

Snap Lake Mine – North Pile Risk Assessment

Report Submitted to the Mackenzie Valley Land and Water Board

September 2012

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EXECUTIVE SUMMARY

This report is in response to Condition 10 in Part E of the Snap Lake Mine licence renewal (Type A Water Licence MV2011L2-0004) issued by the Mackenzie Valley Land and Water Board during the summer of 2012. Condition 10 is one of a number of conditions that address the site's waste management practices. Condition 10 requires Snap Lake Mine to conduct a risk assessment of the North Pile and adequacy of the site's operational procedures and monitoring efforts. This report fulfills the requirement to submit results of the risk assessment to the Board by September 15, 2012.

A multidisciplinary risk assessment review was conducted between April 17 and May 22, 2012 involving personnel from nine different departments/groups active in managing the North Pile Facility. A total of 29 personnel participated.

The risk identification work applied was aligned with the International standard ISO 31000. A list of risks was generated based on events that could enhance, prevent, degrade or delay the achievement of the site's environmental and business objectives. The risk evaluation assists the site to make decisions about which risks need further treatment.

The risk review resulted in risk issues being identified and added to the site's Risk Register as well as revisions to previously identified risk issues. The site's Risk Register allows for ranking of risks and directing of appropriate resources toward risk issues that pose the most significant threat.

In evaluating the risks, a 5 x 5 matrix was applied as per the De Beers Canada (DBCi) risk procedures. Risks ranged between 1 to 25, with 1 being the lowest and 25 being the highest.

Risks ranked as 25 are considered:

*"An **extreme** risk exists that management's objectives may not be achieved. Appropriate mitigation strategy requires urgent attention."*

Risks ranked in the range of 17 to 24 are considered:

*"A **high** risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to receive a high priority."*

Risks ranked in the range of 9 to 16 are considered:

*"A **moderate** risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised."*

The following is a list of the 10 highest ranked environmental risk issues identified in the Snap Lake Mine (SLM) North Pile Risk Assessment related to water management. The risks are ranked from highest to lowest significance.

Ranking	RISK NAME - Unwanted Event	Residual Risk With Existing Controls In Place
1	Future Non-compliance with New Water Licence Criteria (Nitrate, Chloride, Fluoride and Dissolved Solids) * risk with future criteria is still under review	H*
2	Uncontrolled Release of Process Water or Seepage Outside of North Pile Sumps/Ditches (Spill)	17
3	Inadequate Storage Capacity in Water Management Pond	17
4	Water Treatment (Major WTP Breakdown or Significant Reduction in Treatment Capacity)	17
5	Insufficient storage capacity in North Pile	17
6	Sampling and Analytical Errors / Missed Samples	16
7	Paste Piping & Pumping System Failure	13
8	Water Management Pond (spill)	13
9	Instrumentation or alarm failure – North Pile	13
10	Failure to Meet Licence Requirements for Paste Fill Backfill	12

The **highest** ranked risk issue, involves the potential for future non-compliance with the newly established water quality criteria for nitrate, chloride, fluoride, and dissolved solids. The revised criteria were set as part of the SLM water licence renewal issued in June 2012. These criteria will come into effect January 1, 2015. SLM meets existing water quality criteria; however existing controls and water quality practices would have to be improved to meet the new criteria in 2015. The inability to meet the new criteria would result in a premature shutdown of the facility. A mitigation strategy is needed to consider control options to address this issue before the new criteria come into effect.

Risk items ranked 2, 3 and 4 are considered **high risk**, based on existing controls in place.

The **second** highest ranked risk issue involves “Uncontrolled Release of Process Water or Seepage Outside of North Pile Sumps/Ditches (Spill)”. SLM implemented considerable control measures during 2011 and the first half of 2012 to reduce the likelihood of spills. Additional controls and infrastructure upgrades are planned during the latter half of 2012 and into 2013 that will further reduce the likelihood and severity of spills.

The **third** highest ranked risk identified involves “Inadequate Storage Capacity in Water Management Pond (WMP)”. The WMP is the only designated reservoir on surface that can store contaminated water prior to treatment. During exploration the pond initially received PK from the bulk sample plant and in the past few years has been accumulating sediments. It currently has reduced storage capacity. Dredging work has been underway during the summer of 2012 to remove sediment from the pond and recover some design storage capacity.

A project is underway looking at the feasibility of expanding the existing WMP. This may serve to significantly increase the holding capacity and act as a primary settling pond to remove suspended particles from effluent inputs prior to treatment. If feasible, the new reservoir would increase redundancy and reduce the site’s overall dependency on one reservoir.

The **fourth** highest ranked risk identified involves a potential “Major Water Treatment Plant Breakdown or Significant Reduction in Treatment Capacity”. The existing Water Treatment Plant (WTP) could be vulnerable to a catastrophic mechanical breakdown of a single stream critical component such as the reactor tank, thickener or pH adjustment tank. Because the plant has limited redundancy, an unexpected breakdown of a major component (e.g., breakdown of thickener drive mechanism) may take lengthy time to repair. If such a critical component breakdown occurred, it could become necessary to flood lower levels of the mine and reduce mining production for a period of time.

