



July 2018 Environmental Update for SLEMA Board

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July 31, 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 – June 2018

- The Snap Lake Mine remained in suspended operations (Extended Care and Maintenance)
- No June 2018 SNP Monthly Report received by July 31, 2018



2. Inspection Update

- Inspector – Tracy Covey
- Water Licence Inspections
 - Inspected on July 6, 2018 and reported on July 16



2.1 Water Licence Inspection on July 6, 2018

- Reported on July 16, 2018
- Inspected the North Pile, Sumps and ditches, Dam1 of the Water Management Pond, all active fuel tanks, Fresh Air Raise, Waste Transfer Area, Burn Pit and Landfill
- No environmental risks noted during the field inspection



Ponded water in Cell 4 (left photo) and Cell 5 of the East Cell



Landfill in Cell 1 of the East Cell (left photo) and Burn Pit



“Beachlines” indicated that water level in Sump 5 had recently dropped



Sump 3 (left photo) and Sump 4 were essentially empty



Sump 1 (left photo) and Sump 2



Water Management Pond (30% full)



10 Million Litre Diesel Tank Farm with water free



Historic AN Storage Pad, east end (left photo) vs. west end



3. Regulators' Update – MVLWB (I)

- Acknowledged the 2017 Annual Closure and Reclamation Plan Progress Report as submitted, on July 19, 2018
 - The Board encourages De Beers to continue to engage with all stakeholders on components of the Final Closure and Reclamation Plan, specifically on closure criteria, prior to its submission to the Board on January 30, 2019



4. Aboriginal Update

- No comments received in July 2018



5. Stakeholders' Update

- ENR and ECCC commented the AEMP Response Plan – Plankton on July 10, 2018
- ENR and ECCC commented the 2017 AEMP Annual Report on July 11
- ENR and the Inspector commented the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond on July 17
- ECCC commented the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond on July 20



5.1 ENR Comments on the AEMP Response Plan – Plankton (I)

- At a minimum, a medium Action Level should be defined and implemented in time for the 2018 Annual Report submission at which time the need for a high action level can be determined based upon an additional years data
- ENR recommends that Figure 8 be corrected



5.1 ENR Comments on the AEMP Response Plan – Plankton (II)

- Lack of correlation between zooplankton and edible phytoplankton biomass coupled with the finding that “100% difference in edible taxa can be observed from one year to the next in both Snap Lake and the reference lakes” suggests that the edibility assessment of phytoplankton taxa is not providing valuable information. The edibility assessment highlights several sources of uncertainty including taxonomic constraints. As well, Table 2 classifies phytoplankton edibility, but the basis for this classification isn't clear
 - ENR requests that De Beers consider the feasibility of improving the phytoplankton program to eliminate sources of error associated with the lack of taxonomic size classes. This include methods of improvement of edibility classification to provide more reliable estimates of edibility in the future



5.1 ENR Comments on the AEMP Response Plan – Plankton (III)

- ENR recommends that De Beers review references related to diatom fluctuations and silicon concentrations to determine their relevance as there is a potential this may lead to incorrect management actions in the future
- Given the requirement to “describe the likely causes of the Action Level exceedance”, ENR recommends that De Beers respond to the above comments regarding diatom assumptions and provide alternate causes for change in phytoplankton communities, as appropriate



5.1 ENR Comments on the AEMP Response Plan – Plankton (IV)

- ENR recommends that during the next AEMP Design Phase, consideration should be given to the assessment of community composition assessments based on relative abundance calculated from raw counts not biomass data



5.2 ECCC Comments on the AEMP Response Plan – Plankton

- ECCC finds that the proposed approach is reasonable and that further actions can be informed by ongoing monitoring



5.3 ENR Comments on the 2017 AEMP Annual Report (I)

- Section 3.2.2.4 notes that “temporal trends can be visually identified and therefore rigorous statistical trend analysis was not required.” Trend analysis should not be performed visually. Visual interpretation of trends is subjective and may vary from individual to individual. Statistical techniques provide an unbiased determination of trends in water quality and should therefore be the default method of analysis in all case. It appears that only 17 water quality parameters were properly tested using statistical tools
 - ENR recommends that rigorous trend analysis should be performed on data



5.3 ENR Comments on the 2017 AEMP Annual Report (II)

- Section 3.4.5.3 states that approaching an AEMP Benchmark or drinking water guideline will be used to evaluate if future increases in metals concentrations are a concern. ENR notes that cobalt and manganese have no AEMP benchmark or drinking water guideline, other than an aesthetic objective for manganese
 - ENR requests that De Beers clarify how increases in cobalt or manganese would be evaluated given the absence of AEMP benchmark or drinking water guideline.



