



# April 2018 Environmental Update for SLEMA Board

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April 30, 2018

# Outline

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



# Acronyms

- AEMP – Aquatic Effects Monitoring Program
- ARD – Acid Rock Drainage
- DFO – Fisheries and Oceans Canada
- ECCC – Environment and Climate Change Canada
- ECM – Extended Care and Maintenance
- ENR – Department of Environment and Natural Resources, GNWT
- EQC – Effluent Quality Criterion
- GNWT – Government of the Northwest Territories
- INAC – Indigenous and Northern Affairs Canada (formerly Aboriginal Affairs and Northern Development Canada [AANDC])
- MVEIRB – Mackenzie Valley Environmental Impact Review Board
- MVLWB – Mackenzie Valley Land and Water Board
- PK – Processed Kimberlite
- SLEMA – Snap Lake Environmental Monitoring Agency
- SNP – Surveillance Network Program
- SSWQO – Site-Specific Water Quality Objective
- TDS – Total Dissolved Solids
- WEMP – Wildlife Effects Monitoring Program
- WTP – Water Treatment Plant
- WMP – Water Management Pond



# 1.1 Mine Update – March 2018

- The Snap Lake Mine remained in suspended operations (Extended Care and Maintenance)
  - 388 m<sup>3</sup> of water withdrawn from Snap Lake
  - No treated water discharged into Snap Lake
- No reportable spills
- Water sampled in 2 monitoring stations
  - 02-15 and 02-16j



# 1.2 Spill Follow-up Report #18-034

## ➤ Submitted on April 3, 2018

- On February 4, approximately 1.0 cubic meters of untreated domestic effluent was spilled in a travel pipe within a culvert under a roadway near the Water Management Pond
  - It is believed that contraction due to cold weather conditions combined with wear on the pipe may be the cause
  - The pipe was fixed at the time and regular inspection of sewer lines continued. The Sewage Treatment Plant 2 has since been decommissioned, and the smaller, contained modular STP is currently in use, which renders the length of pipe in question obsolete



# 1.3 Responses to the Inspector about Water Management

## ➤ Submitted on April 6, 2018

- Provided a technical memo detailing water management at the Snap Lake Mine, titled Extended Care and Maintenance Water Management Supplemental Information
  - Seepage monitoring (SNP 02-11 and 02-12)
  - SNP data quality (SNP 02-02 and 02-14)
  - Handling of brine waste by-product resulting from the new Reverse Osmosis Water Treatment Plant
  - Contingency option underground pumping



# 1.4 Notice of Exceedance of AEMP Action Levels

## ➤ Submitted on April 12, 2018

- Notice of exceedance of the Action Levels related to nutrient enrichment for phytoplankton biomass
  - “As per the response framework an action plan will be developed to assess the exceedance, this will be submitted by May 31, 2018.”



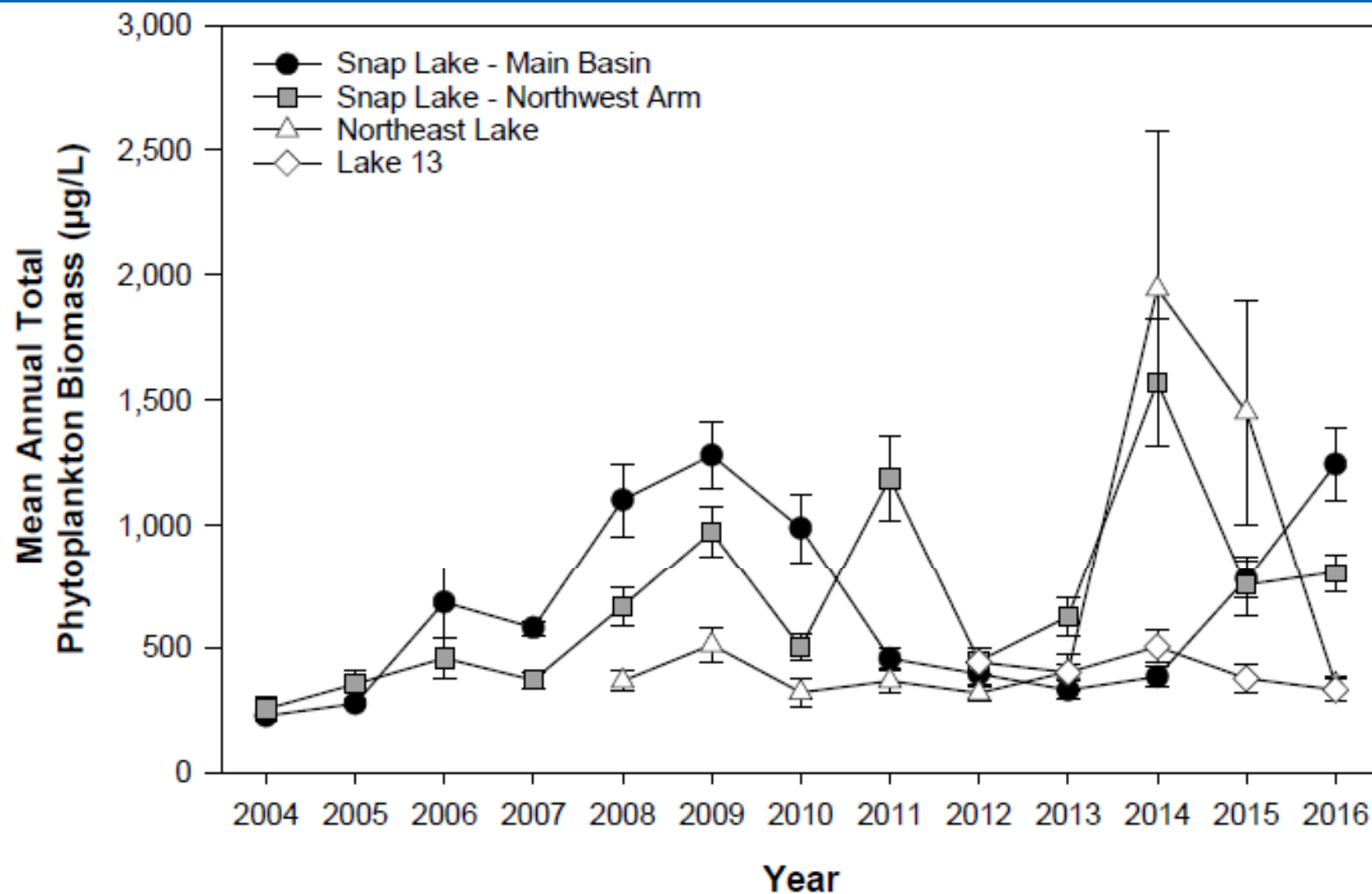
# Action Levels for Plankton

Action Level	Toxicological Impairment	Nutrient Enrichment
Key Information	Differences between Snap Lake and reference lakes or normal range	Differences between Snap Lake and reference lakes or normal range
Negligible	No persistent decline beyond the normal range in total phytoplankton biomass or cladoceran abundance and biomass	No persistent ecologically important changes in richness and community structure
Low	A persistent decline beyond the normal range in total phytoplankton biomass within the main basin of Snap Lake OR A persistent decline beyond the normal range in cladoceran abundance or biomass within the main basin of Snap Lake	A persistent increase beyond the normal range in total phytoplankton or zooplankton biomass in the main basin of Snap Lake AND A minor shift in phytoplankton or zooplankton community composition (based on major <sup>(b)</sup> groups) in the main basin of Snap Lake
Medium	TBD <sup>(a)</sup>	TBD <sup>(a)</sup>
High	TBD <sup>(a)</sup>	TBD <sup>(a)</sup>