A number of debottlenecking improvements were made to the WTP in 2012 that have improved treatment and discharge capacity. Debottlenecking initiatives will be ongoing during the latter part of 2012 and 2013 to further increase the capacity of the existing treatment plant. This will occur while the conceptual design of the future water treatment plant expansion progresses.

The **fifth** highest ranked risk relates to insufficient storage capacity in the North Pile. This relates to and is influenced by the paste program and mine design/plan.

The **sixth** highest ranked risk involves potential “Sampling and Analytical Errors / Missed Samples”. The site has initiated improvements in processes and procedures to reduce the risk of further errors and missed samples. Recently, the site hired two additional sampling

technicians and appointed an Environmental Superintendent to assist with these efforts. Additional measures are planned for 2012 and 2013 that will reduce the risk of errors or missed samples.

The **seventh** highest ranked risk involves a potential “Paste Piping & Pumping System Failure”. Currently paste fill trials are underway to assist the site in optimizing paste fill operations.

The **eighth** highest ranked risk involves the potential for a spill at the Water Management Pond. Monitoring controls are in place and include Geotechnical review. This risk also aligns with risk #3 and storage capacity.

The **ninth** highest ranked risk involves “instrumentation or alarm failure” on the North Pile. A drill is to be brought to site to replace any piezometers which are no longer functioning optimally.

The **tenth** highest ranked risk involves a potential “Failure to Meet Licence Requirements for Paste Fill Backfill”. Paste fill trials currently underway will provide needed information to better assess the site’s capacity to deposit paste fill in the North Pile and in the underground mine workings.

Sections 5 and 6 of this report describe control measures implemented since October 2011 intended to reduce the chance of spills or harmful discharges to Snap Lake (technical measures and human factors).

Section 7 lists future measures planned to manage risks from the North Pile and related water management systems. A schedule of planned activities is provided.

1. INTRODUCTION

The Mackenzie Valley Land and Water Board recommended approval of the Snap Lake Water Licence renewal (Type A Water Licence MV2011L2-0004) in a motion passed on April 4, 2012. The Honourable John Duncan, Minister of Aboriginal Affairs and Northern Development approved the licence and it came into effect on June 14, 2012.

Snap Lake Mine has been operating under the original licence, approved in 2004, which covered construction activity and the operating period from 2008 to 2012. The new licence includes requirements addressing water management at the Snap Lake Mine from June 14, 2012 to June 13, 2020.

This report is in response to Condition 10 in Part E of the Snap Lake licence renewal (Type A Water Licence MV2011L2-0004) issued by the Mackenzie Valley Land and Water Board during the summer of 2012. Condition 10 is one of a number of conditions that address the site's waste management practices. Condition 10 reads as follows:

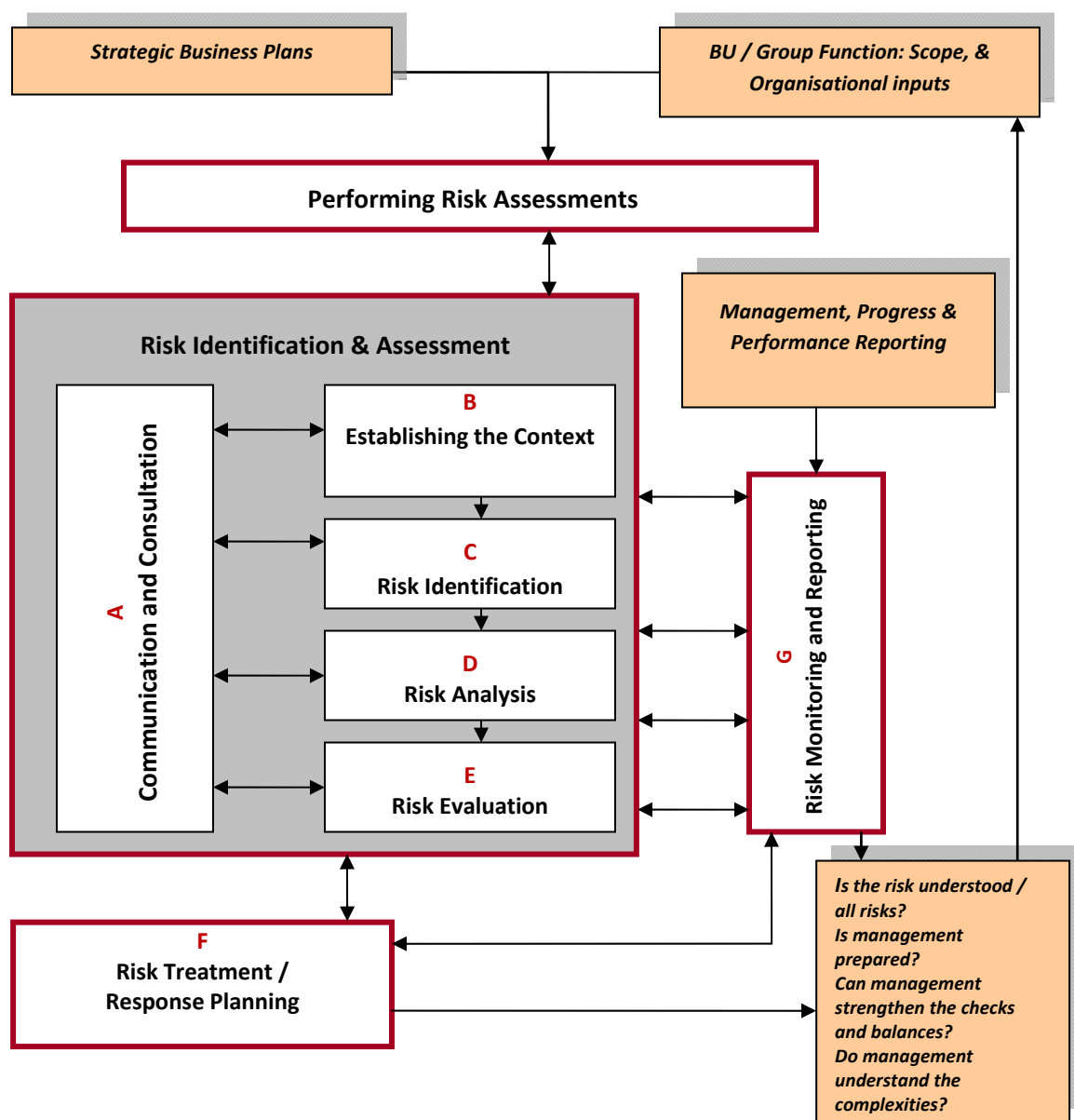
“The Licensee shall perform a risk assessment of the North Pile Facility to evaluate the adequacy of current operational procedures and monitoring efforts to ensure that impacts to the Receiving Environment are prevented or minimized. Results of the risk assessment shall be submitted to the Board by September 15, 2012 accompanied by recommendations for changes to the management of the North Pile Facility and a schedule of implementation.”