5.4 ECCC Comments on the 2017 AEMP Annual Report

- ECCC recommends that De Beers Canada (the Proponent) discuss whether underground overtopping at freshet may continue to be a problem and what methods may be used to prevent a similar situation in future years
- ECCC recommends that the Proponent provide a discussion on whether increased concentrations of nitrate in effluent are anticipated to continue as an issue as the mine proceeds through closure
- ECCC recommends that the Proponent discuss total phosphorus and total zinc concentrations in effluent and whether modelling needs to be updated given the reduced efficacy in treatment and that they provide details on whether this is anticipated to be an ongoing issue



5.5 ENR Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond (I)

- ENR recommends De Beers provide the scale to which the remote visual observation techniques listed in the Tech Memo are capable of monitoring and confirm that the remote visual inspections will be able to accurately and precisely detect the thresholds for each category listed in Table 1. DeBeers should identify examples of other locations where this has been implemented successfully



5.5 ENR Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond (II)

- ENR recommends De Beers indicate with rationale, if only one or a combination of drone, aerial flyover observations or near real-time land satellite imagery is the preferred monitoring technique to complete the visual observations
- ENR recommends DeBeers review the magnitude of sloughing or displacement that would maintain containment during extended care and maintenance, and update the Table 1 thresholds if required



5.5 ENR Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond (III)

- ENR recommends that the proposed monitoring frequency for the North Pile and Water Management Pond Dams must align with the frequency specified in the conditions of the Water Licence



5.6 Inspector's Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond (I)

- Pending field testing that demonstrates the effectiveness of remote sensing in meeting monitoring/inspection requirements of the License/Permit, the MVLWB should accept the EOR's technical memo/Recommended Inspections and Monitoring Frequency report to be grounds to change the Water License condition E (5)



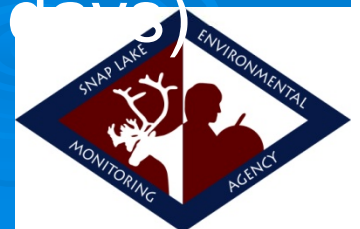
5.6 Inspector's Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond (III)

- Identify where field data collected for the response frameworks in Table 1-5 will be reported



5.6 Inspector's Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond (II)

- To effectively monitor compliance with quarterly sampling requirements, the Inspector needs to know the starting date of that quarterly sampling regiment (i.e., which month, or which 30 day period [if not falling on a calendar month] will the sampling occur within)
 - Select a starting date (thereby, compliance dates will occur every 4 months (+/- 15 days) of that starting date)



5.7 ECCC Comments on the Tech Memo on Geotechnical Monitoring the North Pile and Water Management Pond

- ECCC recommends that the Proponent clarify how any chosen aerial monitoring method can detect issues under snow cover and, if an issue is detected how fast can the Proponent respond to and mitigate any detected issues



6. Agency's Activities

- Sent out three comment letters on the following documents to the MVLWB in July 2018
 - AEMP Response Plan – Plankton, on July 10
 - 2017 AEMP Annual Report, on July 11
 - Technical Memo - Instrumentation and water level monitoring frequencies for the North Pile & Water Management Pond Dams, on July 12
- SLEMA staff had a mine site visit with elders from four aboriginal groups on July 13



6.1 Mine Site Visit

➤ Elders and guests who participants

- Wayne Langenham, NSMA
- Shin Shiga, NSMA
- Lawrence Catholique, LKDFN
- Celine Marlowe, LKDFN
- Philip Liske, YKDFN
- Mike Francis, YKDFN
- Moise Rabesca, Tlicho



Comments from the Elders

➤ Some Elders had concerns:

- Water Quality: noted a brown deposit in the cup when making tea from camp water
- North Pile: worried contaminants will seep through from the NP to Snap Lake despite the water management ponds and grout wall between the NP and the lake
- Waste Disposal: Do not agree waste should be left on site and prefer everything to be taken away



Site Visit Photos



Comments from the Environmental Analyst

- Mine site is under care and maintenance
 - Freshet period appeared to be over
- Following areas were observed
 - Emulsion Plant, Ammonium Nitrate Storage Facility, North Pile Starter Cell and East Cell, ditches and sumps, Waste Management Area, Laydown Area, Tank Farms, Processing Plant, Water Management Pond
- No concerns were raised



7. SLEMA Reviews

- 2017 AEMP Annual Report
- Tech Memo on Instrumentation and water level monitoring frequencies for the North Pile & Water Management Pond Dam



