Wednesday, April 27, 2016
Stream E2: Giant Mine Remediation Project
Location: Level 4, Sal de Bal Centre/Ouest

10:30 am – 10:50 am

Giant Mine Remediation Project

Katherine Ross and Adrian Paradis
Indigenous and Northern Affairs Canada

The objective of the presentation is to introduce the background of the project and discuss the regulatory context within which it is being scoped and implemented.

Abstract

Following the discovery of gold in the Yellowknife, Northwest Territories area, Giant Mine officially opened in 1948. Gold at Giant Mine was found in specific minerals, which need to be roasted at extremely high temperatures. Unfortunately, this roasting process also released arsenic rich gas, a highly toxic by-product. Throughout the 1950s controls were put in place that minimized emissions to the air, however this also resulted in the creation of 237,000 tonnes of highly toxic arsenic trioxide dust. At the time, scientists and government agencies agreed that storing the waste in underground stopes and chambers was an appropriate, long-term alternative.

After the mine closed in 2004 the care and control of the mine fell to the Department of Aboriginal Affairs and Northern Development Canada, and attention focused on the environmental issues left behind, including the arsenic trioxide stored in underground chambers. The Giant Mine Remediation Project was created in 2005 with the overall goal to protect human health and safety, and the environment. To do so requires the long-term containment and management of the arsenic trioxide waste, ongoing water treatment and clean up of the surface elements of the site. The main objectives of the Giant Mine Remediation Project are to minimize risks to public and worker health and safety, minimize the release of contaminants from the site to the surrounding environment, remediate the site the site in a manner that instils public confidence, and implement an approach that is cost-effective and robust over the long term.

The project has recently completed an environmental assessment (EA) process under the Mackenzie Valley Resource Management Act, the governing legislation in the Northwest Territories for major projects. The project team is now proceeding with a clearly defined list of requirements established through the process for the project, but faces many challenges going forward, including: technical considerations; regulatory and jurisdictional constraints; consultation and engagement requirements; and, resource pressures.

In addition to the requirements from the EA, the project will require a land use permit from the Mackenzie Valley Land and Water Board for specific project activities, and various development and demolition permits from the City of Yellowknife. Various other permits or authorizations may be required during the life of the project, such as fisheries authorizations, research permits (wildlife, scientific, medical), archaeology permits and migratory bird permits.

11:00 am – 11:20 am

Planning a Complex Remediation and Mine Closure

Brad Thompson and Jennifer Singbell
Public Services and Procurement Canada

The objective of the presentation is to present the various elements of the remediation plan and their inter-dependencies, the impact of continued care and maintenance on the planning of the remediation, and the federal government policy requirements and procurement rules within which project activities are delivered.

Abstract

When the Giant Mine Remediation Project was created in 2005, the federal government formally assumed care and control of the gold mine property, and developed a remediation plan to address the various environmental liabilities at the site. Many factors contribute to the complexity of planning the remediation project including: its operation as an open pit and an underground mine; the arsenic trioxide (a by-product of the gold recovery process) and its associated storage; the location of a fish habitat flowing through the site and emptying into Yellowknife Bay in Great Slave Lake; the links between the various remediation elements; the mine site's proximity to a major urban centre; its history with nearby stakeholders and regulatory bodies; and, the overlapping federal, territorial, municipal and Aboriginal jurisdictions present at the 800-hectare piece of land.

Further complicating the planning of the remediation is the on-going care and maintenance of the aging and deteriorating site. This has included the completion of urgent risk mitigation activities, such as: the realignment of Baker Creek in 2006, to address seepage into C1 Pit that directly links to the underground workings of the mine; the deconstruction of the roaster complex to address structural concerns and the associated release of arsenic trioxide from within the infrastructure; backfilling stopes including near-surface stopes beneath Baker Creek, stopes adjacent to arsenic storage areas, and high risk arsenic-storage stopes; and, the construction of a buttress to stabilize an unstable pit wall adjacent to Baker Creek. And finally, this work must be completed within federal funding policies, procurement trade agreements, and Treasury Board of Canada Secretariat processes.