# Time Series Plots of Mean Annual Total Phytoplankton Biomass in Snap Lake, Northeast Lake, and Lake 13, from 2004 to 2016



# Comments from the Environmental Analyst

- Data of phytoplankton biomass in 2017 are not available yet, and are expected in May while Aquatic Effects Monitoring Program 2017 Annual Report will be submitted



# 1.5 2017 Annual Closure and Reclamation Plan Progress Report

## ➤ Submitted on April 20, 2018

- Required by Part I, Item 3 of the Type A Water Licence (MV2011L2-0004)
- Appendices attached
  - Closure Criteria
  - 2017 Closure Studies and Reports
    - Closure Workshops including Traditional Knowledge
    - Revegetation Summary Report and 2017 Revegetation Field Program Summary Report



## 2. Inspection Update

- Inspector – Tracy Covey
- Water Licence Inspections
  - Inspected on April 13, 2018, and reported on April 25



## 2.1 Water Licence Inspection on April 13, 2018

- Reported on April 25, 2018
  - North Pile, Sumps and ditches, Dam 1 of the Water Management Pond, all active fuel tanks, Water Treatment Plant
  - No environmental risks noted



No cracking or slumping or bulging  
of the tailings surface was noted in  
the Cell 5 of the East Cell





Efforts to remove ice to maximize storage capacity and facilitate pump intakes at the east end of Sump 5



Dewatering-wells have been maintained of late to enable de-watering o Sump 3 (left) and Sump 2 (right) when the forthcoming freshet arrives

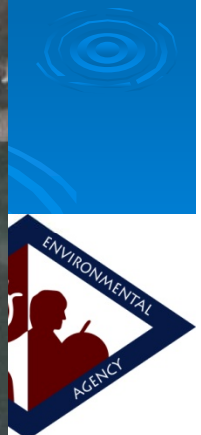




# Reverse Osmosis (RO) filters and treatment components



# Metering to be installed for the new RO unit in April 2018

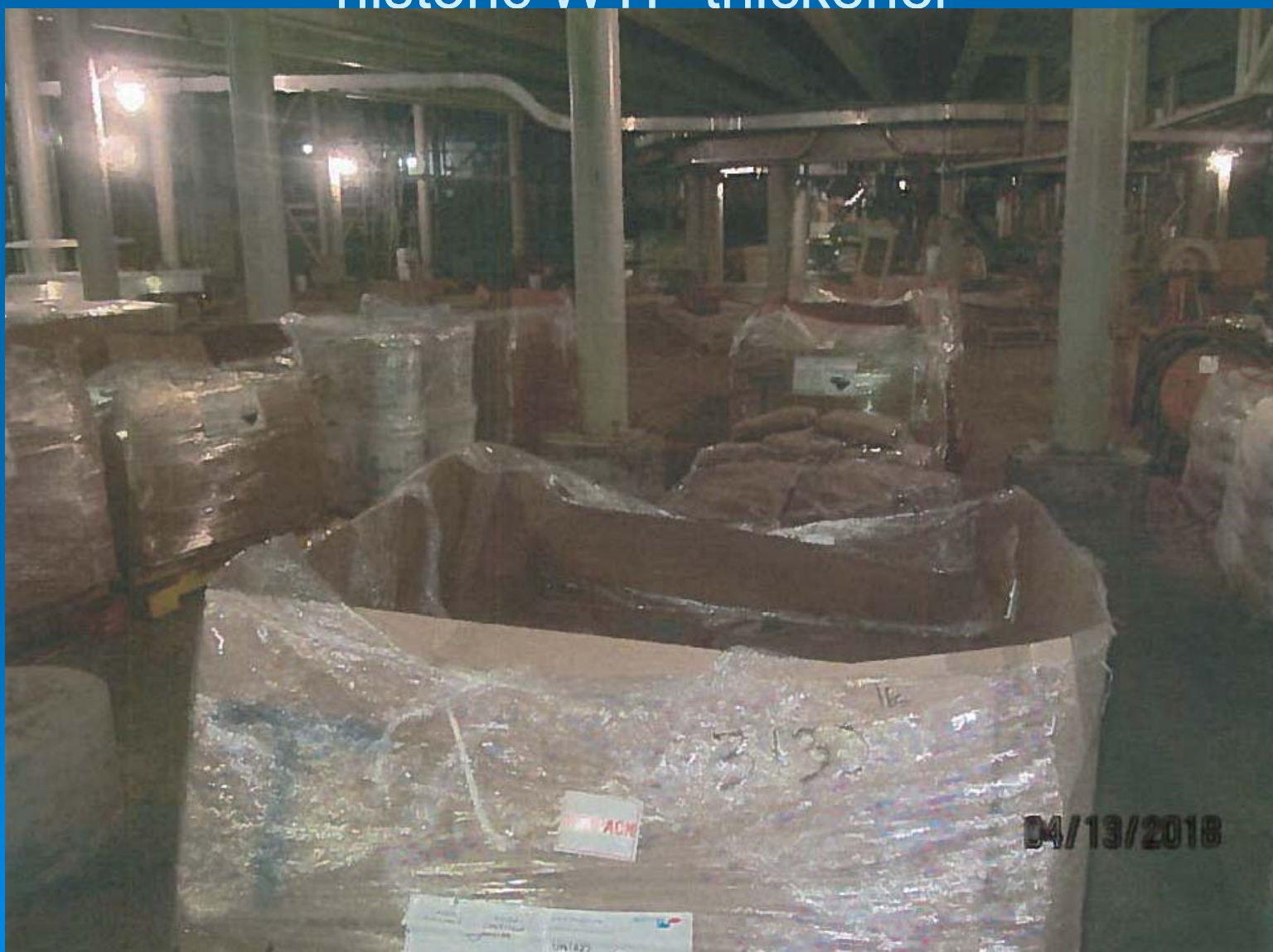




# Scale Inhibitor chemical scheduled to be used in the new RO unit



Bags of Caustic Soda (foreground) and Hydrochloric Acid (background) stored under the historic WTP thickener



### 3. Regulators' Update – MVLWB (I)

- Reviewed De Beers' request to amend Land Use Permit MV2017D0032 on March 19, 2018 and found it to be lacking sufficient information to conduct a preliminary screening
  - Details regarding engagement specific to this amendment application
  - A map, normally at a scale of 1:50,000



### 3. Regulators' Update – MVLWB (II)

- Invited reviewers to submit comments on 2017 Annual Water Licence Report via the LWB Online Review System, on April 9, 2018
  - Comments due on May 2, 2018
- Approved the 2018 North Pile Management Plan, as an interim submission and required De Beers to submit a revised 2018 Plan – Version 2 in accordance with the comments and commitments made during the review by June 11, 2018



### 3. Regulators' Update – MVLWB (III)

- Invited reviewers to submit comments on 2017 Annual Closure and Reclamation Plan Progress Report, on April 30, 2018
  - Comments due on June 28





### 3. Regulators' Update – ENR

- Reviewed the 2016 EAAR update and found it to address the necessary comment items identified, on April 5, 2018
  - “In continuing to work towards a concise report format for the 2017 annual report, ENR will be available for planning or discussion to help ensure it meets the Agreement”





## 4. Aboriginal Update

- No comments received in April 2018



## 5. Stakeholders' Update

- ENR distributed a draft technical report summarizing several statistical aspects of the regional wolverine DNA surveys for data collected between 2004-2015, on April 11, 2018
  - *Analyses of Wolverine DNA Mark-Recapture Sampling in the Northwest Territories 2004– 2015*
  - Average density of wolverine at the three northern sites (Daring Lake, Diavik and Ekati) declined by about 40% between 2005 and 2014, from 5.57 per 1000 km<sup>2</sup> to 3.32 per 1000 km<sup>2</sup>