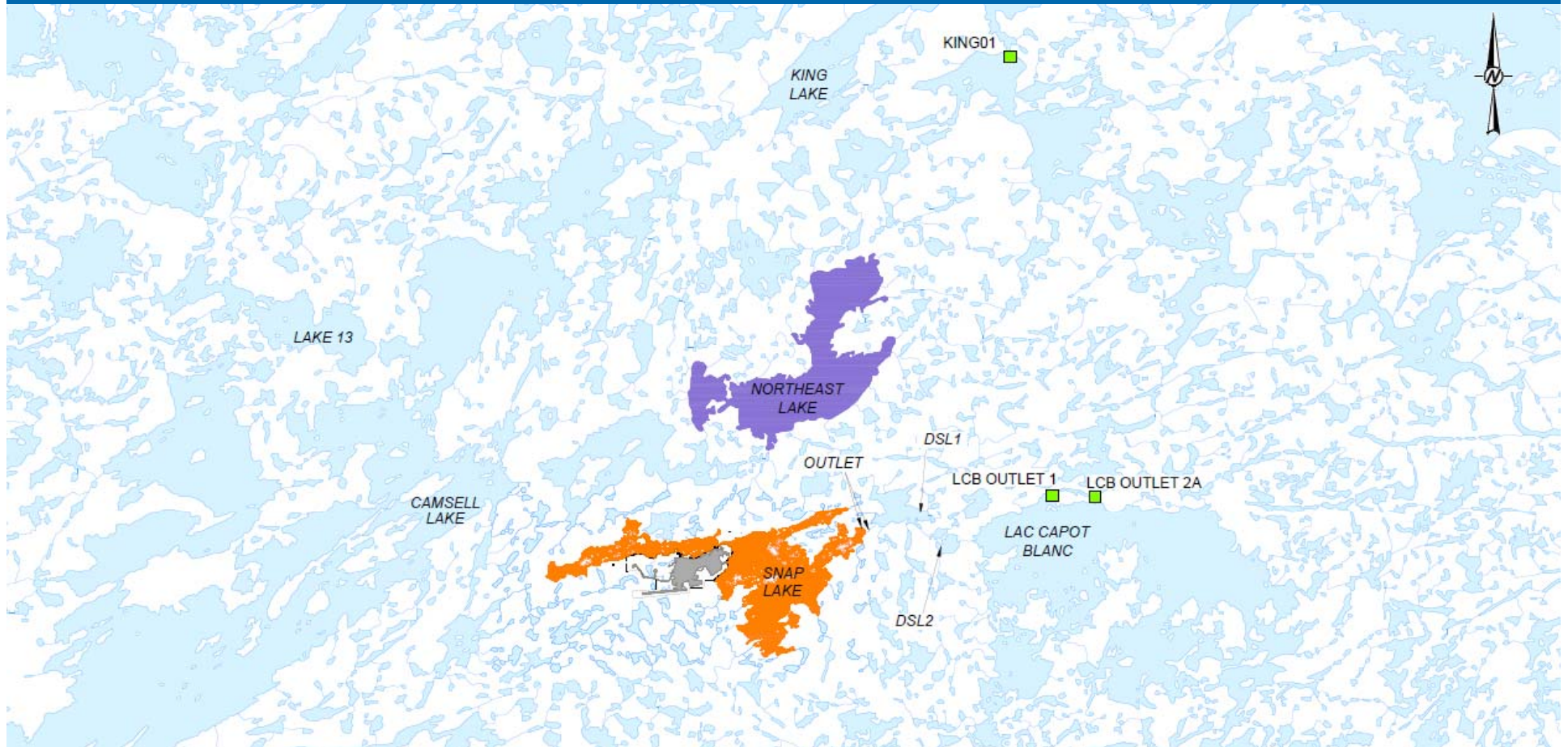
7.1 2017 AEMP Annual Report

➤ Submitted on May 1, 2018

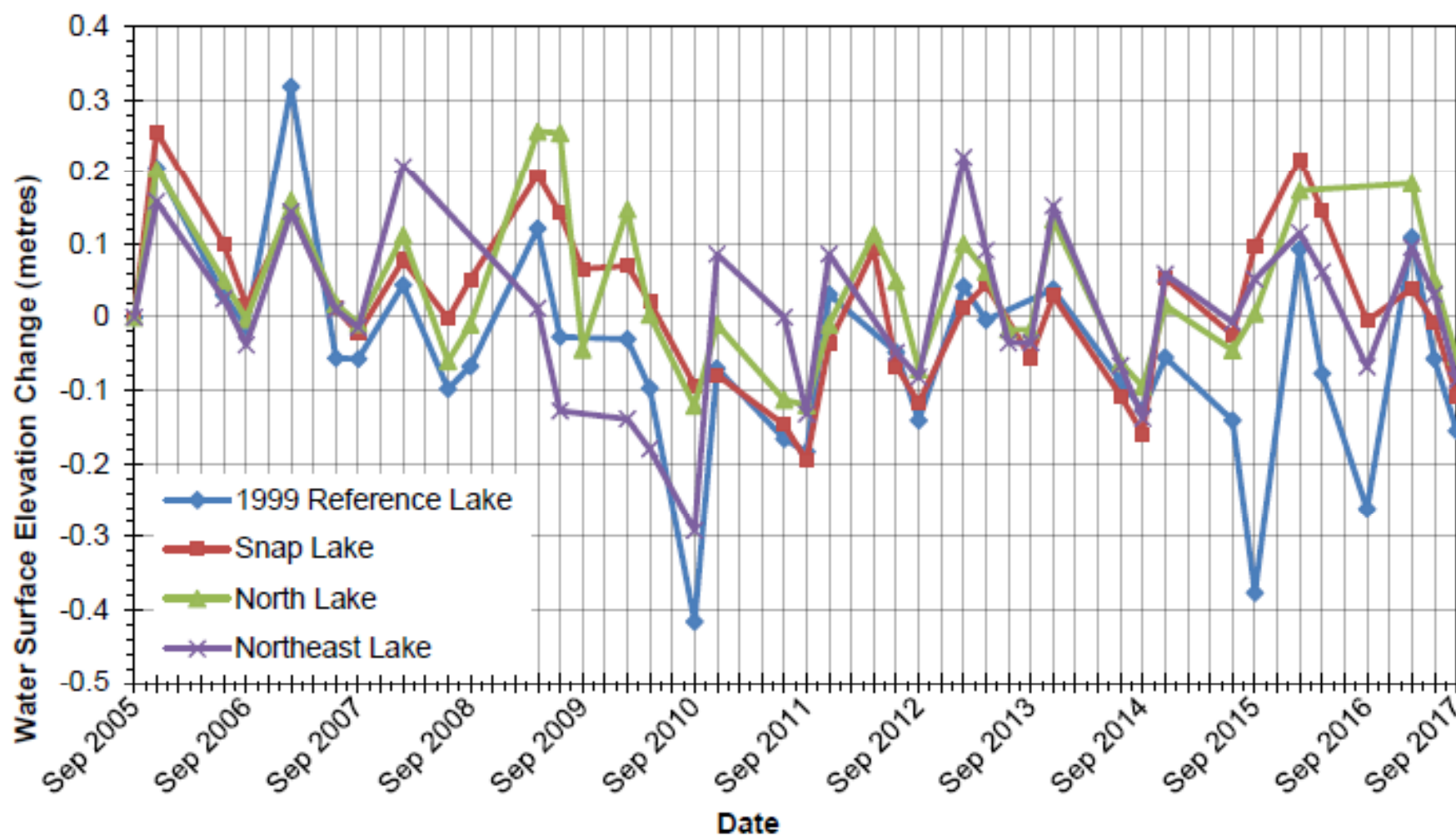
- Presented the results of the 2017 AEMP
- The core programs of the AEMP are: water quality, toxicity, sediment quality, plankton (the small plants and animals that live in the water), benthic invertebrate (the small animals living in the mud of the lake bottom), fish tissue chemistry, and fish community
 - Benthic invertebrate and fish monitoring are completed every three years; they were not conducted in 2017. Fish tissue chemistry was not conducted in 2017, but is planned for 2018. There were no Special Studies completed in 2017



Study Area, 2017 AEMP



Water Surface Elevations of Snap Lake, 1999 Reference Lake, North Lake, and Northeast Lake, 2005 to 2017