11:30 am – 11:50 am

Giant Mine Remediation Project – Consultation and Engagement in Project Planning

Natalie Plato[1] and Fred Sangris[2]

[1]Indigenous and Northern Affairs Canada

[2]Yellowknive's Dene First Nations

The objective of the presentation is to explore the methods the project team will take to engage with community members and other stakeholders when determining and implementing the final remediation plan for the site, and discuss the challenges this can present.

Abstract

Following the discovery of gold in the Yellowknife, Northwest Territories area, Giant Mine officially opened in 1948. After the mine closed in 2004 the care and control of the mine fell to the Department of Aboriginal Affairs and Northern Development Canada (AANDC), and attention focused on the environmental issues left behind, including the arsenic trioxide stored in underground chambers. The Giant Mine Remediation Project was created in 2005, between AANDC and the Government of the Northwest Territories, with the overall goal to protect human health and safety, and the environment.

The site lies within the Mackenzie Valley watershed, and is regulated by the Mackenzie Valley Resource Management Act (MVRMA). The MVRMA is federal legislation aimed at protecting the lands and waters within the Mackenzie Valley watershed. Since the site is under the care and custodianship of AANDC, it is also subject to other federal acts, such as the Canadian Environmental Protection Act, the Fisheries Act and the Migratory Birds Convention Act, among others.

Giant Mine is also within the Akaitcho Dene asserted territory and is in the near vicinity of the Yellowknives Dene First Nation (YKDFN) communities of N'dilo and Dettah. Giant Mine is also within the traditional land use area of the Tlicho, known as Mowhi Gogha De Niitlee, and it falls within the provisions of the Tlicho Agreement (2003).

It is also situated within the municipal boundaries of the City of Yellowknife, and so is impacted by the City's bylaws and permitting requirements.

The site has always had a high profile within the community, with special interest groups and with the local media for both positive and negative reasons. This interest, along with specific requirements established through the MVRMA and other acts, agreements, and by-laws make it incumbent on the project team to engage with community members and other stakeholders when determining and implementing the final remediation plan for the site. This presentation will explore the methods the project team will take to fulfill this requirement, and discuss the challenges this can present in order to deliver a successful project to remediate the Giant Mine site.

1:30 pm – 1:50 pm

Challenges Associated with Construction Management at a Complex Mine Remediation Project in Northern Canada

Sarah Preston, Parsons Canada Ltd.

The objective of the presentation will **be to focus on the challenges associated with the construction management of unique projects at the Giant Mine site in Northern Canada.**

Abstract

The Giant Mine located in Yellowknife, NT produced 220,000 kg of gold from 1949 until 1999 when it was abandoned and the ownership was transferred to the Government of Canada. Aboriginal Affairs and Northern Development Canada has since developed the Giant Mine Remediation Project to address the environmental concerns identified at the site. The Giant Mine Remediation Project is a complex undertaking which has required extensive planning, stakeholder engagement, regulatory commitments and years of effort to develop. In order to prepare the site for the long-term remediation efforts several high-risk physical hazards required mitigation to protect worker safety, the environment and the community. This presentation will discuss some of the challenges and successes associated with construction management of unique projects at the Giant Mine.

Construction management challenges at the mine site are derived from a complex network of stakeholders, environmental, chemical, and physical hazards, project locality and weather related limitations of field seasons in a northern climate. Successful project completion results from implementing proper project planning and stakeholder engagement during the early phases of a project. Institutional and traditional knowledge obtained from stakeholders during the early phases of a project plays a large role in the development of project schedules, work plans and risk mitigation efforts. Carrying out work at an active industrial site which falls under the regulation of the Mine Health and Safety Act of the Northwest Territories poses unusual risks to employees that need to be considered when planning a project on the site. Hazardous materials, open pits, water bodies and failing structures are among the hazards that employers need to include in risk assessments, risk mitigation plans, project orientations and employee training. The locality of the Giant Mine site poses challenges for logistics. Equipment and supplies that are common in other parts of Canada may not be readily available in Yellowknife. Forming relationships and working in conjunction with local contractors plays an important role in overcoming hurdles associated with logistics. The northern locality also poses challenges associated with weather. The main construction season in this area of Canada is April through October, with noticeable losses of production outside these months due to the cold weather. Taking seasonal impacts into consideration when determining resource loading and productivity is important in maintaining field schedules and finishing projects in a timely manner. Large projects may be best handled over multiple season durations, with planned shut downs during the winter months. Strong project teams consisting of clients, consultants, contractors and mine management working together as one management body is the strongest tool for overcoming the challenges associated with working at Giant Mine. The completed and planned projects often have multiple and widely differing challenges and incorporating expertise and knowledge obtained through collaboration by all stakeholders has shown to be the most useful method for the successful completion of remedial efforts.

