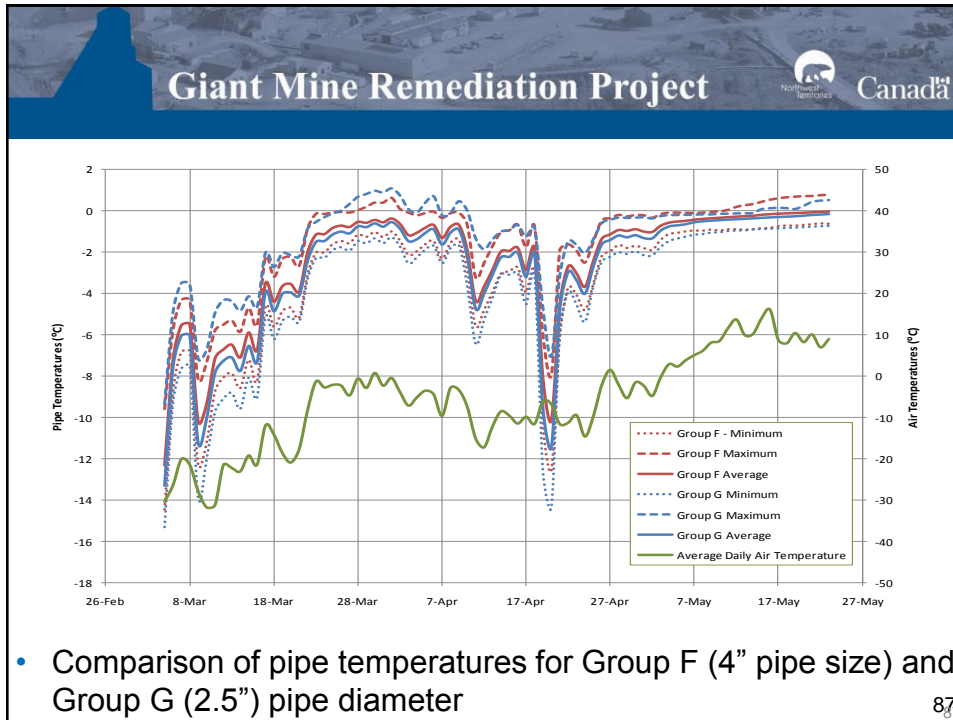


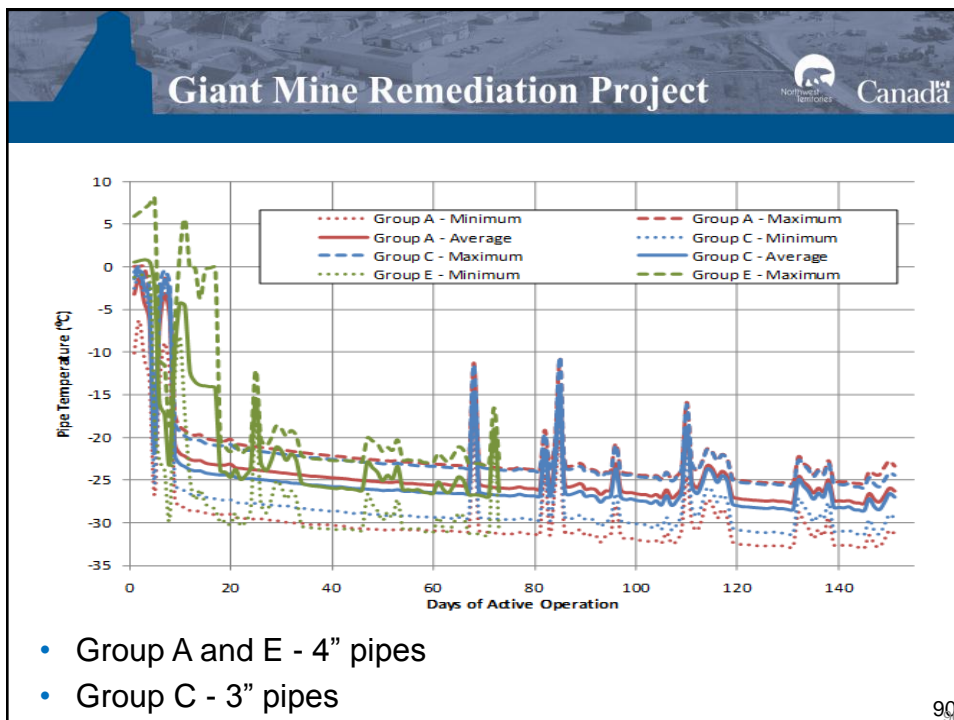
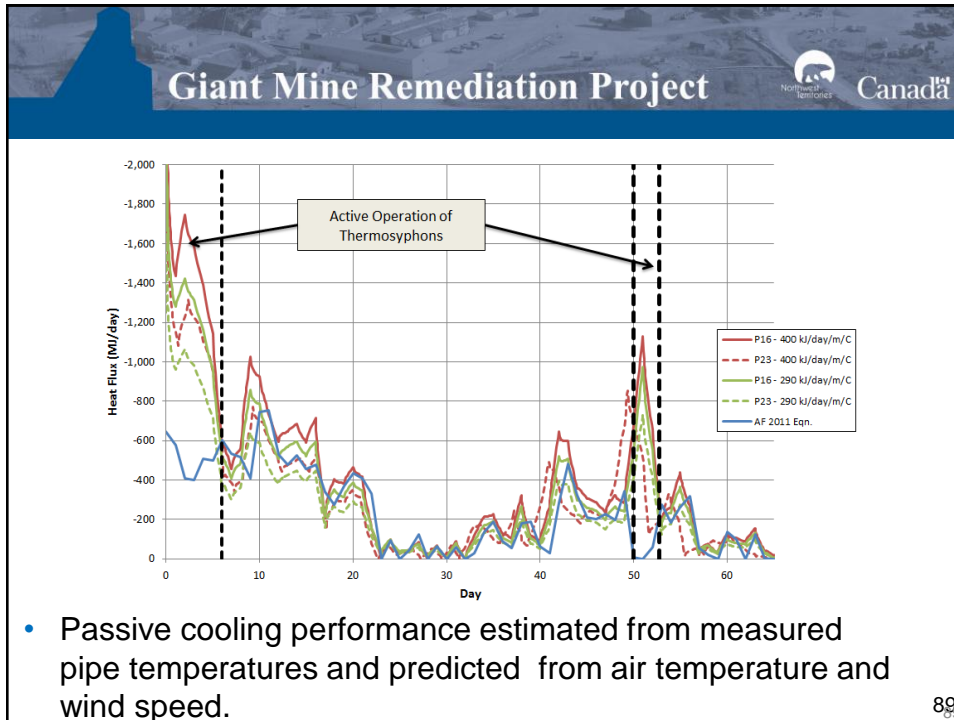
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Canada			
<ul style="list-style-type: none"> Freeze Wall Thickness by Group 			
Group	Period of Operation	-5 C Wall Thickness	-10 C Wall Thickness
A	Active since March	11 m	5 m
B	Active since March	9 m	3 m
C	Active since March	10 m	5 m
E	Active since May 25	8 m	4 m
F	Passive: Mar. 5 to May 25; Active: Since May 25	7 m	0 m
G	Passive: Mar. 5 to May 25; Active: Since May 25	6 m	0 m
H	Active since May 25	8 m	3 m
M	Active since March	11 m	6 m