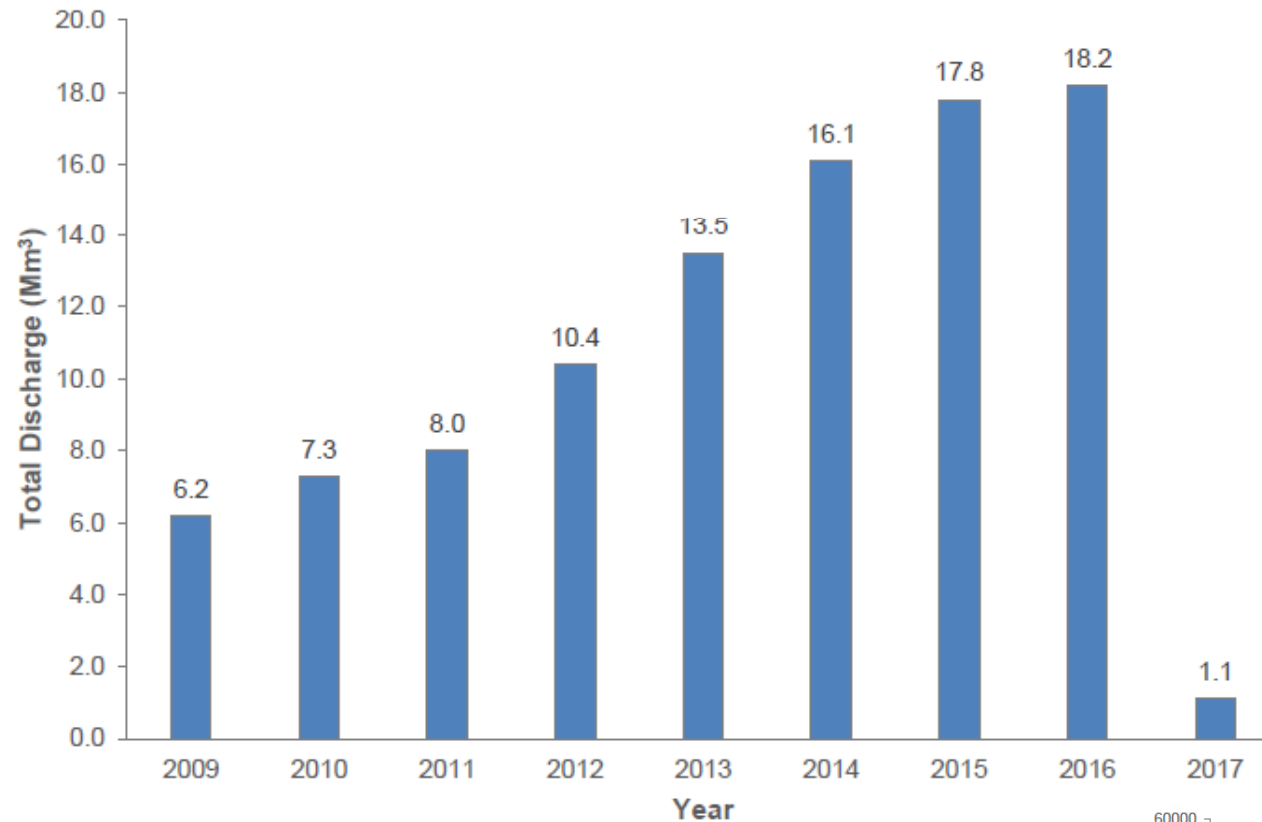


Comments from the Environmental Analyst (I)

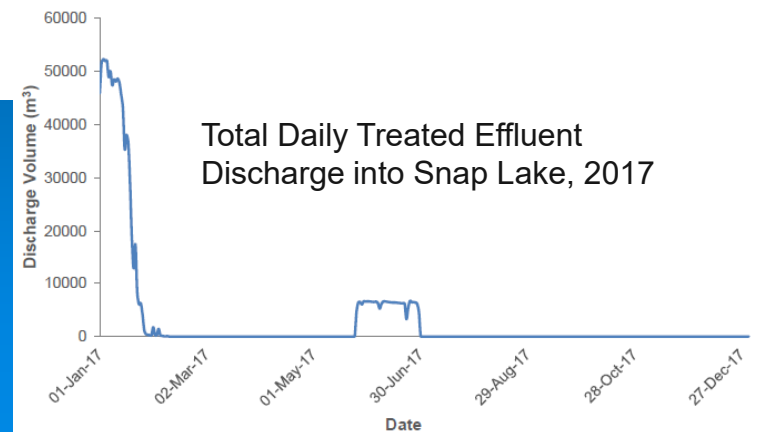
- Water levels in Snap Lake has be up and down with a similar pattern to reference lakes
- No concerns are raised



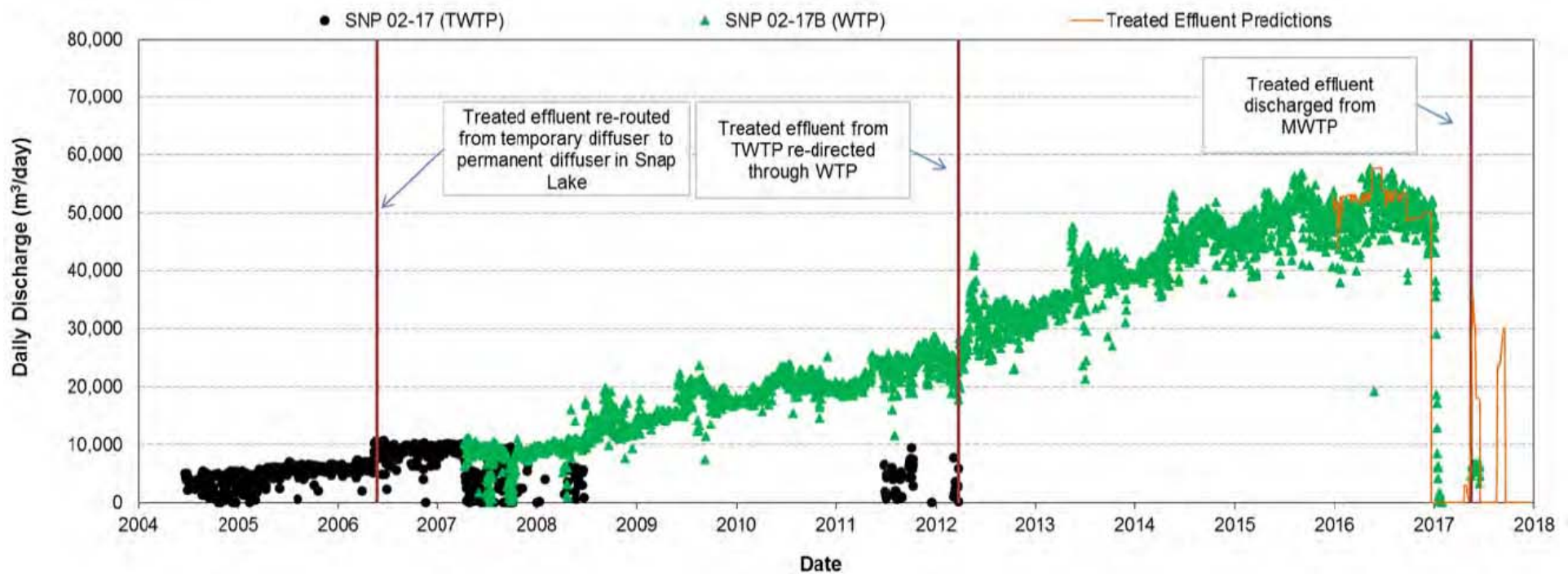
Annual Treated Effluent Discharge into Snap Lake, 2009 to 2017