2:00 pm – 2:20 pm

Recommendations for Stakeholder Consultation in Moving Forward on the Risk Assessment for Giant Mine

G. Mark Richardson[1], Alexis Fast[1], Lindsay Smith-Munoz[1], Jane Amphlett[2], Katherine Ross[2]

[1]Stantec Consulting Ltd.

[2]Indigenous and Northern Affairs Canada

The objective of the presentation is **to describe and discuss the issues and opportunities for stakeholder consultation as the next human health risk assessment of Giant Mine moves forward.**

Abstract

A Giant Mine Remediation Plan was submitted to environmental impact review in 2007. In 2013, the Environmental Assessment Panel of the Mackenzie Valley Review Board concluded that a new human health risk assessment (HHRA)should be conducted to support the remediation plan. This decision was predicated, in part, on the conclusion by the panel that additional effort was required to engage stakeholders in the formulation and conduct of the risk assessment. During 2014/15, Stantec Consulting Ltd was engaged to develop the problem formulation and scope of work for the next risk assessment. The problem formulation and scope of work, themselves, were developed with repeated consultations with the Giant Mine Working Group (GMWG), the primary stakeholder committee for this project.

The resulting problem formulation and scope of work describe multiple issues that will require extensive consultation with the GMWG and other potential stakeholders. Other stakeholders may include all or some of the following:

- Giant Mine Advisory Committee (includes representatives of youth, elders, business and former Chief of the Yellowknives Dene First Nation)
- The Yellowknives Dene First Nation Elders Senate and Chief/Council
- The Giant Mine Oversight Body
- The Northwest Territories Territorial Farmers Association
- The Hunters and Trappers Association
- The Yellowknife Gardeners Association
- Yellowknife Cruising Club
- Mining Heritage Society
- Giant Mine Community Alliance
- General populace of Yellowknife

Issues for which consultation should be undertaken include discussion and finalization of the HHRA problem formulation (if revised), as well as any efforts of joint fact-finding necessary to enhance and supplement the HHRA (including: locations and species for hunting, fishing, and country food gathering; areas requiring further environmental sampling; and, bioaccessibility testing of soils and tailings). A flow chart was created of the anticipated HHRA process specific to Giant Mine to facilitate the timing of stakeholder engagement in that process.

2:30 pm – 2:50 pm

Establishing an Environment Health and Safety and Community Management System for the Giant Mine Remediation Project

Aaron Braumberger, Indigenous and Northern Affairs Canada

The objective of this presentation is to introduce the Giant Mine Remediation Project Environment, Health and Safety, and Community Management System.

Abstract

The Giant Mine Remediation Project (GMRP) has committed to implementing an environmental management system (EMS) to establish the blueprint for how environmental protection and regulatory responsibilities would be managed, monitored and evaluated throughout the stages of remediation.

The framework for the GMRP Environment, Health and Safety, and Community (EHSC) Management System (MS) incorporates the requirements and general guidelines from ISO 14001:2004 Environmental Management Systems along with the compatible the OHSAS 18001: 2007 Occupational Health and Safety Management Systems Requirements in order to enable the integration of environmental and occupational health and safety management systems into a single integrated approach.

A review of the technical and strategic risk assessments for the GMRP have further identified the need for an integrated management system that includes environment, health and safety, and community and that defines roles and responsibilities, communicates key controls, monitors and analyzes information, and when required, identifies activities required to address key hazards/elements across all of these issues at the site.

Based on these requirements and best practice in public sector and mining sector operations, the GMRP expanded the scope of the EMS to include health and safety, and community elements in an integrated EHSC MS.

The GMRP EHSC MS provides a framework and an approach for the GMRP to identify and manage risks, track performance and ensure continual improvement through the "plan-do-check-act" approach.

3:30 pm – 3:50 pm

Innovative Process for Stabilizing the Subsurface at the Giant Mine Site

Chris MacInnis[1] and Darren Kennard[2]
[1]Indigenous and Northern Affairs Canada
[2]Golder Associates Ltd.