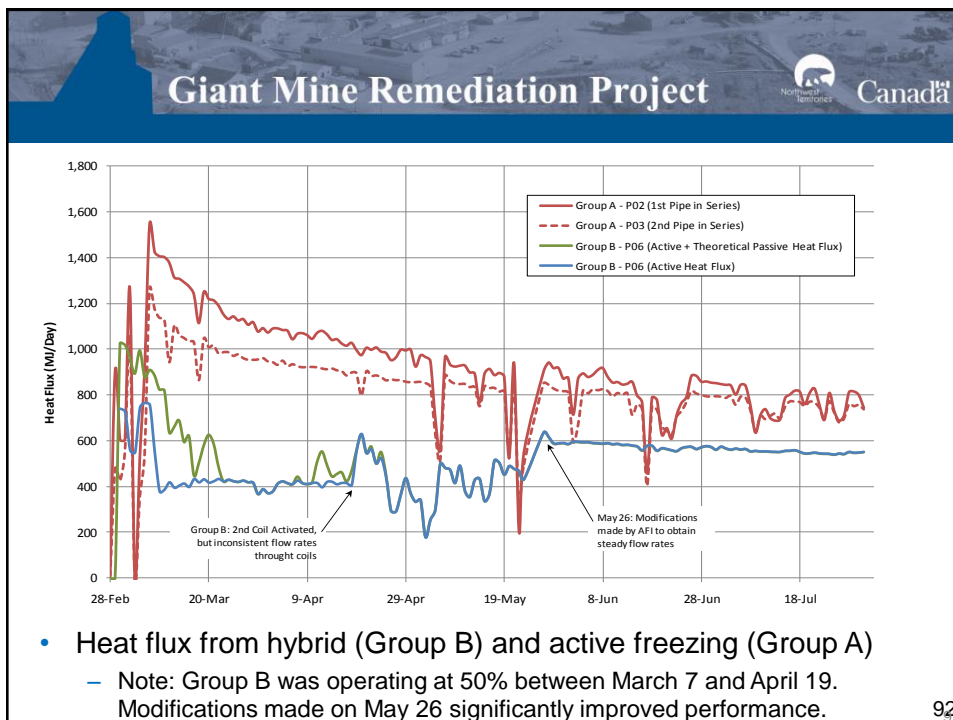
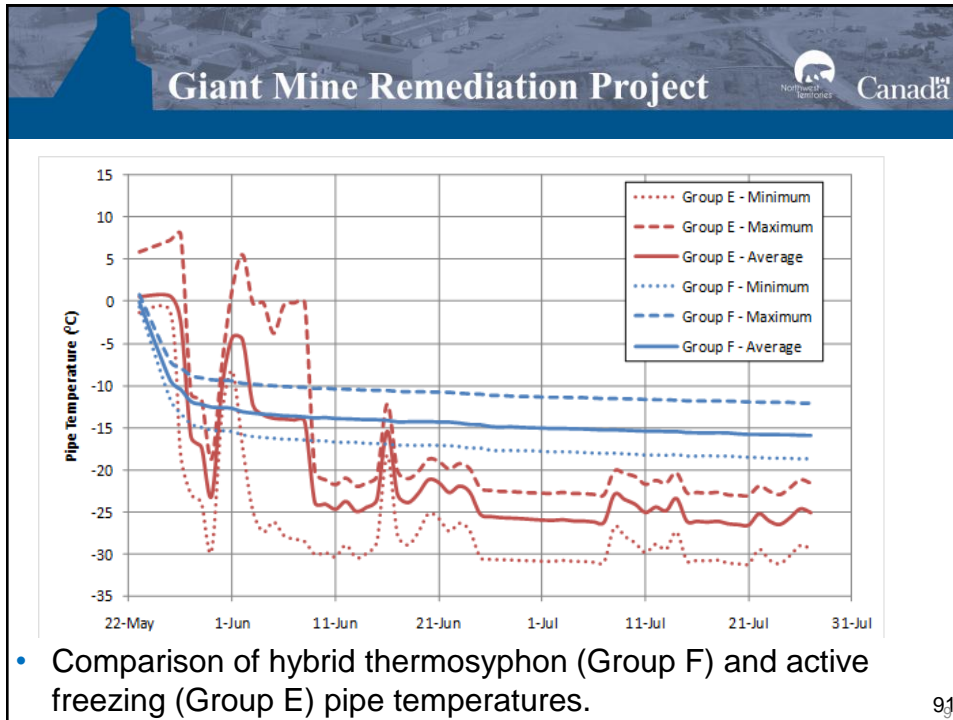
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Canada

- Monitoring system
 - Design and setup learning curve
 - Instrumentation and set up of data management system took much longer than expected
 - Still problems related to some data acquisition, especially operating parameters
 - In-ground system has proven very reliable
 - 539 thermistors installed
 - Less than 2% damaged, less than 4% malfunctions
 - 158 Resistance Temperature Devices (RTD's)
 - 100% reliable so far

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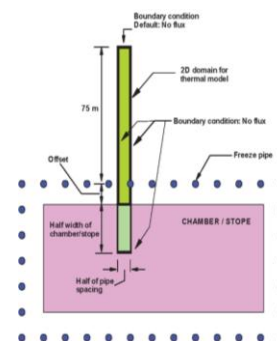
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Canada

- Use of FOS findings
 - Time to create frozen shell
 - 10 m width at -10°C

DAR predictions	9.5 to 11 months
FOS active freezing (Group A)	6.5 to 9 months
FOS hybrid thermosyphons (active operation only)	8 to 10.5 months



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- Use of FOS findings
 - Effects of freeze pipe layout on number of months to complete frozen shell

	4m spacing, 7m offset	4m spacing, 10m offset	5m spacing, 10m offset	6m spacing, 10m offset
FOS Active Freezing	6.5 to 9	8.5 to 12	10 to 14	12 to 16
FOS Hybrid Thermosyphons	8 to 10.5	11 to 15	13 to 17.5	15 to 20


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- Next steps
 - Continue operating the FOS for another winter
 - Need to test thermosyphons at full performance
 - Complete energy balance and electricity cost calculations after full year
 - Update predictive modeling once complete results are available
 - Construction of plugs in the upper and lower tunnels
 - Complete frozen shell

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- **Conclusions to date**
 - FOS construction went well
 - Good learning curve
 - Tested several readily available technologies and collected data to support future procurement
 - FOS operating as planned
 - Rock is cooling faster than expected
 - Data collection continues
 - Interim results indicate that designs presented in DAR are conservative

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