## 6. SLEMA Reviews

- Extended Care and Maintenance Water Management Supplemental Information
- Water Licence 2017 Annual Report
- Preliminary Data Analysis for Water Quantity of Seepage and Runoff from the North Pile



# 6.1 Extended Care and Maintenance Water Management Supplemental Information

- Provided a technical memo detailing water management at the Snap Lake Mine, titled Extended Care and Maintenance Water Management Supplemental Information
  - Seepage monitoring (SNP 02-11 and 02-12)
  - SNP data quality (SNP 02-02 and 02-14)
  - Handling of brine waste by-product resulting from the new Reverse Osmosis Water Treatment Plant
  - Contingency option underground pumping



# Site Water Management Strategy during Freshet Period

## ➤ Diversion

- To route surface water that has not interacted with mine workings away from Permanent Sump (PS) 5

## ➤ Perimeter Water Control (Sump) Management

- To collect surface water runoff and internal seepage from the North Pile for pumping to the WMP

## ➤ Underground Water Return

- To be used in conjunction with sump management and potential water treatment options to store treatment residuals or high concentration surface water

## ➤ Water Treatment (Underground and/or Surface Water)

- Treatment for Metals to allow for underground blending of water with surface; and/or,
- Treatment for Metalloids +TDS+ Nitrogen for surface water or for underground blending with surface water



# Reverse Osmosis Water Treatment

- To be installed prior to 2018 freshet
  - This new water treatment module fits within the existing plant. It is designed to treat the surface water run-off collected in the water management pond during extended care and maintenance
  - This new water treatment module is a contingency option that will ensure that water from the water management pond can meet the EQCs for discharge to Snap Lake if daily flow volumes exceed what the underground can accept directly



# Justification of the Deposition of High TDS Water to the Underground

- Section 2.1.6 of the approved Extended Care and Maintenance Water Management Plan states *“All water from the North Pile is diverted to the WMP and then treated at the WTP before discharge or stored underground in the lower mine workings while remaining compliant with MV2011L2-0004”*



# Comments from the Environmental Analyst (I)

- Underground workings has been receiving recharge from Snap Lake since De Beers stopped pumping mine water, and the capacity of underground workings for receiving runoff/seepage from the North Pile may be limited
  - Underground water return might not be a reliable option for site water management





# Comments from the Environmental Analyst (II)

- The capacity of underground workings for receiving runoff/seepage from the North Pile is not clear
  - It is requested that De Beers assess the underground capacity and provide an estimate of the capacity
  - It is requested that De Beers clarify what is the maximum discharge rate to underground and how long the practice could last



# Underground Discharge Estimated on Mar 6, 2018

- De Beers responded to reviewers' comments related to this issue raised for the review of the 2018 North Pile Management Plan on March 6, 2016 that at the rate of 2000 m<sup>3</sup> per day or less, the water level in the mine workings remained relatively constant; high TDS water discharged into the deeper connate (saline) waters (the 5180 level approximately 260 m below the mine entrance) would not rise due to its density



# Underground Discharge

## Estimated April 6, 2018

- Surface water that does not meet discharge criteria for Snap Lake may also be placed directly in the underground without treatment. This is the preferred option for water collecting in the perimeter water control structures and water management pond. This option will be pursued when the flow rates are low enough to ensure there is no-overtopping of the underground. We anticipate that the underground can take ~3000m<sup>3</sup>/day without risk of overtopping
- Because flows are anticipated to be higher than that during freshet, it is likely that this option will not be pursued during freshet



# 6.2 Water Licence 2017 Annual Report

## ➤ Submitted on March 31, 2018

- As required by the Type A Water License, Part B, Item 7 in accordance with Schedule 1, item 1 (MV2011L2-0004)
  - Addressed the annual SNP reporting requirements



# Appendices Attached

- Appendix I 2017 Snap Lake Mine Surveillance Network Program Water Quality Data
- Appendix II 2017 Graphical Summaries of parameters with Effluent Quality Criteria
- Appendix III 2017 Effluent Toxicity Reports
- Appendix IV 2017 Geochemical Field Inspection Report
- Appendix V 2017 Acid/Alkaline Rock Drainage and Geochemical Characterization Report
- Appendix VI 2017 Geotechnical Instrumentation Monitoring Program Summary
- Appendix VII 2017 Geotechnical Site Inspection of the North Pile Facility and Water Management Pond Dams
- Appendix VIII Calibration Records of Water Intake Meters



# Comments from the Environmental Analyst (I)

- No concerns are raised except a few editing issues for the Water Licence 2017 Annual Report
  - The sewage treatment plant discharge for October to December 2017 is missing in Table 4-1
  - Table 20-1 should be titled Table 21-1
  - Section 6.1.1 of the ARD and Geochemical Characterization 2017 Annual Report (page 26)



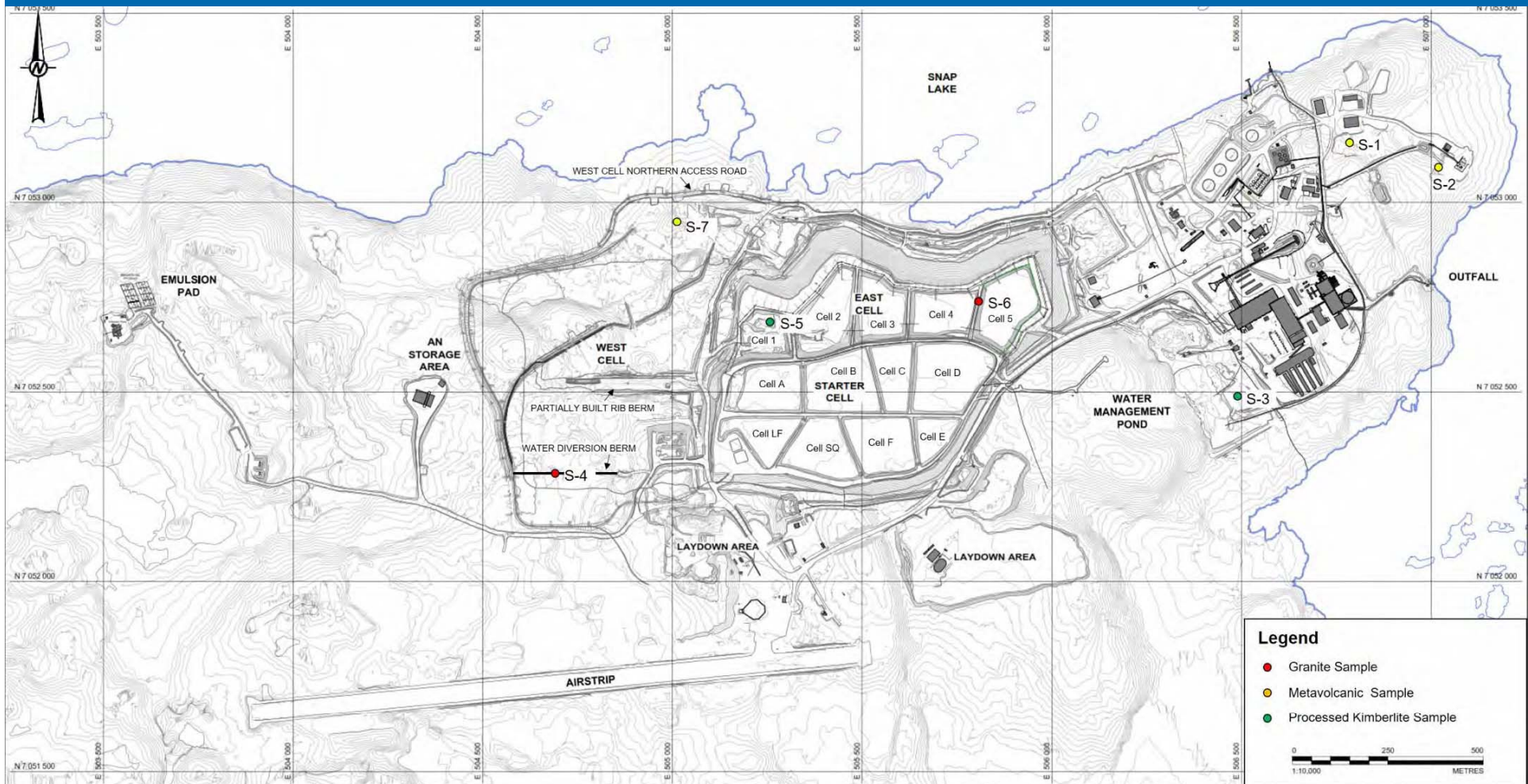
# 6.2.1 2017 Geochemical Field Inspection Report