A multidisciplinary risk assessment review was conducted during April and May 2012. It involved participation by 29 individuals in all of the major departments that are actively involved in managing the North Pile Facility. The review led to new or revised inputs into the site's Risk Register. The risk assessments also led to the development of a number of recommendations for improvement to complement other initiatives that were put in place following spills that occurred late 2011 and early 2012.

For the purpose of this risk assessment, issues related to water management in the North Pile were examined, as well as water management infrastructure, including the water treatment plants and the Water Management Pond.

2. METHODS USED TO CONDUCT RISK ASSESSMENT

The risk assessment sessions were conducted using risk methodology established by De Beers (DBSA). This methodology is used by all sites within the De Beers family of companies and brings consistency across the operations. Figure 1 outlines the general approach taken, which is consistent with ISO 31000 methodology.



The specific tables used to assess risks are provided in Appendix 1 – De Beers Risk Assessment Matrix and Appendix 2 De Beers Risk Assessment Framework.

Results of risk assessment sessions conducted at the Snap Lake Mine were applied to update the site's Risk Register, allowing for the ranking of risk issues from highest to lowest. This allows for attention to be directed towards issues of most concern.

Three terms were used in the evaluation of risk:

Inherent risk - used to determine the risk without adequate or effective controls in place.

Residual risk - determined with existing controls in place.

Remaining risk - determined after considering further actions that can be implemented to further reduce the impact and/or likelihood of the risk.

It is important to note that risk matrices or registers are tools to prioritize risks. It provides a qualitative means to determine relative significance of risk issues that helps guide priorities in preventing or mitigating the risks.

3. PARTICIPANTS INVOLVED IN RISK ASSESSMENT

Risk assessment meetings were facilitated by a third / external party Pat Bolger, from Bolger and Associates Ltd. who operates an environmental, health and safety consulting business. Mr. Bolger has over 30 years of experience working on mining and industrial projects in Canada and internationally.

George Inman, the site's SHEMS Administrator served as co-facilitator for all of the risk assessments.

Sessions were held between April 18 to 24 and May 14 to 27, 2012.

The following is a list of personnel who participated in the risk assessment sessions and provided valuable input into developing the Risk Register and proposed recommendations for improvement:

SITE SERVICES

- Mike Cripps
- Mike Easthom
- Paul Kaeser
- Bradley Stauber

SAFETY, HEALTH AND ENVIRONMENTAL

- Tom Bradbury
- Alex Hood
- George Inman
- Ron Messier
- Darren Raymond
- Gail Seto

PROJECTS

- Joe Kriston

MINE OPERATIONS

- Fred Bailey
- Pat Decque
- Al Lychowyd
- Derk Murdock

PROCESSING FACILITY

- Glenn McCrimmon
- Peter Mooney

MAINTENANCE

- John Groenewegen
- Maurice Palfy
- Cory Stinson
- Craig Wessner
- Peter Yates

TECHNICAL SERVICES

- Riyaz Dawood
- Per Lunder
- Alex MacKay
- Chris Twiggs

GOLDER ASSOCIATES LTD.

