



April 2014
Environmental Update
for SLEMA Board

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April 30, 2014

Outline

1. Mine Update
2. Inspection Update
3. Regulators' Update
4. Aboriginal Update
5. Stakeholders' Update
6. Agency's Activities
7. SLEMA Reviews
8. Water Licence Amendment Application



Acronyms

- AANDC – Aboriginal Affairs and Northern Development Canada (previous INAC – India and Northern Affairs Canada)
- AEMP – Aquatic Effects Monitoring Program
- ARD – Acid Rock Drainage
- DFO – Fisheries and Oceans Canada
- EC – Environment Canada
- ENR – Department of Environment and Natural Resources, GNWT
- GNWT – Government of the Northwest Territories
- MVLWB – Mackenzie Valley Land and Water Board
- PK – Processed Kimberlite
- SLEMA – Snap Lake Environmental Monitoring Agency
- SNP – Surveillance Network Program
- TDS – Total Dissolved Solids
- WEMP – Wildlife Effects Monitoring Program
- WTP – Water Treatment Plant
- WMP – Water Management Pond

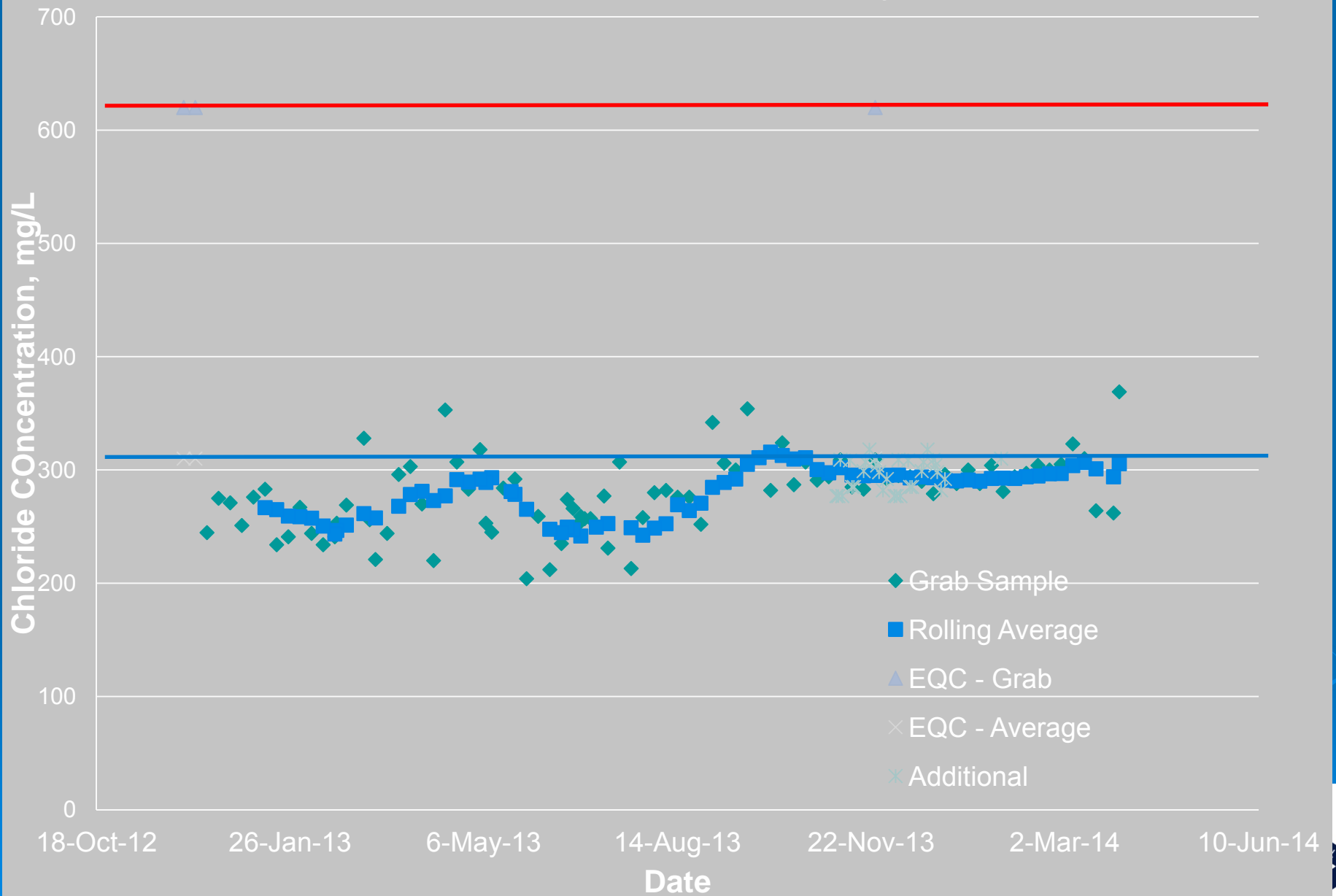


1.1 Mine Update – March 2014

- Production rate: 92.3% of its capacity (90,127 tonnes of kimberlite processed)
- 4,409 m³ of water withdrawn from Snap Lake
- 1,275,068 m³ of treated water discharged into Snap Lake
- 81,204 tonnes of coarse reject and 53,298 m³ of slimes deposited in the North Pile, no paste deposited in the North Pile or backfilled in the underground
- 6 surface spills (0 reportable)
 - 171 underground hydrocarbon spills (6,317 L)
- Water sampled in 7 monitoring stations
 - The monthly average for all parameters met compliance
 - The new Sewage Treatment Plant still has operational problems. An action plan of recommendations from the membrane supplier will be implemented in an attempt to improve operations at the plant
 - Due to the inability to consistently pump paste to the North Containment Facility, operations has implemented thickened slimes disposal as an alternative disposal technique