- The geochemical inspection occurred from September 7 to 10, 2017
  - A visual inspection of the Engineered Structures designed to contain, withhold, retain, or divert Water or Waste was completed
    - Seven rock grab samples were collected from various mine site areas for geotechnical laboratory analysis
    - sixteen water grab samples were collected to support completion of the Seepage Survey
- Field Inspection Report was submitted to the MVLWB by November 9, 2017



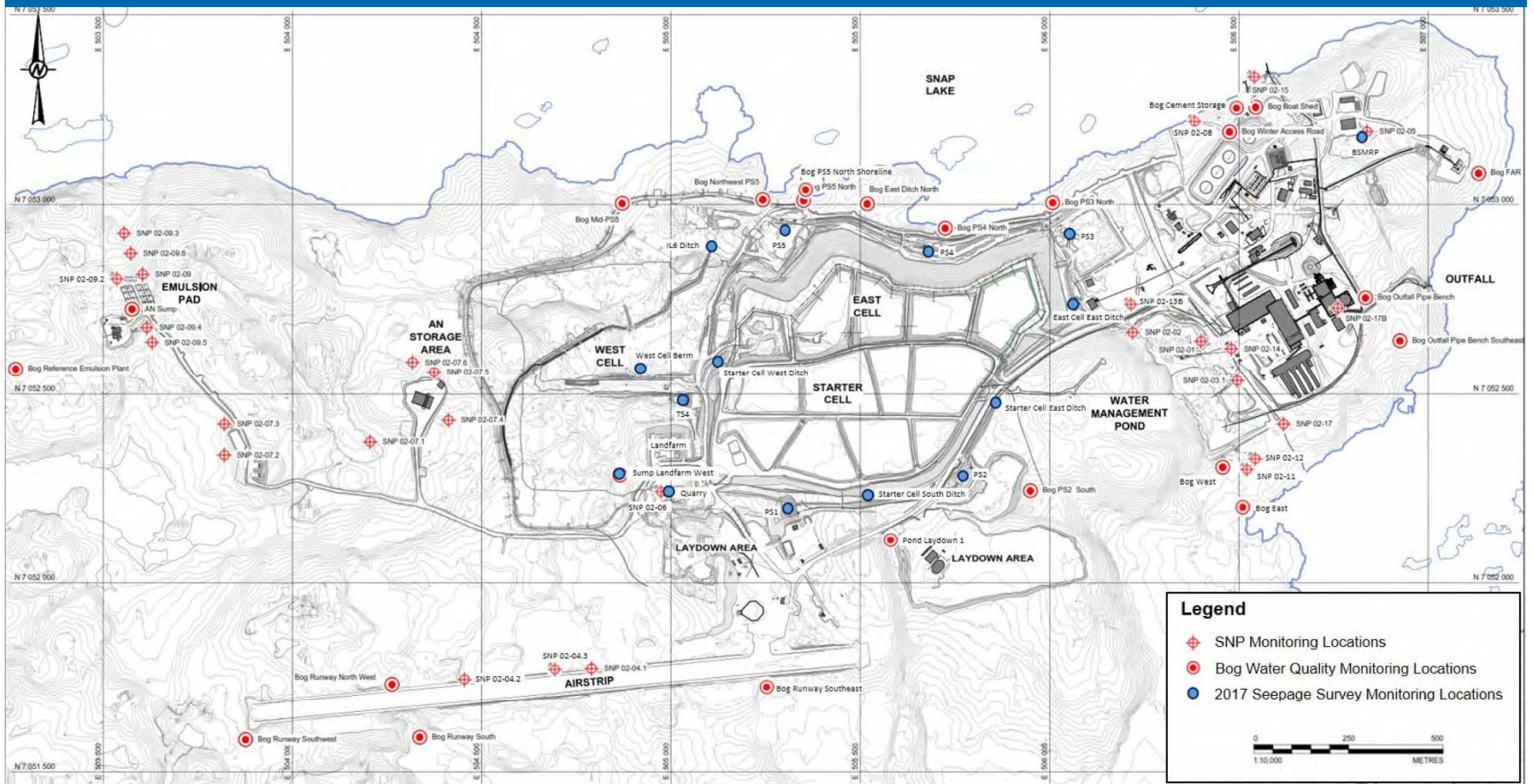


# Rock grab samples locations for geochemical analysis





# Water quality sample locations for chemical analysis



# Report Conclusions and Recommendations

- All locations inspected continue to show no apparent signs of incipient acid generation or Acid Rock Drainage based on visual observations. Assessment of the geochemical laboratory analysis for rock and water are required to confirm this preliminary observation
- Samples of standing or flowing water should continue to be collected from the locations identified within the North Pile perimeter ditches, sumps, west cell berm area, quarry, and BSMRP (Former Bulk Sample Mine Rock Pit) as part of the spring and fall seepage surveys