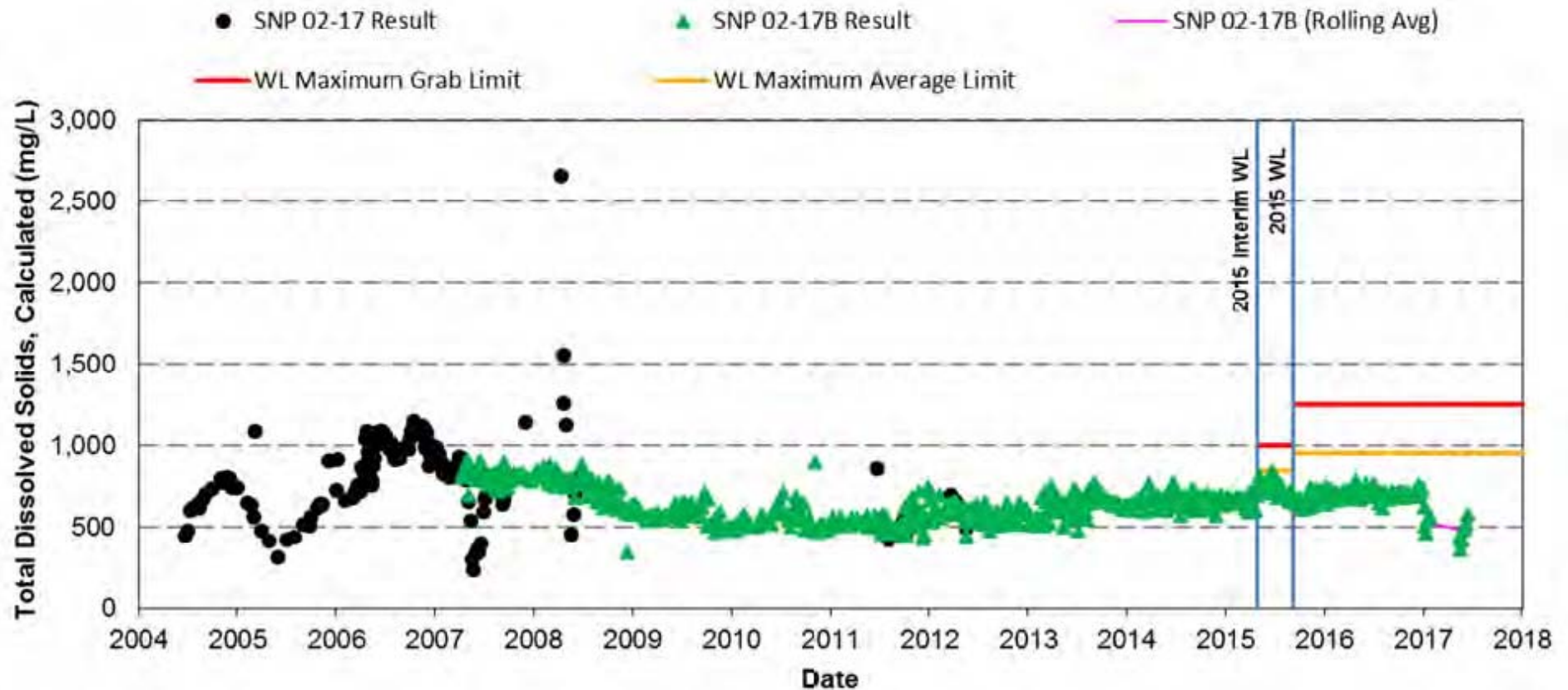
Mm³ = million cubic metres.