Effluent Chloride Data Analysis

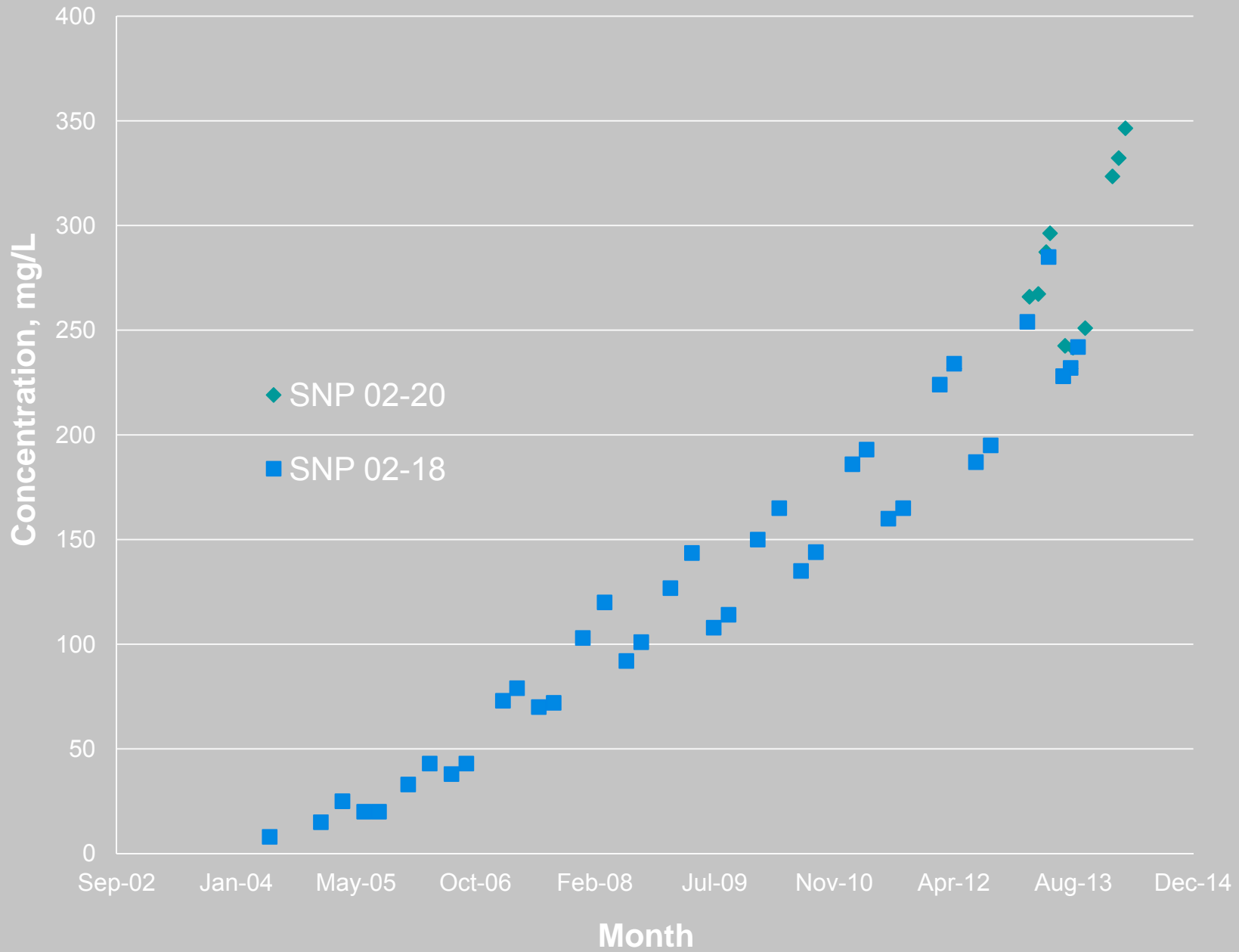


Comments and Recommendations from the Environmental Analyst (I)

- Chloride levels in the Water Treatment Plant effluent (SNP 02-17B) are approaching the monthly average limit (310 mg/L) in March 2014
 - Rolling average: as high as 306.5 mg/L
 - March 30, 2014: 369 mg/L
 - If Chloride concentration on April 4 is above 333 mg/L, exceedance will occur



TDS Levels in Snap Lake



Comments and Recommendations from the Environmental Analyst (II)

- TDS levels at the edge of the mixing zone of Snap Lake are approaching the Water Licence limit (350 mg/L) on March 18, 2014
 - Average of four stations: 346.5 mg/L
 - SNP 02-20e: 350 mg/L
 - Based on the experience in the past, TDS levels will be higher in late winter. As a result, the exceedance at SNP 02-20 is very likely in April and May 2014. The exceedance of whole lake average (SNP 02-18) is also possible in April and May 2014



Comments and Recommendations from the Environmental Analyst (III)

➤ It is recommended that

- De Beers increase the sampling frequency at SNP 02-17B, and take necessary mitigation measures
- The inspector of the Department of Lands inspect the Mine in a more frequent manner and begin to take legal samples at SNP 02-17B and SNP 02-20



1.2 Spill Reporting in April 2014

Date	Location	Waste Spilled	Amount (L)	Cause
April 18	Anoxic sewage tank in the Sewage Treatment Plant	sewage	70	Tank overflow



1.3 2013 Water Licence Annual Report

- Submitted on March 31, 2014, with 4 Appendices
 - Summary of Paste Backfill Work conducted at Snap Lake
 - An Overview of Paste Tailings Disposal
 - Status Update North Pile Development
 - Summary of September 2013 Geotechnical Site Inspection of North Pile Facility and Water Management Pond dams
 - Geotechnical Monitoring Program Summary for the Period 1999-2013