- Paul Bedell

MATERIALS MANAGEMENT

- Stephen Anderson
- Jeff Nystrom

4. RESULTS OF RISK ASSESSMENT

The following table presents the ranking of risks issues related to the North Pile and related water infrastructure.

RISK NAME - Unwanted Event	Inherent Risk	Residual Risk	Desired Risk
FUTURE NONCOMPLIANCE WITH NEW WATER LICENCE (Nitrate, Chloride, Fluoride and Dissolved Solids): The 2015 limits for nitrate, chloride, fluoride and dissolved solids are not expected to be attainable with existing operations and infrastructure. * future risk yet undetermined	H*	M*	Not yet determined.
UNCONTROLLED RELEASE OF PROCESS WATER OR SEEPAGE OUTSIDE OF NORTH PILE SUMPS / DITCHES (Spill): Contaminated water escapes from the North Pile collection ditches, and related piping infrastructure.	21	17	4
INADEQUATE STORAGE CAPACITY IN WATER MANAGEMENT POND: Water Management Pond does not have adequate storage capacity to serve the site's needs especially during peak flow periods (freshet / major storm). Buildup of ice and sediment reduces storage capacity.	21	17	4
WATER TREATMENT (Major WTP Breakdown or Significant Reduction in Treatment Capacity): Limitations existing in the WTP preventing design output from plant.	21	17	8
SAMPLING AND ANALYTICAL ERRORS / MISSED SAMPLES: Missing samples or having sampling or analytical errors occur could lead to regulatory nonconformances.	20	16	4
CATASTROPHIC EMBANKMENT FAILURE (North Pile): Sudden and major breach of North Pile embankment structures.	22	8	2
CATASTROPHIC DAM FAILURE (Water Management Pond): A sudden breach of either of the Water Management Pond dams	22	8	2
PASTE PIPING & PUMPING SYSTEM FAILURE: Paste pumping and piping system fails (line to North Pile or on surface to the mine)	18	13	8

RISK NAME - Unwanted Event	Inherent Risk	Residual Risk	Desired Risk
DIFFUSER LINE (Failure): A failure or blockage of the single diffuser line results in a non-authorized discharge close to shore	18	8	2
FAILURE TO MEET LICENCE REQUIREMENTS FOR PASTE FILL BACKFILL: Water licence requires placing 50% of processed kimberlite underground. Paste process is not implemented or does not meet licence requirements.	18	12	2
WATER MANAGEMENT POND (Pumping and Piping): System between the WTP and Water Management Pond fails	12	8	8
COMPUTER CONTROL SYSTEM FAILURE: Failure of the PCS7 SCADA computer system that controls processes and monitoring.	12	8	8
ELEVATED NITRATE LEVELS IN WATER, ORE AND ROCK: Elevated nitrate levels in water, ore, and rock from underground which contributes to site nitrate loadings. Sources include ineffective explosives use / housekeeping / spills.	11	11	8
HYDROCARBON SPILL (Small Spills on Surface): Hydrocarbon spills on surface entering environment	16	11	11
NON-COMPLIANCE OF WATER LICENCE (General): The current and new water licence both have rigorous discharge and receiving water quality criteria that are challenging to meet without rigorous water management processes being in place.	20	9	6
WATER MANAGEMENT POND (Spill): Escape of pond water over, through or under the Water Management Pond dams (at seepage rates higher than scoped during the environmental assessment).	17	13	6
POTENTIAL FOR ACID DRAINAGE: There is a potential for acid drainage to occur from Potentially Acid Generating (PAG) rock and entry into surface drainage / Snap Lake.	5	3	3
INSTRUMENTATION OR ALARM FAILURE (North Pile): Loss of data (or inaccurate data) occurs from the North Pile monitoring network (levels, flow, thermistors); failure of alarms may result in delayed response time to adverse conditions	18	13	5
INSUFFICIENT STORAGE CAPACITY IN NORTH PILE: North Pile fills prematurely - insufficient capacity to contain slimes or waste.	21	17	3

5. RISK MANAGEMENT (Technical Measures Implemented)

Following the spills that occurred in October and December 2012, SLM initiated actions plans aimed at preventing further spills. Work included upgrading pumping and piping infrastructure, improving monitoring instrumentation, and applying various best practices for water management. SLM initiated investigations on ways to optimize the operation of the site's water treatment systems.

The following describes some of the key technical measures that were implemented in recent months that have been successful in efforts in preventing further spills into Snap Lake.

Improvements to the Water Treatment Plant

The WTP did not perform to its design discharge capacity during 2011 and in previous years. Considerable effort was directed during 2012 to improve the capacity and effectiveness of the various treatment system components as part of an overall debottlenecking effort.