# Comments from the Environmental Analyst (II)

- No concerns are raised for the 2017  
Geochemical Field Inspection Report



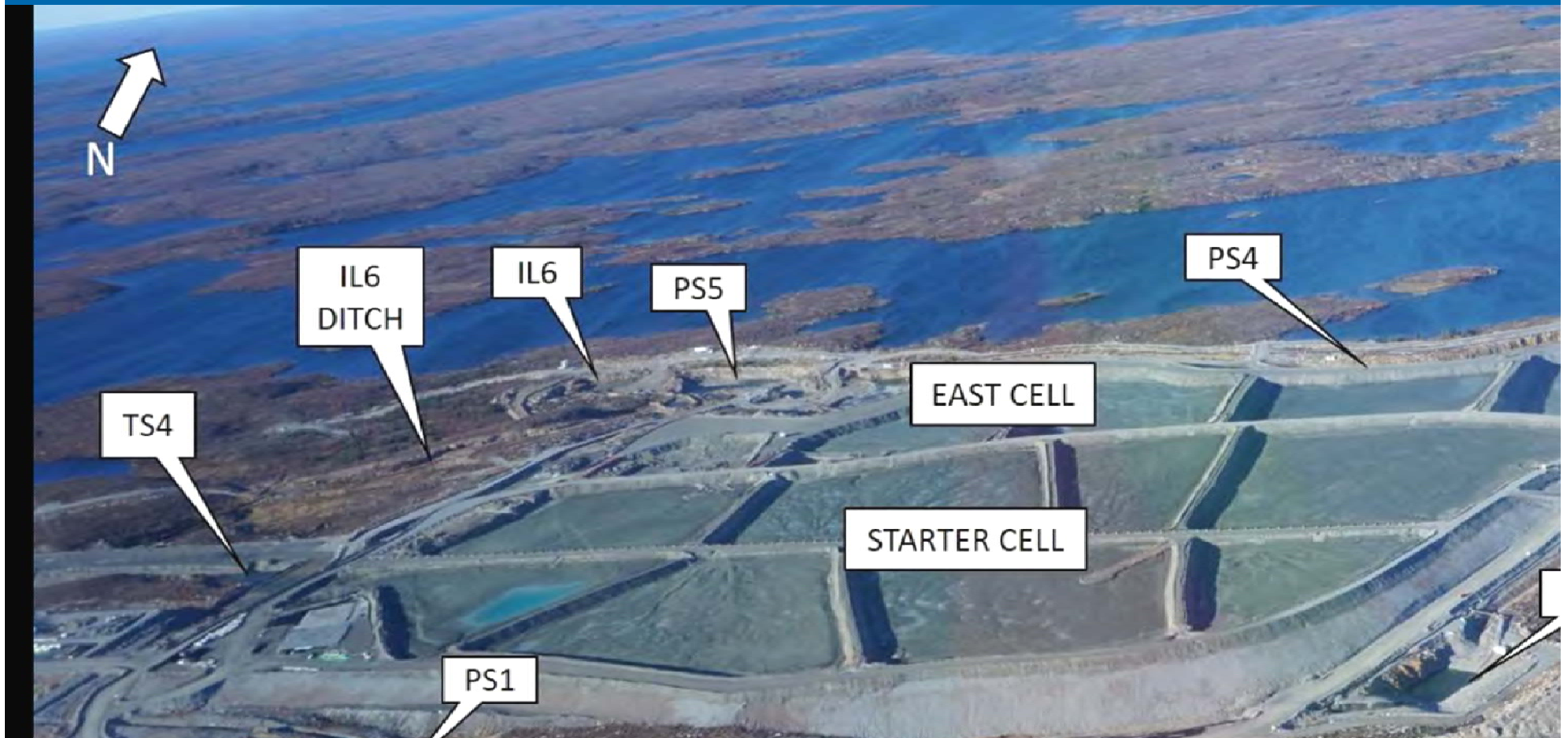
## 6.2.2 ARD and Geochemical Characterization 2017 Annual Report

- Summarized the acid/alkaline rock drainage (ARD) and geochemical conditions observed at the Mine between January 1 and December 31, 2017
  - Appendix A Selected Photographs from 2017 Site Inspection
  - Appendix B Water Quality Results From Several Locations Sampled in Support of the 2017 Geochemistry Evaluation
  - Appendix C Water Quality Results from Selected Surveillance Network Program Monitoring Stations
  - Appendix D Results of Geochemical Characterization of Supplemental Geochemistry Samples
  - [Appendix E 2017 Seepage Survey Summary Report](#)