 - 2013 Acid/Alkaline Rock Drainage (ARD) and Geochemistry Monitoring Report



1.4 Amendment to Fuel Storage

- Submitted on April 2, 2014
 - De Beers requested an amendment to the volume of the fuel storage on site under Land Use Permit MV2010D0053
- Additional diesel fuel storage capacity is required due to increased fuel demands from ongoing underground mine expansion, as well as the increase in water management infrastructure
- Construction commence in summer 2014



1.5 Spill Contingency Plan

➤ Submitted on April 23, 2014

- Updated from November 2013 Version
 - The map showing the location of Snap Lake
 - Contact information
 - Land farm information
 - Fuel Tank – Application process
 - Water Management Pond – System Failure Preventative Measures
 - Sewage Treatment System
 - Appendix D – added a new chemical (AdBlue) for the use of emission reduction and provided up to date information



Comments from the Environmental Analyst

- The Spill Contingency Plan was approved by the MVLWB on January 30, 2014
- The updated Plan is acceptable



2. Inspection Update

- AANDC Inspector
 - Patrick Kramers resigned in April 2014
- No inspection reports in April 2014
 - The absence of inspection reports' submission lasts for 6 months, although two briefing meetings were held with SLEMA staff by the Inspector



3. Regulators' Update - MVLWB

- Denied the Water Management Plan on April 2, 2014, and requested to resubmit the Plan by July 2
- Distributed 2013 Water Licence Annual Report for review on April 4
 - Comments due on May 14
- Approved the Waste Management Plan conditionally on the incorporation of the commitments by reviewers, on April 24
 - Revised submission due on May 26
- Decided that De Beers shall submit the updated ARD and Geochemical Characterization Plan by June 6, 2014, on April 24
 - “This update should address the requests made in the letter sent to De Beers by Board staff on December 13, 2013”