The first priority was to improve the Water Treatment Plant filtering system which had suffered minor mechanical damage and reduced filtration capacity due to rapid fouling of the filter media. As a temporary measure, portable filtering systems were brought in to increase the filtering capacity. Significant filter maintenance work was carried out, including inspection and repair of the filters and replacement of filter media. Operational changes were made to optimize the performance of the filters, including optimization of the backwash flow rates, air scouring practices, chemical cleaning schedule, and feed pump control algorithm. A filter media trial is planned for the later part of 2012 to assess the opportunity to increase flow capacity and filtration efficiency of the existing filter plant by using alternative filtration media. Modifications were installed to enable the Temporary Water Treatment Plant to be operated in parallel with the main WTP filters, to increase the site's filtration capacity during peak flow periods.

Another priority was to remove discharge bottlenecks which prevented the WTP from discharging the design treated flows to Snap Lake. Additional diffuser ports were opened to enable the full flow capacity of the discharge line. The discharge line from the pH Tank was re-engineered to increase flow capacity, and additional combination valves were installed on the line to address potential flow restrictions due to entrapped air. Modifications were made to the pH tank to increase throughput, including lifting the overflow line elevation and installing a booster pump on the discharge line to increase flow to the design point. A study is underway to evaluate the long term efficiency of these modifications.

Another priority was to minimize flow surges that occur from the underground pumping facilities. A control mechanism is being installed for the underground pumping system to smooth the WTP inflow surges by diverting flow peaks to the WMP. Other improvements

to the underground system included increased attention to maintenance of the Main Settling Sump in order to reduce sediment loading and turbidity spikes to the treatment plant.

a) Increased Use of the Temporary Water Treatment Plant

The Temporary Water Treatment Plant (TWTP) served as a valuable system during 2012, during spring freshet. It successfully operated to supplement treatment of site effluent.

Filter maintenance and media replacement is planned for the TWTP filters during Q3 2012, along with upgrades to the air scouring and backwash control system to improve reliability of the TWTP's filtration capacity.

It is expected that the TWTP will continue to be used to manage water treatment.

b) Improvements in Pumping and Piping Infrastructure

Improvements were implemented in 2011/12 relating to the pumping and piping infrastructure (better insulation, additional heat tracing, redundant piping, larger pumps, redundant pumps, etc.) from the perimeter sumps to WMP. Although some of the changes made during the first half of 2012 were of a temporary nature, more permanent improvements are being implemented in Q3 and Q4 2012 (See Section 7 on future improvements).

c) Real Time Monitoring Instrumentation

Water level instrumentation was installed during 2012 at all North Pile sumps. Flow metering was expanded to cover critical pumping components associated with the North Pile. Water management personnel now have real time elevation information available to support improved decision-making during the freshet period when conditions can change rapidly and year-round while managing the water system.

d) Nitrate Monitoring Instrumentation

The site installed inline nitrate instrumentation in both the Water Treatment Plant and the Temporary Water Treatment Plant in 2012 to improve management of water treatment performance and meet regulatory requirements. This instrumentation provides real-time information to support improved decision-making during management of the multiple inflows into the treatment system.

e) Installation of Interception Trench (Downstream of TS4)

During Q1 2012, an inrush of water resulted in the overtopping of TS4. A series of ice berms were constructed to immediately contain the water to ensure it did not reach Snap Lake.

To manage this spill water as it thawed the IL6 Ditch was constructed to provide a means of intercepting the non-compliant melt water flow and the protection of Snap Lake. Environmental monitoring had been conducted at IL6 and was submitted as a summary report under separate cover.

f) Implementation of Paste Fill Disposal (North Pile and Underground)

The North Pile began receiving paste fill in 2012 as the site undertook paste fill trials. These trials are expected to continue into 2013.

g) Aquatic Effects Monitoring

Golder Associates Ltd. was contracted in November 2011 to assess impacts from the October spills 11-391 and 11-398 from PS3 into the northwest arm of Snap Lake.

On the basis of the data from October 2 to October 24, 2011, the spills had the potential for a short-term, localized effect on the water quality in the area immediately surrounding the spills in the northwest basin of Snap Lake. The spills were not acutely toxic to fish or aquatic life.

6. RISK MANAGEMENT (Measures Implemented to Improve Human Factors)

To complement the technical improvements that were initiated in 2011, considerable effort was directed toward strengthening human factors. This included assigning dedicated water management leadership roles, establishing clear expectations/strategy, providing training to improve personnel competencies at all levels and improving communications (internal and external).

a) The following provides information about key measures implemented in recent months to address human factors to manage the water balance at SLM **Single Point Accountability / Integrated Water Management Team**

An integrated water management team was established in 2012 to address water management issues. The cross-departmental team was led by an engineer who served as the Project Manager. Support was provided by r site engineering personnel

An integrated water management team was developed with representatives of various departments to serve in interrelated operational roles. The single point accountability and integrated team are deemed as positive steps, helping to ensure personnel work in an aligned manner.

b) Monitoring and Site Inspections

To address earlier weaknesses and reduce the likelihood of future spills, the site significantly increased attention toward monitoring and inspection. Inspections of the North Pile Sumps and other critical elements of the infrastructure were conducted each shift.