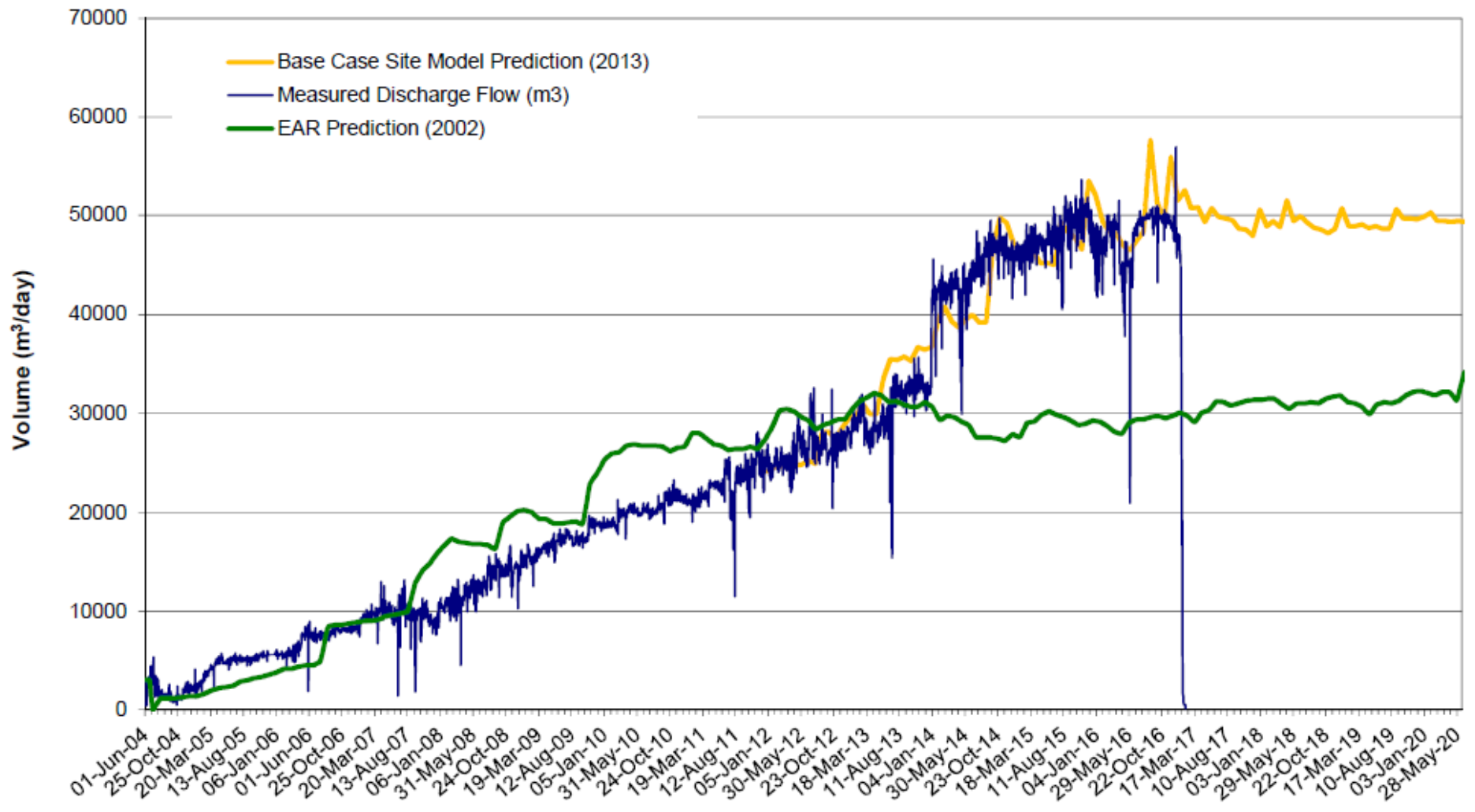




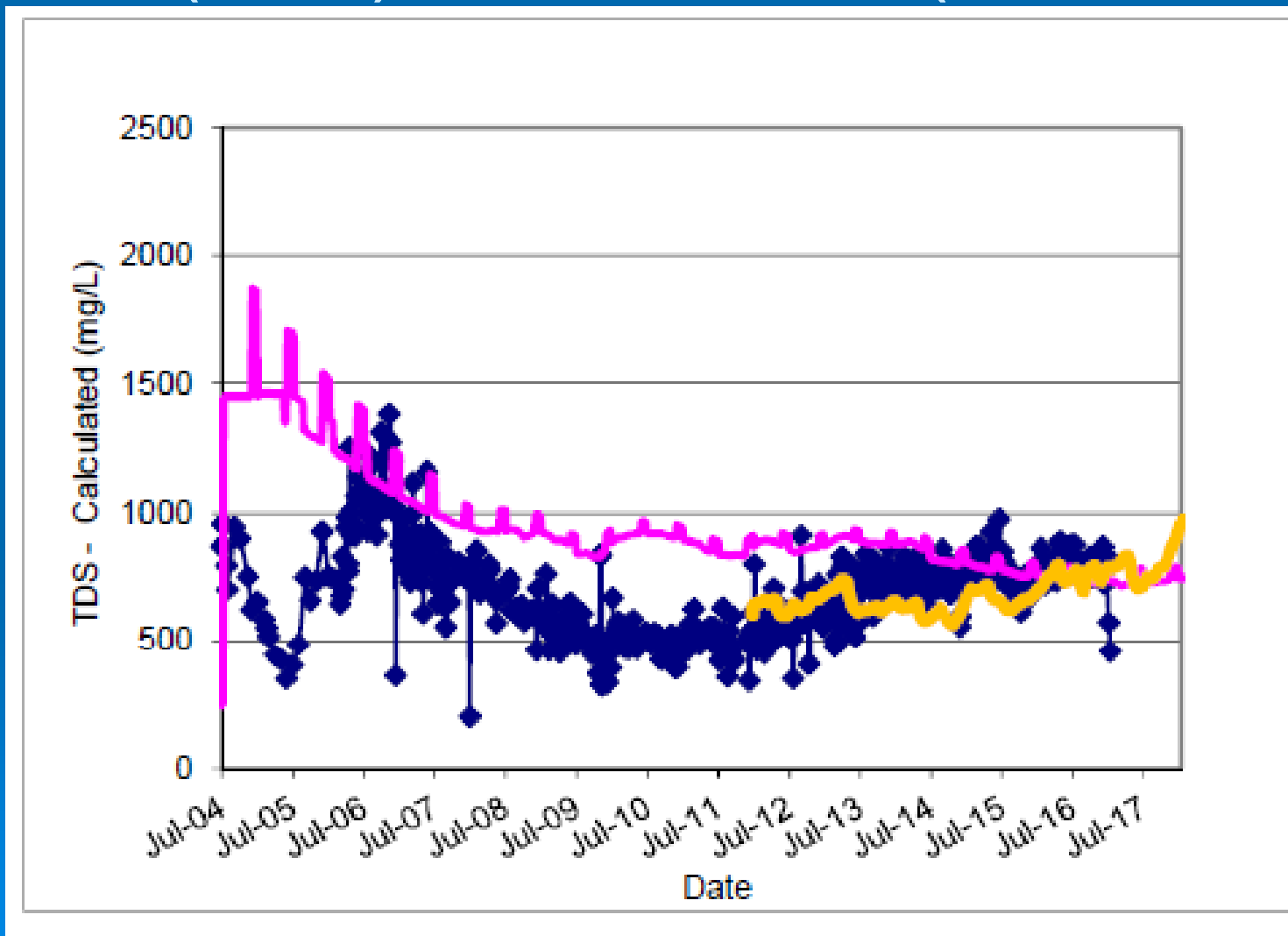
# Aerial View of Starter Cell and East Cell Areas in September 2016



# Minewater Discharge Rate through February 9, 2017



# Concentrations of Total Dissolved Solids (TDS) in Minewater (SNP 02-01)



Monitoring Values

2002 EA Predictions

2013 Base Case Site Model Predictions





# Water Quality – Water Management Pond (SNP 02-14)

- The composition of water at SNP 02-14 largely reflects the composition of minewater pumped to the WMP
- In 2017, concentration trends continued to be stable and were generally consistent with observations from previous years, with only a few parameters showing initial signs of change as a result of the cessation of minewater pumping to the WMP in early 2017, including slight decreases in the concentrations of calcium, chloride, lithium, manganese and strontium



# Water Quality – North Pile (SNP 02-02)

- Water flow from the North Pile is dominated by process water inputs, surface runoff, and a smaller seepage component. Water quality is primarily influenced by the quality of the process water deposited, reactions within the pile, and water from consolidation of PK
- Overall trends in 2017 were similar to those observed in 2013, 2014, 2015 and 2016. Differences relative to 2013 Base Case Water Quality Model predictions result from changes in North Pile operating conditions relative to assumptions used in the model predictions, notably the entry of the mine into Care and Maintenance and cessation of PK deposition in December 2015. The water from SNP 02-02 is treated prior to release



# Water Quality – Bog Water

- The comparison of site bog water quality (i.e., WMP and North Pile bogs) to reference bog (North Shore and Emulsion Plant reference bogs, Air Strip bogs, outfall pipe bench bog and FAR bog) water quality indicates that bog water has a naturally occurring wide range of composition



# Water Quality – Water Treatment Plant Discharge

- The composition of treated effluent water quality was strongly correlated with the composition of mine water discharge (SNP 02-01), which is expected as the underground mine contributed the most water to the WTP up until February 2017
- During an authorized emergency discharge from May 25th to June 29th, 2017, the concentrations of sulphate, magnesium, potassium, nitrate, cobalt, molybdenum and uranium increased above the 2013 Base Case Site Water Quality Model predictions, while the concentrations of calcium, chloride, sodium, TDS and strontium decreased below model predictions. The concentration of nitrate also exceeded the EQC for maximum grab and monthly average concentrations, and the concentration of TSS exceeded the monthly average EQC in May



# Geochemical Characterization of Mine Rock and Processed Kimberlite (I)

- The composition of samples collected in 2017 was within the range of composition of samples in the existing geochemical dataset
- The geochemical assessment of kimberlite, PK, metavolcanic and granite has not changed based on the results of the 2017 geochemical assessment compared to the existing geochemical dataset
- It is not expected that the metavolcanic materials currently near surface on site will result in acidic conditions developing in the runoff, based on current results and ongoing monitoring data from SNP 02-05 (bulk sample mine rock pad) over the past decade



# Geochemical Characterization of Mine Rock and Processed Kimberlite (II)

- Based on the current results and existing geochemical dataset, the geochemical criteria for mine rock management are considered appropriate and no changes to these criteria are proposed at this time
  - A sulphide sulphur cut-off of 0.17% by weight was defined as the operational criterion for geochemical classification of granite rock at the Snap Lake Mine





# Comments from the Environmental Analyst (III)

- No concerns are raised for the Acid Rock Drainage and Geochemical Characterization 2017 Annual Report



# 6.2.2.1 2017 Seepage Survey Summary Report

- Both a walking and a driving tour inspection along the perimeters of the Snap Lake Mine Waste storage facilities (stockpiles, rock piles, dams, and roadways) was performed by ARKTIS from June 17 to 18, 2017 and September 9 to 10, 2017 to inspect for the presence of ponded and/or flowing water
  - Based on these inspections, sampling locations were identified, including the North Pile sumps, and water quality samples were collected
- A runoff survey of bogs and receiving waters downgradient of site facilities was also completed by De Beers in May and September 2017



# Main Findings of the 2017 Seepage Survey

- Nearly all monitoring locations had at least one measurement that was elevated compared to the Water Licence's treated effluent quality criteria. The monitoring locations, except for bogs and some SNP stations, are within a catchment at the mine that directs the water to the water management pond for treatment to ensure Water Licence effluent quality criteria at the controlled discharge to Snap Lake is achieved
- Monitoring locations will be re-evaluated in subsequent seepage surveys to assess if high concentrations remain



# Comments from the Environmental Analyst (IV)

- No concerns are raised for the 2017 Seepage Survey Summary Report



## 6.2.3 2017 Geotechnical Instrumentation Monitoring Program Summary

- This report provides an annual update of the geotechnical monitoring program at the Site
  - Monitoring data of thermistors, piezometers, and survey prisms installed on the Site from 1999 to Q4 2017, as well as the results of the previous summary report was used in the preparation of this report



# Report Findings

- In general, the geotechnical conditions and trends at the North Pile and water management pond are consistent with previous years, and no notable changes were observed throughout 2017, with the possible exception of a potential decrease in water levels adjacent to Dam 1. Results from the new instrumentation introduced in 2016 is currently limited in duration and challenges meaningful interpretation
- The replacement or repair of a few thermistors, piezometers, and survey prisms are recommended