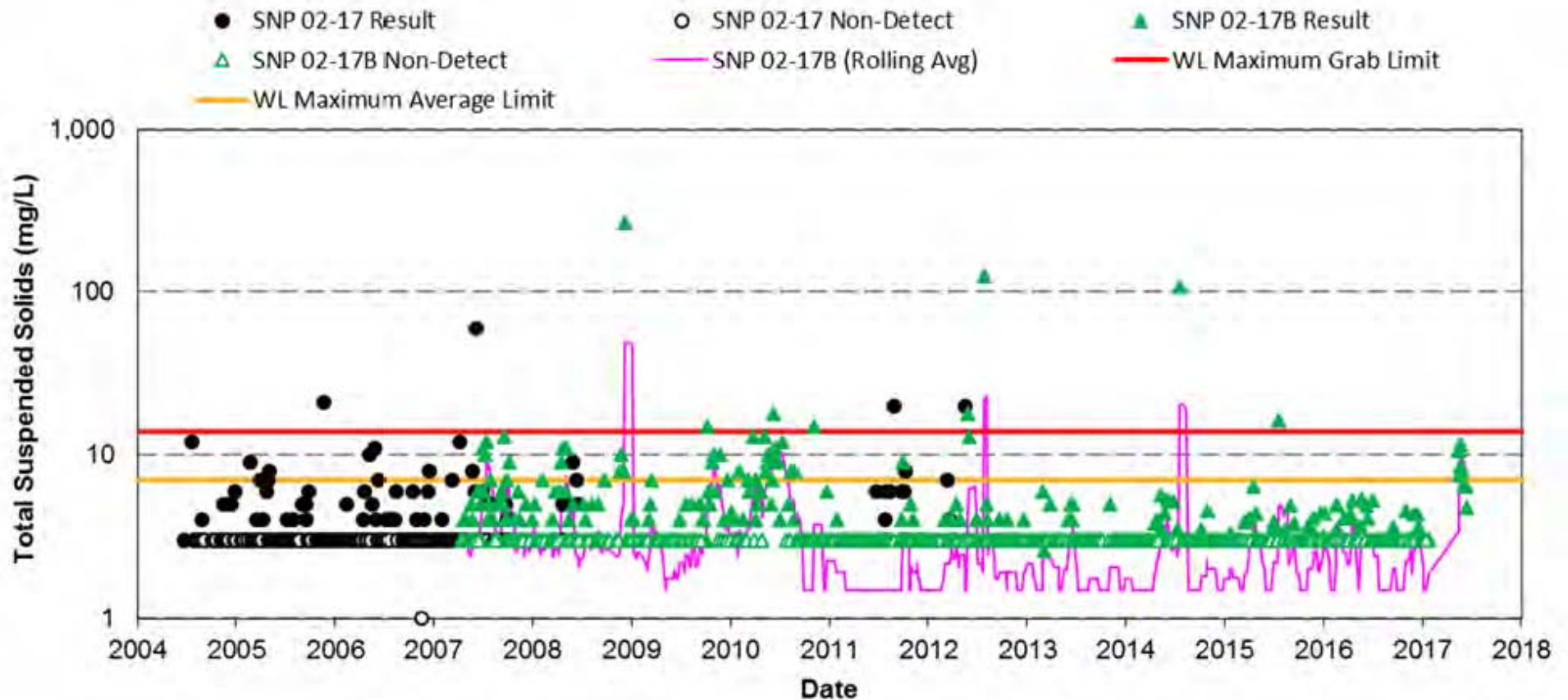
Treated Effluent Predictions and Discharge Rate to Snap Lake, 2004 to 2017



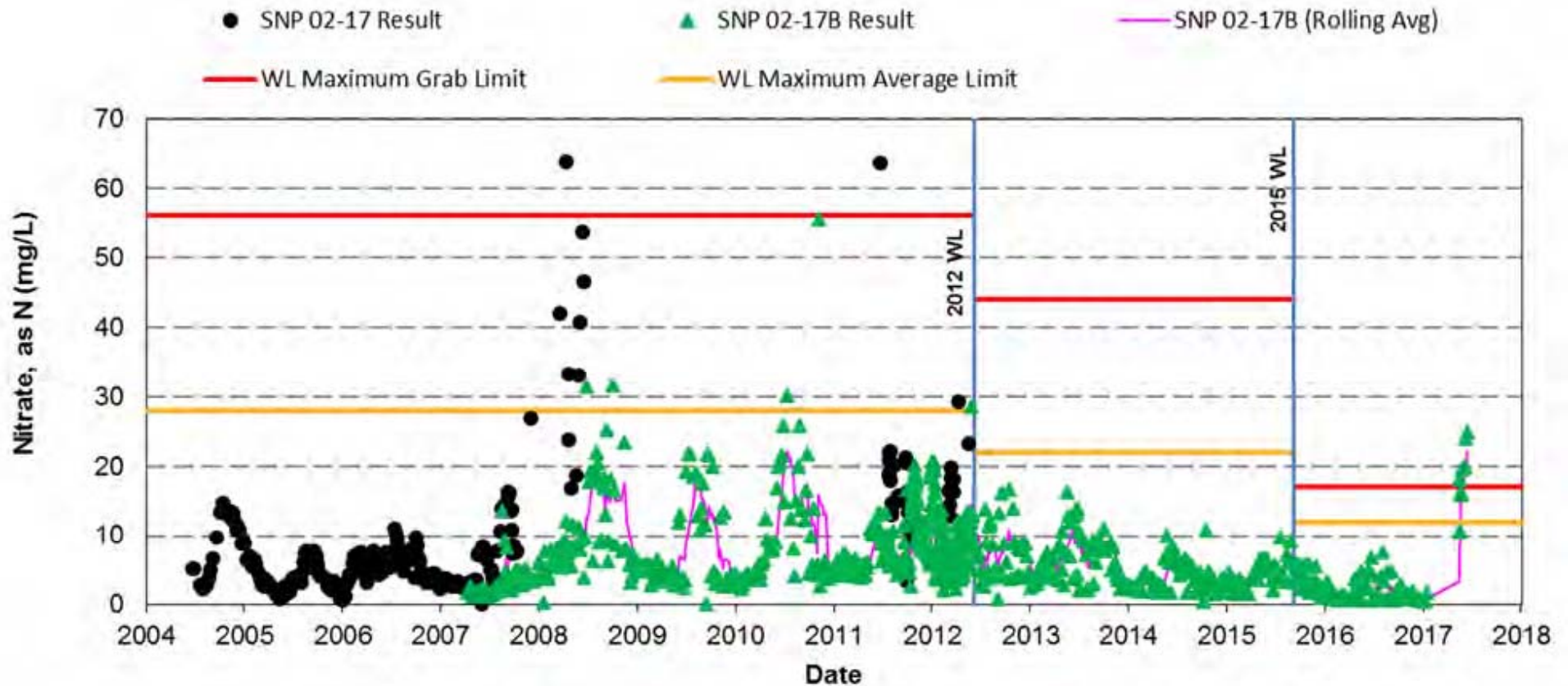
Total Dissolved Solids in Treated Effluent, 2004-2017