This objective of this presentation is to describe the process to design and deliver the stabilizing paste, and the lessons learned in undertaking this innovative approach in a unique operating environment.

Abstract

The former Giant Mine is one of Canada's largest contaminated sites, now under the control of Aboriginal Affairs and Northern Development Canada (AANDC) on behalf of the Federal Government. It operated from 1948 to 1999, producing over 7 million ounces of gold. This ore body is such that it required an oxidation process to extract the gold. Chemical roasting was the only efficient oxidation process available when Giant Mine was developed. Roasting operations began in 1949, converting raw ore into calcine, that was further processed, and sulfur dioxide and arsenic vapor, which were vented directly to the atmosphere. The first air emissions controls were introduced in 1951 and began capturing arsenic in the form of arsenic trioxide. The complex expanded over time as more efficient technologies became available and were incorporated into the process train. According to some estimates, as much as 20,000 tonnes of arsenic trioxide would have been released into the atmosphere by the Roaster Complex, whereas 237,000 tonnes were collected by the emissions controls measures and are currently stored underground, inside mined out rock chambers. Arsenic trioxide is highly toxic. As little as 1 to 2.5 mg/kg of arsenic trioxide is a potentially fatal dose.

A key component of mine closure is to backfill underground voids to prevent collapse of portions of the mine that could pose immediate risks to public and worker safety and lead to failure elsewhere. In the case of the Giant Mine site, there is the additional risk that underground collapse could allow surface water to eventually flood the mine. Severe environmental consequences could result from such a flooding event due to the presence of arsenic trioxide dust in the underground stopes. In order to mitigate risks related to underground stability at the mine site an innovative short-term advanced remediation backfilling program is underway while the long-term overall remedial plan for the site continues to be developed.

AANDC engineers working with Public Works and Government Services Canada (PWGSC), and industry leaders in mine closure developed an innovative and efficient approach to stabilizing the underground voids using tailings paste backfill. Paste backfill is commonly used in operating mines to maximize production but its use in mine mitigation and remediation is limited. The Giant Mine project team utilized thousands of tonnes of tailings that had been deposited on surface as a waste by-product during historical production mining as the primary component of the backfill required to stabilize the underground voids. It is cost-effective to use on-site tailings material for underground backfilling but also reduces the future effort required to remediate surface tailings pond areas.
The project was initiated by carrying out field-scale tests to first determine if the on-site tailings could be used to provide suitable backfill material and second, establish what amount of binder (cement) would be required. The early testing showed that suitable backfill material could be produced using the on-site tailings and a small amount of cement.

Tailings were extracted from the surface ponds and paste was produced by adding water and cement to it in a mobile mixing system. The paste was delivered to the targeted underground voids via boreholes drilled from surface. Backfill was contained within the targeted voids by constructing underground barricades.

Few examples of using frozen tailings material to make backfill in large volumes under such extreme conditions exist.

The project faced the added challenges of extremely cold weather and limited daylight as paste production started in late October. Additional logistical challenges including complicated underground void geometry, worker health monitoring, and stringent regulatory requirements had to be overcome.

4:00 pm – 4:20 pm

Engineering Controls to Mitigate High-Risk Physical Hazards

Sarah Preston, Parsons Canada Ltd.

This objective of this presentation is to focus on how engineering controls were used to successfully mitigate high-risk physical hazards in preparation for the longer term, complex Giant Mine Remediation Project efforts to safely take place in the future.

Abstract

The Giant Mine located in Yellowknife, NT produced 220,000 kg of gold from 1949 until 1999 when it was abandoned and the ownership was transferred to the Government of Canada. Aboriginal Affairs and Northern Development Canada has since developed the Giant Mine Remediation Project to address the environmental concerns identified at the site. The Project is a complex undertaking which has required extensive planning, stakeholder engagement, regulatory commitments and years of effort to develop. In order to prepare the site for the long-term remediation efforts several high-risk physical hazards required mitigation to protect worker safety, the environment and the community.

This presentation will discuss three case studies that demonstrate how engineering controls were used to mitigate these hazards so that remediation efforts can be safely carried out in the future.