# Comments from the Environmental Analyst (V)

- No concerns are raised for the 2017 Geotechnical Instrumentation Monitoring Program Summary

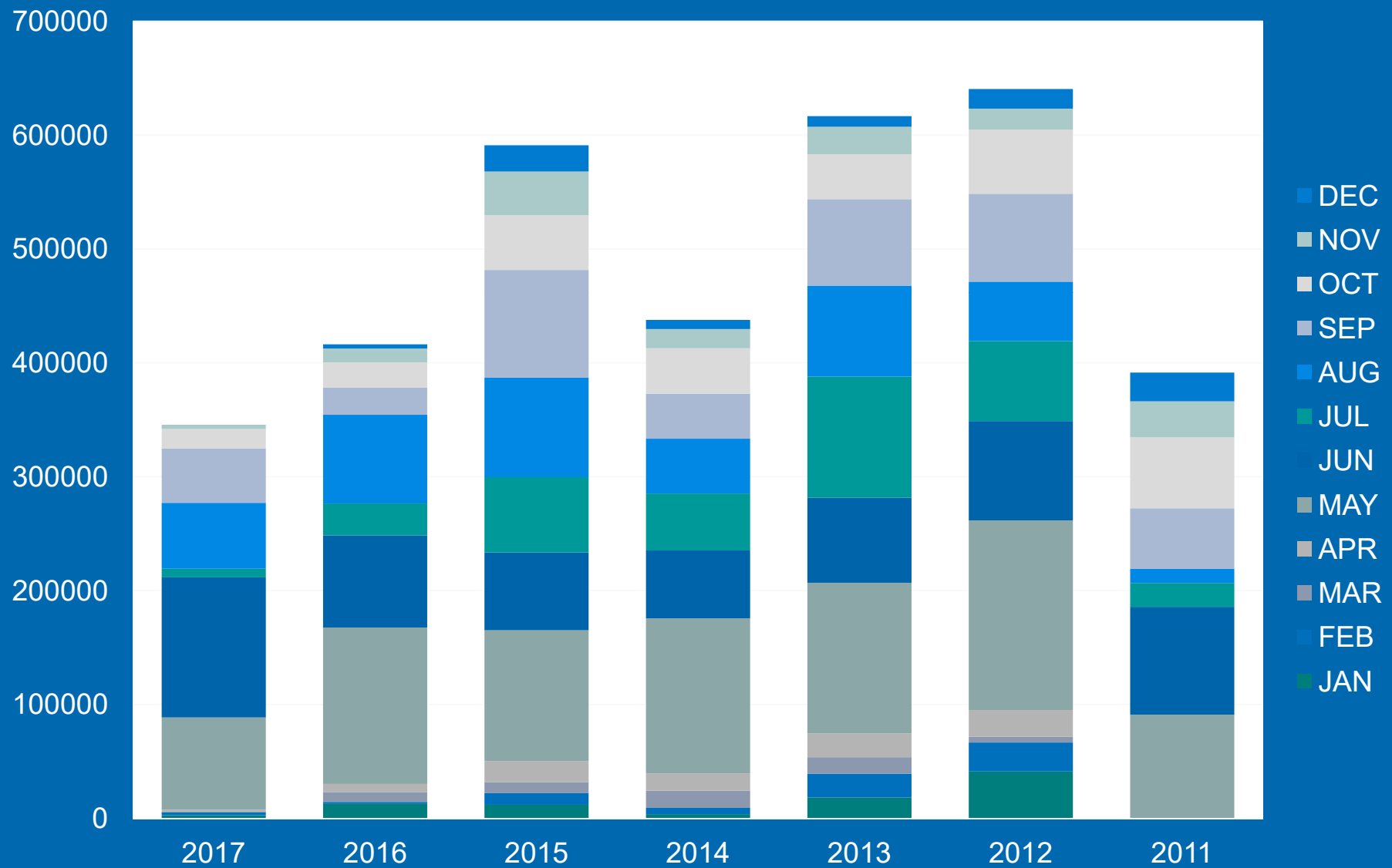


## 6.3 Preliminary Data Analysis for Water Quantity of Seepage and Runoff from the North Pile

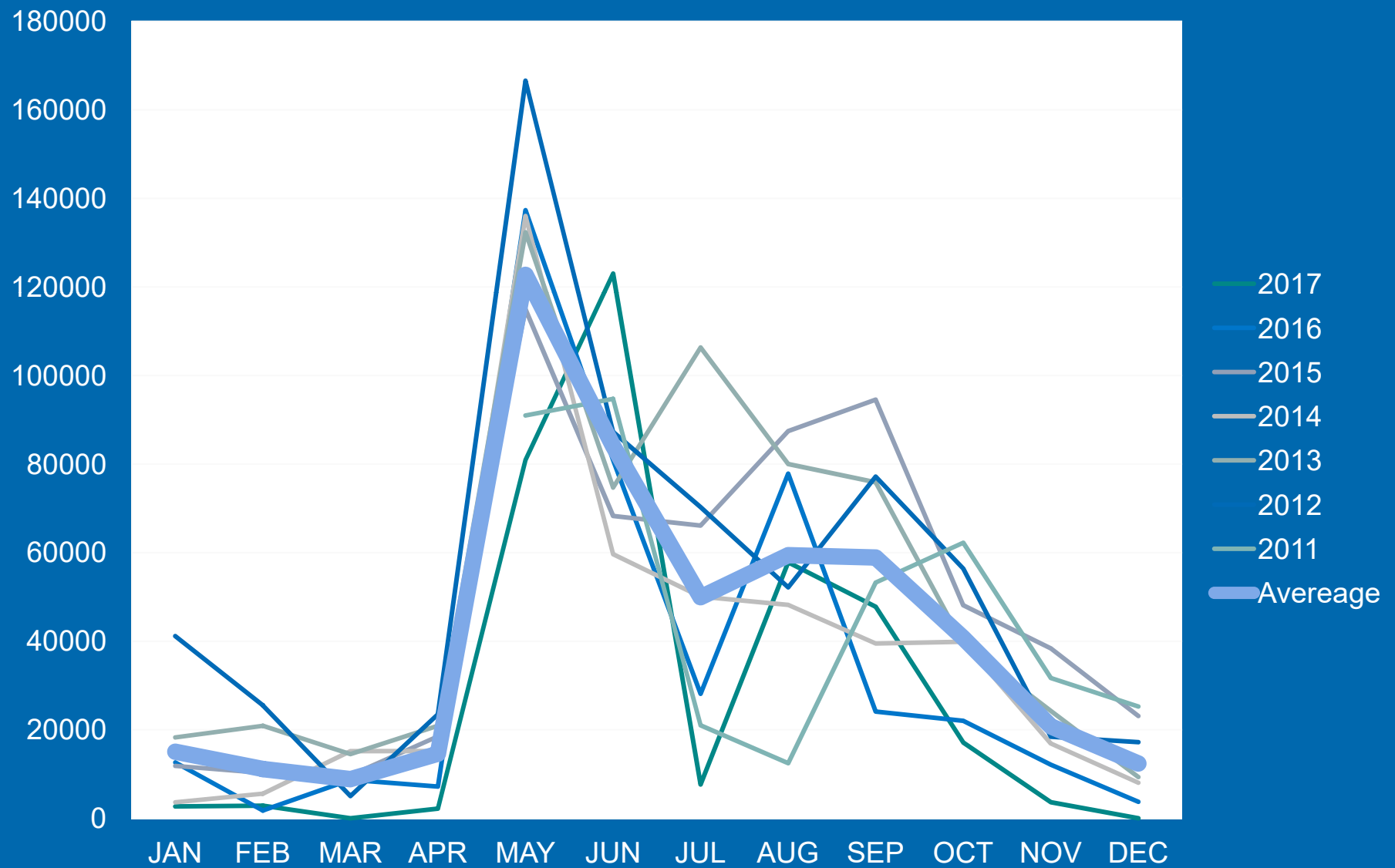
- Data of seepage and runoff from the North Pile were analyzed (source: Water Licence Annual Reports, 2011-2017)