3.1 Reasons for the Water Management Plan Denial (I)

- More information is required about the locations at which the Action Levels for seepage quality apply
- Action Levels must be developed for seepage quantity, as required in Schedule 5 of the Water Licence. Details of how seepage quantity will be monitored must be included
- The specific types of changes or thermal conditions that would trigger review and reporting of monitoring data should be clearly outlined
- Timelines must be specified for the submission of response plans when triggered by Action Levels



3.1 Reasons for the Water Management Plan Denial (II)

- Information must be included on contingency measures for the Waste Management Pond
- Given the Total Dissolved Solids (TDS) and Nitrogen Response Plans are currently tied-up in the Water Licence Amendment process, this Water Management Plan should be a stand-alone document that does not reference these plans
- Other revisions and updates to the Water Management Plan are necessary as per the commitments made by De Beers Canada Inc. during the review process



4. Aboriginal Update

- YKDFN commented the proposed amendments to the Environmental Agreement on April 1, 2014
- Deninu Kue First Nation (DKFN) commented the Wildlife Effects Monitoring Program (WEMP) and Wildlife and Wildlife Habitat Protection Plan (WWHPP) on April 8



4.1 YKDFN Comments on the proposed amendments to the Environmental Agreement (I)

- YKDFN do not support or agree with the proposed amendments
 - “To see a government seek to remove itself from this agreement, at a time when the Caribou and the people who depend on them are in crisis, is not the type of good governance that we expect from our Treaty Partners”



4.1 YKDFN Comments on the proposed amendments to the Environmental Agreement (II)

- “Broadly speaking, we would accept amendments that
 - Advance GNWT as the primary Minister (notwithstanding the objection of YKDFN to the authority of the GNWT and the ability of the Crown to transfer responsibilities over lands which have not been surrendered).
 - See the Federal Minister revert to a secondary role (similar to that held by GNWT within the agreement now).
 - See the Federal Minister role moved from the Minister of AANDC to a department more involved, such as Environment Canada or the Department of Fisheries and Oceans.”



4.2.1 Comments on the Wildlife Effects Monitoring Program

- “we encourage De Beers to seek additional options for the monitoring of wildlife in relation to the project to address the effects predictions. Options can include the use of traditional knowledge studies, academic/industry partnerships to answer specific research questions and applying an ecosystem-based approach to the reporting of mine-related effects”



4.2.2 DKFN Comments on the Wildlife and Wildlife Habitat Protection Plan

- “It is clear from the WWHPP that the health and safety of wildlife around the Mine site is being compromised. While the incidents reported to date have resulted in minimal amounts of wildlife mortality to species of concern, having ineffective mitigation and response actions in place means that the incidents of wildlife mortality can be expected to increase. We hope that the MVLWB will take the appropriate action to ensure that De Beers improve upon its commitments to monitor wildlife around the Mine site and maintain compliance with the permit conditions”



5. Stakeholders' Update

- No Comments received from stakeholders in April 2014, except information requests by EC and ENR (see Section 8.2)



6. Agency's Activities

- SLEMA staff attended the Technical Sessions from April 15 to 16, 2014
- SLEMA submitted an information request on April 22



7. SLEMA Reviews (I)

- Amendment to Fuel Storage
- Quarterly Toxicity Testing Results for SNP 02-17B in January 2014
- 2013 Water Licence Annual Report
 - Summary of Paste Backfill Work conducted at Snap Lake



7. SLEMA Reviews (II)

- Amendment Application for Water Licence Limits
 - Nitrogen Response Plan
 - Strontium Response Plan
- 2013 Annual Report for Wildlife Effect Monitoring Program
- 2013 Annual Report for Wildlife and Wildlife Habitat Protection Plan



7.1 Amendment to Fuel Storage

- De Beers requested an amendment to the volume of the fuel storage on site under Land Use Permit MV2010D0053
 - Snap Lake Mine fuel (diesel) consumption is projected to increase from 42,795,512 L in 2014 to 52,567,314 L in 2027 under the current mine plan
 - Snap Lake Mine has a total gross fuel storage capacity of 42,998,800 L, consisting of three 12 ML main tanks, plus 18 smaller tanks of 330,000 to 500,000 L capacity



Proposed Fuel Storage

- Additional diesel fuel storage capacity is required due to increased fuel demands from ongoing underground mine expansion, as well as the increase in water management infrastructure
 - One 10 M L (10,000,000L) fuel tank in 2014, to be located to the East of the existing 12 ML fuel tank farm, while a second tank may be required at a later date