Additional attention was directed to managing seepages from TS4. This involved posting a person 24 hours per day to monitor and report on evolving conditions and prevent the likelihood of overtopping events.

c) Internal Communication of Expectations and Strategy / Accountability

During 2012, water management was given top priority by corporate and site management. De Beers set out to improve its risk management and risk communications efforts. Town Hall Meetings were scheduled to ensure that all site personnel were informed about the seriousness of the company's water management issues and the need for everyone to participate in implementing improved controls.

Water management concerns were also communicated at management meetings, routine site safety meetings and via newsletters and bulletin boards. These efforts at communicating expectations, strategy and the need for change were successful in engaging all personnel in the various risk mitigation measures implemented.

d) Leadership Workshops

During 2011 and 2012 the site conducted a series of leadership workshops that involved most front line supervisors and managers. These workshops (referred to as “Facets of Leadership”) have been instrumental toward creating a stronger team approach for addressing the water management issues.

e) Risk Management Workshops / Risk Based Decision-Making

In January 2012, Snap Lake engaged MIRARCO, a Laurentian University research group, to engage managers in a week-long risk management training workshop. The program is part of the Global Mining Industry Risk Management (GMIRM) initiative being taught through various universities internationally. The workshop introduced site managers to various principles for assessing and managing risk.

Selected personnel also attended a customized train-the-trainer session. Plans are to have in-house instructors roll out a condensed version of the risk training to operations personnel.

f) Increased Manpower and Supervision

During 2012, a considerable increase in manpower was assigned to manage water infrastructure and treatment systems and to monitor water quality. Dedicated monitoring personnel were assigned 24 hour watch in critical areas, during sensitive flow periods, to ensure that water levels were within safe levels.

g) Water Management and Communications Logs

In October of 2011, the site initiated a water management log to document water management activities. The log includes information about how sump water levels are being managed, the pumping of water between sumps, ponds and the water treatment facilities. This log will continue to be maintained during critical periods to document water management activities and communications. The Hydro Engineer will be responsible to ensure this log is maintained.

A log of communications between key external stakeholders is also being maintained. The Permitting Coordinator and Environment and Permitting Superintendent are responsible for maintaining this log.

h) Water Management Planning Room

To address the 2012 spring freshet, a Water Management Planning Room was set up in the administration complex. Its purpose is to provide a control centre for the integrated water management team, when assessing real-time monitoring data and coordinating water management operational activities across site. This centre was a critical element in the success of the site in managing water during the 2012 freshet.

Snap Lake Mine plans to continue having a Water Management Planning Room available to address water management issues during next year's freshet. The centre will assist in coordinating a multi-department approach, and helping to ensure all departments and individuals are aligned in their actions. Data inputs to the room will be enhanced as additional monitoring infrastructure is improved. The real-time monitoring data that is received will assist in managing the wastewater infrastructure and effluent treatment.

The Water Management Room will be under the leadership of the Hydro Engineer who will ensure its effective operation.

i) Environmental Monitoring

Sampling efforts were increased to facilitate managing of conditions during the freshet, and were ramped down as water inputs decreased, while still ensuring compliance with sites licences and permits. Labs have also been made aware of licensing requirements to ensure stakeholders have early warning of non-compliant parameters.

j) Recruitment – Environmental Personnel to Oversee the Site's Water Quality Monitoring Program and Regulatory Requirements

Snap Lake Mine has experienced site-wide turnover of personnel, which has also affected the Environmental Department. Recruiting efforts were carried out recently, successfully acquiring additional personnel into the Environmental group.

Positions of Environmental Superintendent and Environmental Coordinator have recently been filled.

Two additional field technicians have been created and filled. This brings the complement of field technicians to four (two per rotation).

k) Flow Modeling Software Training

In June 2012, several site technical personnel participated in a 2-day offsite training course for FluidFlow3, a pump and pipe flow modelling software tool which has been purchased by the site. This software tool and training will enable improved application of pumps, improved piping system design, and improved operational planning for both underground and surface water management systems.

7. RISK MANAGEMENT (Future Measures Planned to Manage Risks)

PROPOSED IMPROVEMENTS

The following are proposed improvements that are being investigated or planned over the next two years. Dates provided are approximate and may vary as more detail is obtained from the study results and investigations.

a) Recruitment of Engineer to Serve in Water Management Leadership Role

Funds were approved in July 2012 to hire a full time Hydrological Engineer to lead the water management efforts. Recruitment has commenced to fill this important position. The candidate is expected to have several years of experience in a related water management / water treatment discipline to lead and coordinate the site's efforts.

Proposed Timing: 2013 recruitment

b) Dedicated and Integrated Water Management Team

Since having a dedicated water management team proved successful during the 2012 freshet, it is important for the site to establish a more permanent integrated team. Once the Hydro Engineer is in place, the organizational structure for water management will be firmly established and resources provided to ensure its success.