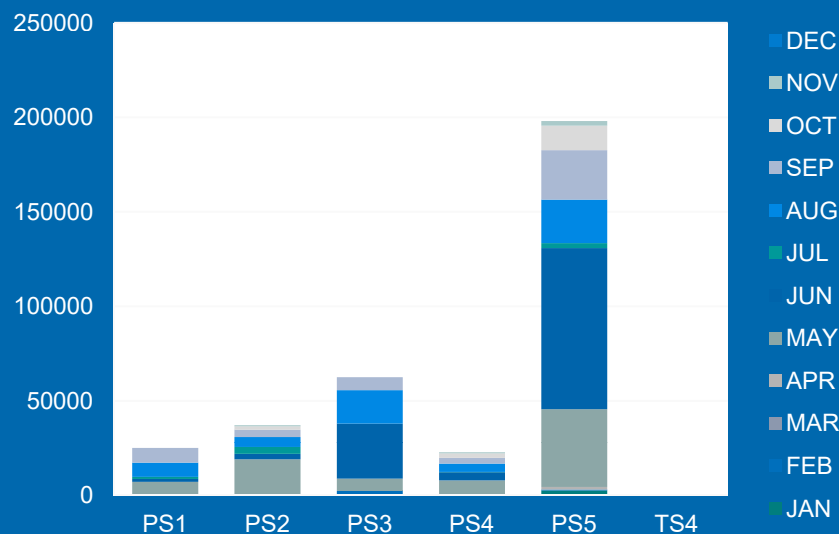
# Annual Runoff and Seepage from the North Pile, m<sup>3</sup>



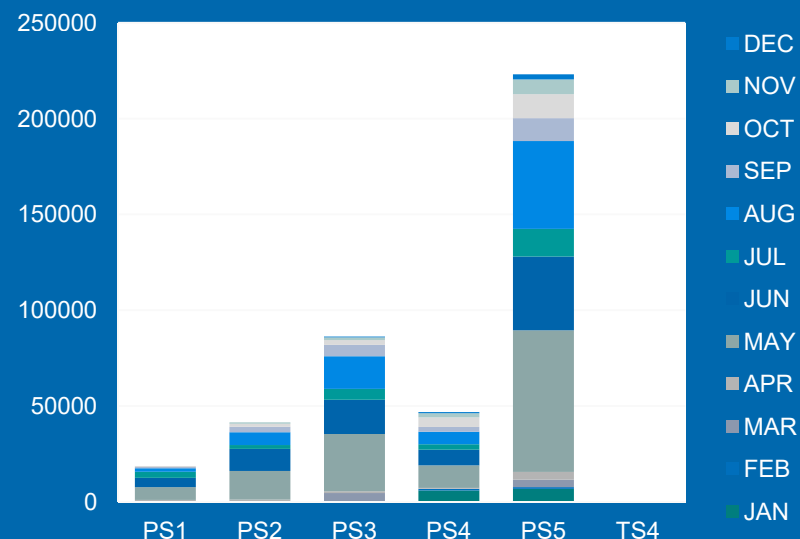
# Monthly Runoff and Seepage from the North Pile, m<sup>3</sup>



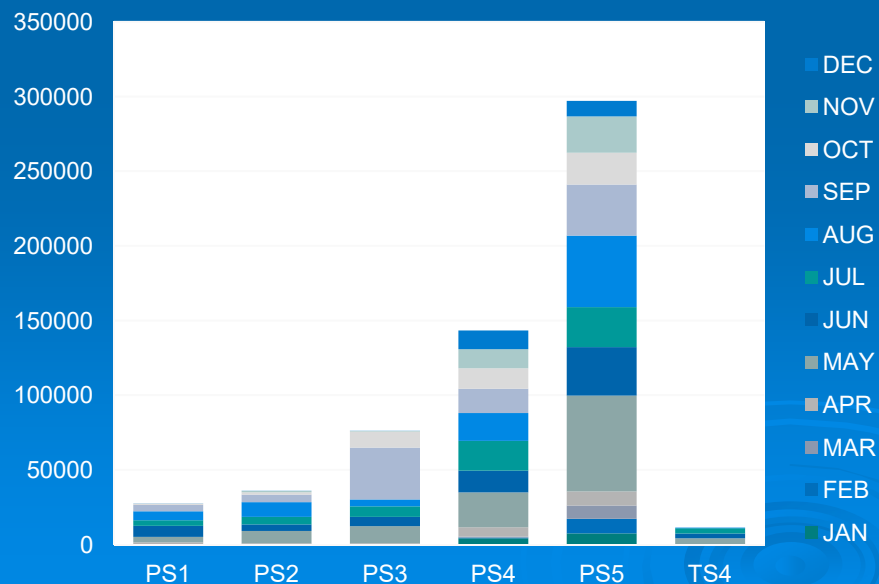
**Water Reporting to Sumps from North Pile  
(m<sup>3</sup>), 2017**



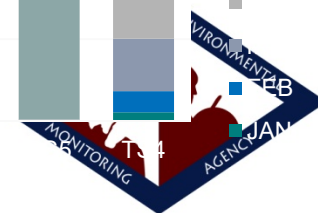
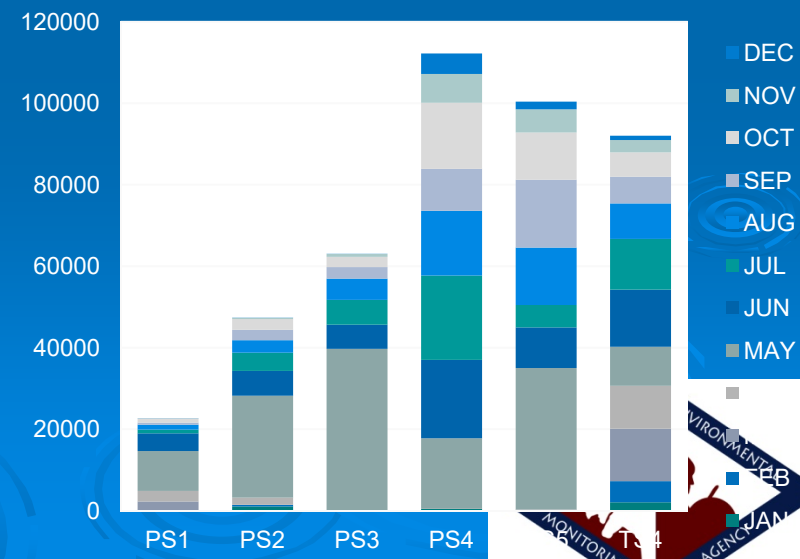
**Water Reporting to Sumps from North Pile  
(m<sup>3</sup>), 2016**



**Water Reporting to Sumps from North Pile  
(m<sup>3</sup>), 2015**



**Water Reporting to Sumps from North Pile  
(m<sup>3</sup>), 2014**



# Comments from the Environmental Analyst (I)

- North Pole runoff and seepage amount changes from year to year, ranging from 300,000 m<sup>3</sup> to 700,000 m<sup>3</sup> per year
- Runoff and seepage amount peaks during freshet period (May) and then goes down
- For the past three years Permanent Sump 5 (PS5) receives more runoff and seepage from the North Pole than other sumps





# Comments from the Environmental Analyst (II)

- Seepage and runoff should be actively managed from May to October
- For better understanding of the seepage and runoff quality, It is recommended that De Beers regularly takes samples from each of the active sumps