Fuel Tank

- The new 10 ML tank will be 32.5 m in diameter and 12.1 m in total height
 - The fuel tank will be situated such that the edge of the tank will be at least 100 m away from Snap Lake
 - A containment berm with liner will be built surrounding each fuel storage tank
- Environmental impacts and effects as a result of the project are predicted to be minimal
 - De Beers will follow its environmental protection measures and mitigation plans in order to address any potential concerns



Proposed Fuel Tank Location



Comments from the Environmental Analyst

- No concerns are raised



7.2 Quarterly Toxicity Testing Results for SNP 02-17B in January 2014

- Submitted on March 31, 2014
- Water Treatment Plant (WTP) effluent samples taken on January 27 were tested
 - By HydroQual Laboratories Ltd. (Calgary) during January to February 2014
- Standard biological test methods used
- 4 analysis reports submitted
 - Algae tests – significant stimulatory effects in growth observed
 - Ceriodaphnia tests – endpoints for mortality could not be calculated (no effect occurred); endpoints for reproduction were calculated
 - Trout tests (by CARO Analytical) – no effect occurred
 - Daphnia tests – no effect occurred



Comments from the Environmental Analyst

- No concerns are raised



7.3 Summary of Paste Backfill Work conducted at Snap Lake

- Dated March 31, 2014
 - An Overview of Paste Tailings Disposal
 - Status Update North Pile Development



7.3.1 Current Status – Paste Deposition

- The orientation and complexity of the underground ore body, as well as mine configuration will preclude the design concept of 50% PK paste underground. De Beers estimates that less than 30% PK by volume will be deposited underground as paste
 - Currently, less than 1% of PK has been deposited
- Technical Challenges in Creating Sustainable Paste Tailings
 - The Nature of PK as a Paste
 - The Layout of the Orebody and Underground Mine Workings



Technical Challenges – The Nature of PK as a Paste (I)

- Variability of ore type, hence gradation, physical properties, and fluid characteristics
- The tendency for kimberlite particles to break down in a pipe and flowing stream
- The limitations of laboratory testing in predicting slurry characteristics, particularly rheology (viscosity and solids content)
- The difficulty of preparing a fluid of suitable water content for delivery to the Deep Cone Thickeners (DCTs)



Technical Challenges – The Nature of PK as a Paste (II)

- The original failure of the DCT to perform adequately. Note that this was a common problem in the mining industry and certainly one that was more prevalent when the system was originally designed. Ongoing adjustments, testwork and water balances across the process plant are resulting in improved DCT performance
- The significant distances the paste has to be pumped to a suitable deposition location in the underground mine workings—and the difficulties of working around existing underground facilities
- The need for robust underground pipe support systems to support the pipes necessary for slurry transport
- The inability of cement to significantly enhance paste properties, and the additional pumping difficulties introduced by adding cement to the paste mix



Technical Challenges – The Layout of the Orebody and Underground Mine Workings (I)

- The ore body is a shallow dipping dyke that has an approximate dip of 10-15 degrees. The original mining method was a modified room & pillar method. This meant that blocks and panels were developed then pillars were slashed out on retreat. As there is no overhead roof support in these areas, access into these areas is prohibited and thus paste piping cannot be installed. Many of the stopes on the upper levels of the mine (where the paste reticulation system is extended to) were mined using this mining method.