Proposed Timing: Q4 2012 for defining roles of team members. Q1 and Q2 2013 for strengthening the team and ensuring readiness for the 2013 freshet.

c) Improvements to Site Pumping and Piping Infrastructure (Insulation and Heat Tracing)

Funding has been approved for a \$5.1 million upgrade to the pump and piping infrastructure managing water from the perimeter sumps to the WMP. The upgraded infrastructure will consist of enclosed, heated electric pump stations installed at each

perimeter sump, with a new insulated & heat-traced piping system. This upgrade will greatly increase the reliability of pumping activities during the winter season, and reduce the likelihood of spills due to frozen lines and frozen pumps.

Additionally, a heat-trace supplier has been brought to site and completed a site-wide review of existing heat-trace on all surface water lines. They will be making recommendations for performance and reliability improvements, execution of which will commence prior to freeze up.

Proposed Timing: Q4 2012 to complete study and recommendations. Q4 to complete heat tracing improvements and install improved insulation.

d) Repair of SP3

An engineering firm has been engaged to perform a third-party review and design improvements to SP3 which is believed to be the source of spilled effluent in October 2011. Resulting changes are intended to reduce the likelihood of a future spill from this location.

Proposed Timing: Q3 2012 for completion of engineering review. Remediation work to follow as may be necessary.

e) Improved Training / Operational Manuals / Standard Operating Procedures / Safe Work Plans

The site will be initiating a number of improvements in work methods related to water management, including revisions to operating manuals, SOPs and SWPs.

Improved training will be conducted to better inform personnel about specific work methods applicable to their role. They will receive information about how their work connects with work conducted by other personnel involved in managing the water systems. These changes will help reduce the likelihood of errors and misunderstandings.

Proposed Timing: Ongoing.

f) Water Management Workshop

The site is planning to engage Golder Associates Ltd. to facilitate a workshop (North Pile 101) to better inform team members about the design and operation of the North Pile and associated water infrastructure. The goal of the workshop will be to help ensure that all team members understand the interrelationships that are important to effective management of the North Pile.

Proposed Timing: Q1 2013.

g) Risk Awareness Training

The site is in the process of rolling out a condensed version of the Global Mining Industry Risk Management (GMIRM) training to all operations personnel. Once completed, this training will provide a more integrated approach to risk assessment and management at Snap Lake.

Proposed Timing: Training will commence Q3 2012. It is anticipated that approximately 95% supervisors and employees will receive training by end of Q1 2013.

h) Internal Communication / Employee Engagement

With respect to internal communications, the site will continue holding town hall meetings to discussing water management improvement strategies and expectations. Water management issues will also be discussed at various site meetings, with recognition given for team successes. Water management information will also be communicated in newsletters, on bulletin boards and using other communication means available.

Proposed Timing: Ongoing.

i) External Communication

With respect to external communications, water management information will continue to be shared with regulatory officials, the Snap Lake Environmental Monitoring Agency, and other external stakeholders.

Proposed Timing: Ongoing.

j) Water Treatment Plant Expansion and Second Diffuser

An engineering firm with specialization in wastewater infrastructure has been contracted to continue design work started in 2011 toward the future expansion of the site's water treatment facilities. Design work will incorporate updated water models and treatment needs for the life of the mine. This work is being done in association with planning for a second diffuser which would be needed if the plant capacity is increased. Amendments to the water licence would be necessary if a significant upgrade of the water treatment plant occurs and discharge levels are to exceed permitted levels.

Proposed Timing: Conceptual Design Report Q3. Design report to be completed by Q4 2013 for completion of design with construction occurring in 2014.

k) Water Treatment Plant - Optimization

Ongoing debottlenecking efforts continue to optimize the performance of the existing Water Treatment Plant. Areas of future optimization include a permanent solution for

enhanced pH Tank discharge capacity, the trial of a new filter media to increase filtration capacity, and additional automation of modified valves and pumps to improve operational reliability.

Proposed Timing: Q4 2012.

l) Retain Portable Filters

For the immediate future, the site plans to retain the existing portable multimedia filters to supplement wastewater treatment capacity.

Proposed Timing: Ongoing.

m) Piezometer and Thermister Repairs

A drill will be brought to site to repair or replace some of the site's piezometers which have become damaged or are not optimally functioning.

Proposed Timing: Q3 2012.

n) Water Treatment Plant - Reactor Tank Cleaning and Repair

Another major improvement in the Water Treatment Plant will be to clean accumulated sediment from the reactor tank and repair its agitator.

Proposed Timing: Q4 2012 to clean and repair reactor tank.

o) Nitrate Source Reduction

The site will continue its efforts aimed at reducing losses of nitrate within the underground mine workings, in order to meet conditions in the water licence dealing with source control.

Proposed Timing: Ongoing.

p) Paste Fill

The site will continue paste fill trials that have been underway during 2012.