The Roaster Complex is a set of ten structures that were used to process and extract gold from the ore. These processes left the buildings heavily contaminated with arsenic trioxide dust and other hazardous materials. Failure of these structures could have resulted in injury to workers as well as an uncontrolled release of hazardous waste to the environment. The structure that carried the highest risk of failure and represented the biggest challenge to safely deconstruct was the 46 m tall brick stack. The engineered design of a mobile, elevated working platform was developed to allow the structure to be manually disassembled from the top down in a manner that reduced the risk of an arsenic trioxide dust release to the environment.

The C-Shaft Head Frame structures were located in close proximity to the site office complex and mechanical facilities that are used daily by the mine care and maintenance staff. The structures were in deteriorating structural condition and contained hazardous materials. In particular, the 34 m tall timberhead frame displayed evidence of advanced dry rot in most structural beams and failing interior access ways and landings. An engineered deconstruction plan was developed to make repairs to the access ways and to manually advance to the top of the structure to deconstruct, rig and hoist building sections to the ground by crane. Further complicating the deconstruction of the head frame was the 600 m deep open vertical mineshaft located directly under the structure. The presence of the shaft required that a temporary engineered cap to be installed that could withstand the force of any dropped deconstruction debris.

The construction of the C1 Pit Buttress was necessary to stabilize the nearly vertical pit wall of the former open pit located adjacent to Baker Creek, which runs through the mine site. Assessment of the pit wall determined that it was becoming unstable and that failure could have result in water from Baker Creek flooding the underground mine workings and arsenic trioxide storage stopes. Completion of the project included the development of an onsite quarry and the processing, hauling, and placement of nearly 50,000 m^3 of rock against the pit wall. Tight survey control was used to ensure that the buttress met the engineered design throughout construction. The successful completion of the two-level buttress stabilized the pit wall and significantly reduced the risk of mine flooding.

4:30 pm – 4:50 pm

Containing Arsenic Trioxide Dust Underground using a Freeze Method at Giant Mine

Tauhid-Brian Thomas[1], Michael Nahir[1], Daryl Hockley[2], Peter Mikes[2]

[1]Indigenous and Northern Affairs Canada

[2]SRK Consulting

The objective of this presentation is to describe the freeze optimization study, detail the outcomes of the study and how the results will contribute to the final design of the freeze project at Giant Mine.

Abstract

Giant Mine is located in Yellowknife, Northwest Territories (NWT) about five kilometres north of the city centre. The mine produced gold from 1948 until 1999, and ore for off-site processing from 2000 until 2004. After the owner of the mine went into receivership in 1999, Giant Mine was transferred to Aboriginal Affairs and Northern Development Canada (AANDC). AANDC and the Government

of the Northwest Territories (GNWT) continue to be responsible for the management of the site, including a variety of environmental concerns that need to be addressed. One of those concerns is how to manage approximately 237,000 tonnes of arsenic trioxide dust waste currently stored underground.

Gold in the Giant Mine ore was associated with an arsenic-bearing mineral known as arsenopyrite. The process used to release the gold from the arsenopyrite led to the production of arsenic-rich gas as a by-product. From 1951 to 1999, operators of the mine captured this gas in the form of arsenic trioxide dust which was transferred to underground storage areas at the mine site. The dust is approximately 60% arsenic, which is hazardous to both people and the environment. Furthermore, the form of arsenic present in the dust is soluble, meaning that it could dissolve in any water that contacts the dust and could then be transported to nearby water bodies such as Baker Creek or Great Slave Lake.

To address the environmental concerns at the site, a proposal to protect human health, public safety and the environment was developed for the mine site. One of the specific objectives within the Giant Mine Remediation Plan is to manage the underground arsenic trioxide dust in a manner that will prevent the release of arsenic to the surrounding environment, minimize public and worker health and safety risks during implementation, and be cost effective and robust over the long-term.

This issue has been evaluated through many technical studies and consultation with the public. Several options have been considered; the preferred option is to maintain the arsenic dust and the rock around each underground storage area completely frozen. The techniques for accomplishing this are being examined through a detailed technical study known as the freeze optimization study (FOS).

The FOS was constructed around one of the arsenic dust containing storage areas starting in 2009. The study includes tests of various types of design considerations including freezing systems, installation methods, hardware options, and other design options. Results of the FOS have now been finalized and the next step in the freeze program will be to construct a detailed design for all the underground arsenic containing areas.