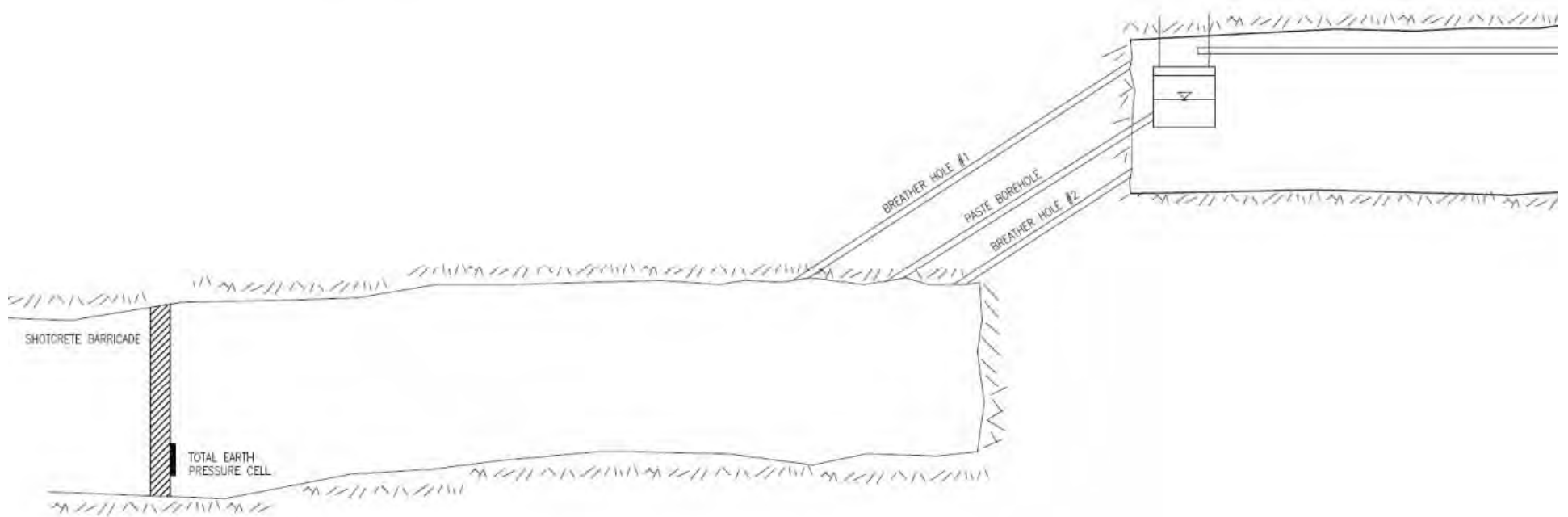


Technical Challenges – The Layout of the Orebody and Underground Mine Workings (II)

- To further complicate the tight-filling of the older stopes, many of the ore stopes were driven with a positive gradient from the access points. This means that the high points in the panels, where the paste pipes need to discharge in order to tight fill the panels, are unreachable. To fill these areas, boreholes are required to be collared from near-by stopes that have not yet been slashed out



Example of how Fill Blocks are filled when the high points in the block cannot be reached by pipe due to being under unsupported ground



Technical Challenges – The Layout of the Orebody and Underground Mine Workings (III)

- Every fill block will need to be individually evaluated and assigned a custom fill factor based on geometry and ease of filling. A single fill factor cannot be assigned to the paste backfill system as a whole
- The relative density difference between the intact rock and the paste backfill also significantly decreases the ability to return up to 50% of the PK back underground
- To add to the challenges in reaching the 50% target, approximately 10% of the mine development is assigned to life of mine ventilation drifts and as such cannot be filled with paste



Volume required to return 50% of the PK back into the underground mine workings

Paste Density (t/m ³)	1.905
Paste Solids Conc. (%m)	76%
Ore Density (t/m ³)	2.54
Req'd Backfill Placement By Mass	50%
Req'd Backfill Placement By Volume	88%



Summary of Paste Disposal to Date (I)

- The Mine has demonstrated that paste backfill can be placed in the underground mine workings
- Paste tailings have been deposited in to the “North Pile” although the beach angles are flatter than required to successfully be used for upstream embankment construction
- The Mine operator bench strength has increased. Familiarity with the paste production and distribution system has increased. Mainly due to understanding the complexities associated with paste tailings systems



Summary of Paste Disposal to Date (II)

- Stope layouts and overall underground mine geometry and mining methods will make attaining the required backfill placement rates difficult.
- Further research work with admixtures may be required to increase the workability of the product for surface disposal.
- Continued testing and research in the future will be done on the rheology of the kimberlite in order to ensure the safe and efficient backfill of the Snap Lake Mine



7.3.2 Current Status – North Pile

- The Starter cell has undergone three phased raises in the height since the original design
 - The Starter Cell is expected to reach capacity as early as in May 2014; East Cell will reach capacity as early as in June 2015
- Cone penetration tests results indicate that further upstream increase in embankment height of the Starter cell is at present not geotechnically feasible
- De Beers expects production rates to increase above name plate rates (3150 tonne/day) life of mine



Conservative Design Assumptions and Facts for the North Pile Extension

- All waste host rock, and PK will be deposited on surface
- Paste technology and paste strengths will not meet the requirements of the original envisaged North Pile design requirements.
- Upstream heightening of the Starter cell embankments will not be geotechnically feasible



Conceptual Options of the North Pile Expansion

- Raising the height of the current Starter and East Cells by changing angle of embankment slopes from currently permitted 3:1 slope to 2:1 to facilitate a downstream embankment build; or
- Expanding the current North Pile footprint; or
- A combination of both