Proposed Timing: Paste fill trials for the North Pile and backfilling underground will continue into 2013. After conclusion of the trials, future paste deposition and backfilling plans can be developed

q) New Licence Criteria / Development of Site Specific Criteria

During the summer of 2012, very strict discharge and receiving water quality criteria were established for certain parameters within the Snap Lake Water Licence. The new criteria will be in effect in 2015. With existing treatment system and water management infrastructure, it is expected that the site will not be able to meet the new limits.

A mitigation strategy is being prepared to address this issue before the new criteria come into effect. Snap Lake has initiated studies to develop technically defensible site-specific benchmarks for parameters of interest.

Proposed Timing: Define strategy and specific benchmarks Q2/Q3 2013.

r) Water Management Pond Improvements (Dredging / Possible Expansion)

Over the past several years, the Water Management Pond has experienced reduced retention capacity due to the buildup of settled particulate matter and earlier deposition of PK from the bulk sample plant. Dredging operations are underway to restore capacity in the pond. Notifications were sent to the MVLWB and the Inspector regarding dredging plans.

The site is investigating options for expanding the Water Management Pond in order to facilitate future dredging efforts and overall water management. An engineering firm has been retained to perform a pre-feasibility study on a potential expansion, and provide recommendations on optimizing the operation and maintainability of the WMP through the addition of divider dykes.

Proposed Timing: Q3 & Q4 2012 and Q1 2013 to complete dredging work. Q3 for WMP expansion pre-feasibility study.

s) Repair of WMP Wharf

The site is reviewing a possible requirement to repair the wharf which supports the TWTP feed pumps in the WMP. The original wharf has not withstood the severe winter conditions, and an improved design to the floating pipe/pump may need to be installed. Proposed Timing: Q3/Q4 of 2012 for review and design.

8. APPENDICES

Appendix 1 – De Beers Risk Assessment Matrix

Appendix 2 – De Beers Risk Assessment Framework

APPENDIX 1 – Summarised De Beers Risk Assessment Matrix

Impact	Hazard Effect / Consequence (Where an event has more than one "Loss Type" choose the 'Consequence' with the highest rating)				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
(Additional 'Loss Types' may exist for an event; identify & rate accordingly)					
People - Safety and Health	First aid case/ Exposure to minor health risk	Medical treatment case/ exposure to major health risk	Lost time injury/ Reversible impact on health	Single fatality or loss of quality life/ irreversible impact on health	Multiple fatalities/ impact on health ultimately fatal
People – Occupational Health * *The assessment for likelihood in respect of occupational health is as follows: 5 – Almost certain (within 1yr) 4 – Likely (within 5 yrs.) 3 – Possible (within 20 yrs.) 2 – Unlikely (within 20 yrs.) 1 – Rare (within 20 yrs.)	Non-conformance e.g. single exposure to over OEL with minor health risk	Non-clinically apparent decline in medical surveillance parameter or exposure on routine monitoring	Treatable or non compensatable impact on health or exposures discovered on investigation of medical incidents	Compensatable impact on health or single death resulting from accidental exposure of occupational disease.	Multiple fatalities or epidemics of disease resulting from workplace exposure
Legal (Include Regulatory)	Low level legal issue	Minor legal issue; noncompliance and breaches of the law	Serious breach of law; investigation/ report to authority, prosecution and /or moderate penalty possible	Major breach of the law; considerable prosecution and penalties	Very considerable penalties and prosecutions. Multiple law suits and jail terms
Reputational (Impact on Reputation / Social / Community)	Slight impact – public awareness may exist but no public concern	Limited impact – local public concern	Considerable impact – regional public concern	National impact – national public concern	International impact – international public attention
(Environmental)	Minimal Environmental Harm, no effect on environment or negative public perception – L1 incident	Minor environmental harm, an incident limited to the immediate area of occurrence and can be remedied in the short term – L2 environmental incidence	Moderate environmental harm, an incident associated with widespread ecological or social impact and risk of legal liability, reversible in the medium term – L3 environmental incident	Significant environmental harm, an incident associated with widespread ecological or social impact and the risk of legal liability, reversible in the long term – L3 environmental incident	Extreme environmental harm, an incident associated with widespread, long term, irreversible negative or social impacts and high risk of legal liability – L4 environmental incident
Likelihood	Risk Rating				
5 (Almost Certain)	11 (M)	16 (M)	20 (H)	23 (H)	25 (E)
4 (Likely)	7 (L)	12 (M)	17 (H)	21 (H)	24 (H)
3 (Possible)	4 (L)	8 (L)	13 (M)	18 (H)	22 (H)
2 (Unlikely)	2 (L)	5 (L)	9 (M)	14 (M)	19 (H)
1 (Rare)	1 (L)	3 (L)	6 (L)	10 (M)	15(M)

APPENDIX 2 – De Beers Risk Assessment Framework

Extreme (25)	An extreme risk exists that management's objectives may not be achieved. Appropriate mitigation strategy requires urgent attention
High (17 – 24)	A high risk exists that Management's objectives may not be achieved. Appropriate mitigation strategy to receive a high priority
Medium (9 – 16)	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised
Low (1 -8)	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required