Planning for the North Pile

- De Beers recognizes that the above options would constitute an expansion to the existing approved facility, and would require an application to amend its current authorization(s). De Beers will complete its evaluation of the feasibility of the options to increase capacity of the North Pile by March 2015
- De Beers intends to commence construction of the West Cell by late 2014 or early 2015



Comments from the Environmental Analyst

- Higher pile, bigger footprint or both will be necessary, if the percentage of PK deposition in the North Pile is up from 50% to 70%
- The Summary will be presented to next SLEMA TK Workshop in June 2014. The information will be helpful for SLEMA TK Panel to understand the current and future North Pile development and assess the related impacts



8. Water Licence Amendment Application

- Technical Sessions from April 15 to 16, 2014
- Information Requests
- Joint Government of Canada and NWT Letter to NSMA
- SLEMA's Investigation on TDS Removal



8.1 Technical Sessions

- Dated April 15 and 16, 2014
- Co-Chaired by the MVEIRB and MVLWB
- De Beers and their consultants as presenters
- Participants from ENR, EC, YKDFN, NSMA, SLEMA, etc.



April 15, 2014 (I)

➤ De Beers Presentation on Water Balance Models

- Groundwater Flow Model Update
- Site Model Water Balance Report
- Site Model Hydrogeological Report

➤ De Beers Presentation on Site Water Quality Models

- Mine Site Water Quality Model Report
- Snap Lake Hydrodynamic and Water Quality Model Report



April 15, 2014 (II)

- De Beers TDS Response Plan Presentation
 - Proposed WQO for TDS
 - Proposed WQO for Fluoride
 - Proposed WQO for Chloride
 - Proposed Mitigations
- De Beers Nitrogen Response Plan Presentation
 - Proposed WQOs
 - Proposed Mitigations



April 15, 2014



April 16, 2014

- De Beers Strontium Response Plan Presentation
 - Proposed WQO
 - Proposed Mitigations
- De Beers Proposed EQC Presentation
 - Effluent Quality Criteria Report



April 16, 2014



8.2 Information Request (I)

- MVEIRB issued the Information Requests from the Technical Sessions on April 17, 2014
- EC submitted additional requests arising from De Beers supplemental information on April 22



8.2 Information Request (II)

- On April 22, 2014, ENR submitted 5 information requests and the following supplemental information, and noted that this information is being supplied at this time to aid the proponent in its response to Information Request #7
 - Examples of Other Relevant Jurisdictions with TDS or Chloride Regulations
 - Amendment -relevant Scientific Journal Articles (attached within GNWT IR response)
 - Other Amendment-relevant Articles for the Proponents Response to IR#7 (not attached)
- As per Information Request #7, ENR requests that the proponent provide rationale and clarity on why several of the guidelines and primary references were not included in its derivation of Site Specific Water Quality Objectives (SSWQO's) for Total Dissolved Solids, chloride and other EA parameters
- On April 29, ENR submitted Dissolved Solids Water Quality Standards Criteria Summaries: A Compilation of States/Federal Criteria (US EPA, 1988)



8.2 Information Request (III)

- YKDFN requested, on April 22, 2014, that “the company describe the socio-economic and cultural impacts that will result from the proposed activities and submit evidence to support their position, particularly relating to community perception of the area and the downstream impacts after operations have ceased”



8.3 Joint Government of Canada and NWT Letter to NSMA

- Received by the MVEIRB on April 25, 2014
 - NSMA is encouraged to participate in the joint workplan processes of the Review Board and MVLWB, as well as in the engagement efforts of the Developer, and to provide input
 - Funding from the GNWT Interim Resource Management Assistance program can be utilized for projects such as this one
 - The Northern Projects Management Office of CanNor will act as the Crown consultation coordinator on behalf of federal ministers with statutory decision making in relation to the Project



8.4 Investigation on TDS Removal

- During the Technical Sessions from April 15 to 16, 2014, De Beers presented options to reducing Total Dissolved Solids (TDS) in effluent, and stated that treatment of full mine effluent was not cost-effective
- Snap Lake Environmental Monitoring Agency (SLEMA) investigated the impacts of TDS level in mine water and TDS removal efficiency of mitigations such as reverse osmosis on the ratio of mine water which must be treated to meet the proposed Effluent Quality Criterion (EQC) for TDS



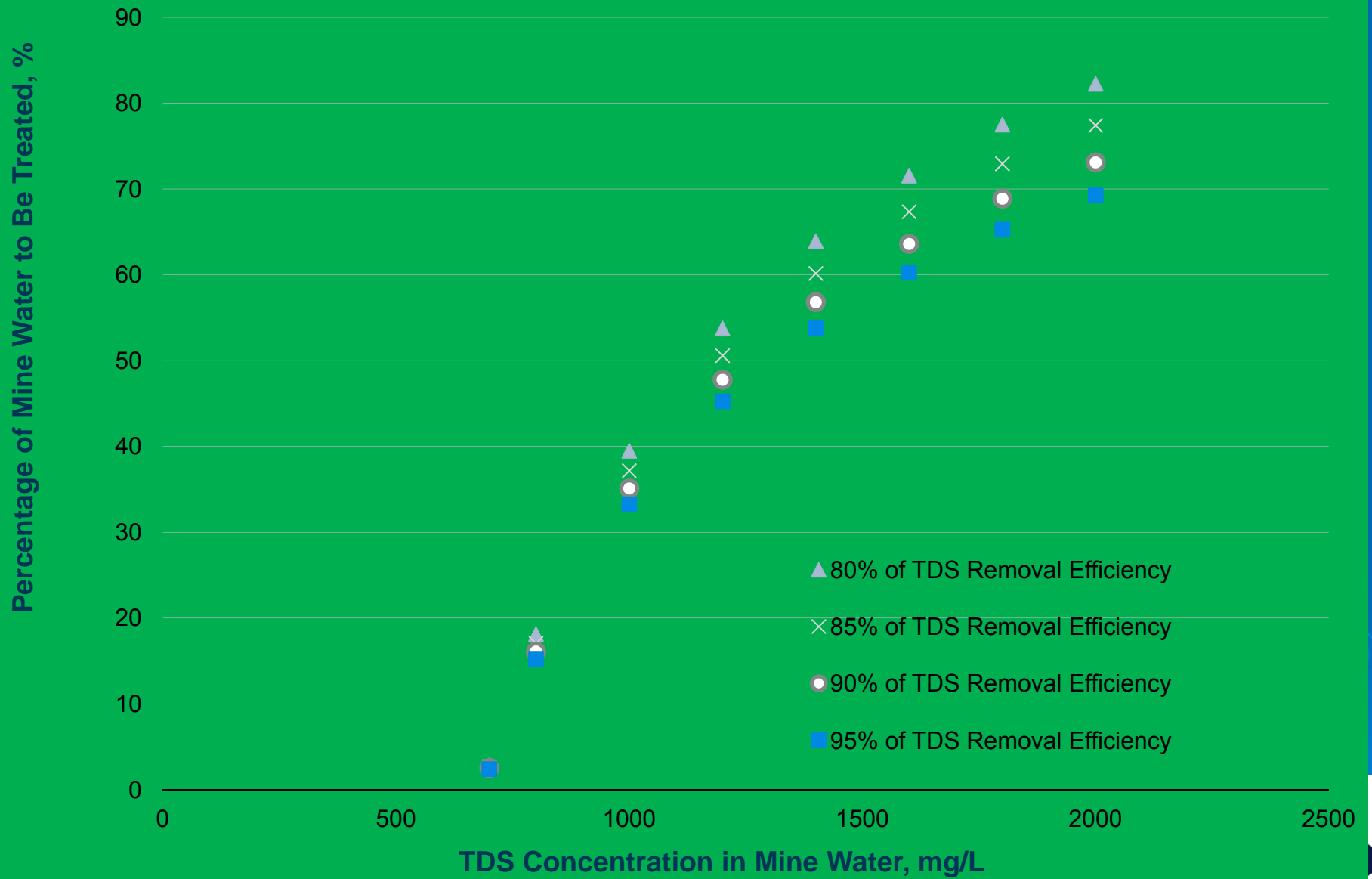
Ratio of Mine Water to Be Treated

➤ $R > 100(C - EQC / (\eta C))$

- Where, R – Ratio of mine water to be treated, %
- C – TDS concentration in mine water, mg/L
- EQC - Effluent Quality Criterion for TDS, mg/L
- η – TDS removal efficiency, %



Impacts of Mitigation Efficiency and TDS Level in Mine Water on the Percentage of Mine Water to Be Treated



Information Request from SLEMA

- It is clear that the more TDS removal efficiency could be achieved, the less mine water has to be treated; the more TDS is in mine water, the more mine water has to be treated
- SLEMA would like to request De Beers review the equation and results provided above and confirm whether they are justifiable