Total Suspended Solids in Treated Effluent, 2004-2017



Nitrate in Treated Effluent, 2004-2017



Answer to Key Question 1: Are Concentrations or Loads of Key Water Quality Parameters in Discharges to Snap Lake Below Water Licence Limits and Consistent with Predictions?

- Concentrations and loadings of key water quality parameters in discharges to Snap Lake were below Water Licence limits, with the exception of concentrations of TSS and nitrate (during the May and June 2017 Emergency Discharge of Mine Water Authorization period)
- The exceedances of Water Licence Limits in the treated effluent for TSS and nitrate were not expected to cause impacts to aquatic life because measured concentrations in Snap Lake were either below detection (for TSS) or below the AEMP benchmark (for nitrate)



Comments from the Environmental Analyst (II)

- Except for the concentrations of TSS and nitrate above the water licence limits during the May and June 2017 Emergency Discharge of Mine Water Authorization period, no concerns are raised

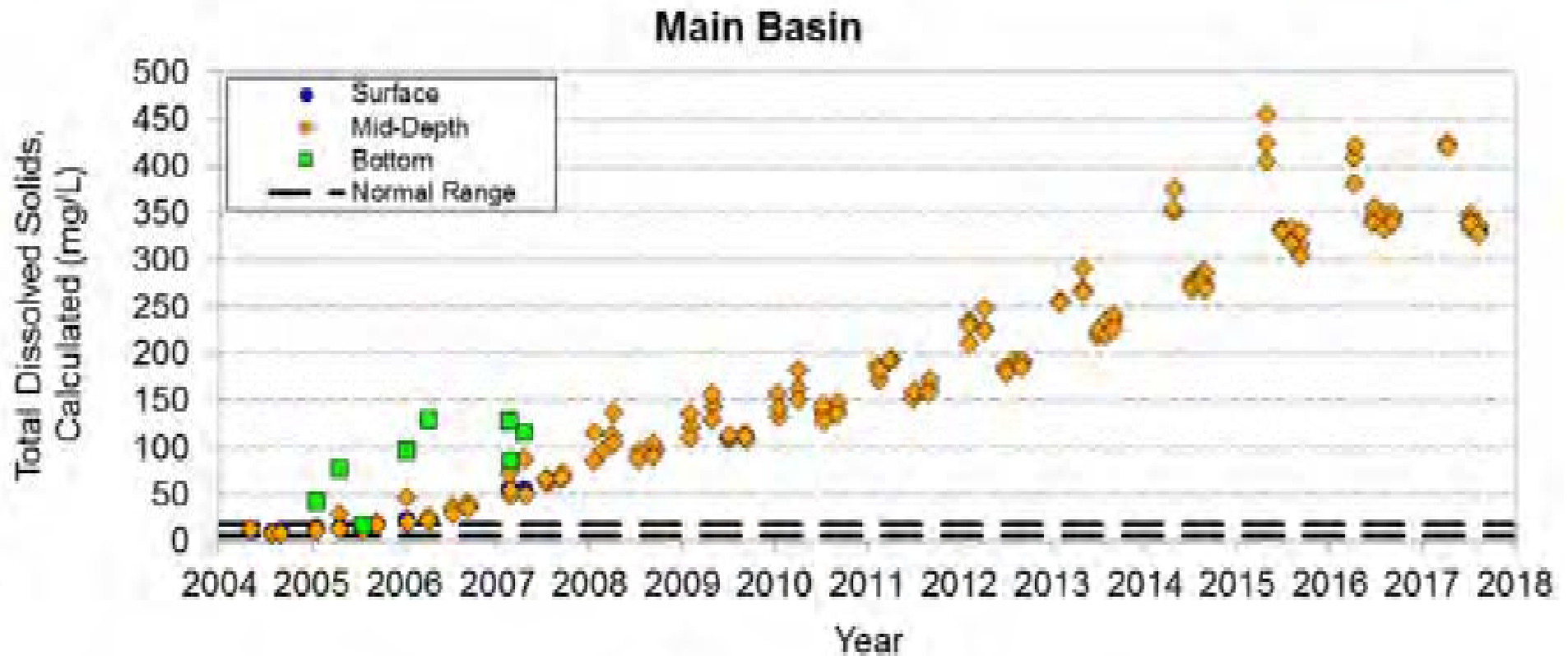


Answer to Key Question 2: Are Concentrations of Key Water Quality Parameters in Snap Lake below AEMP Benchmarks?

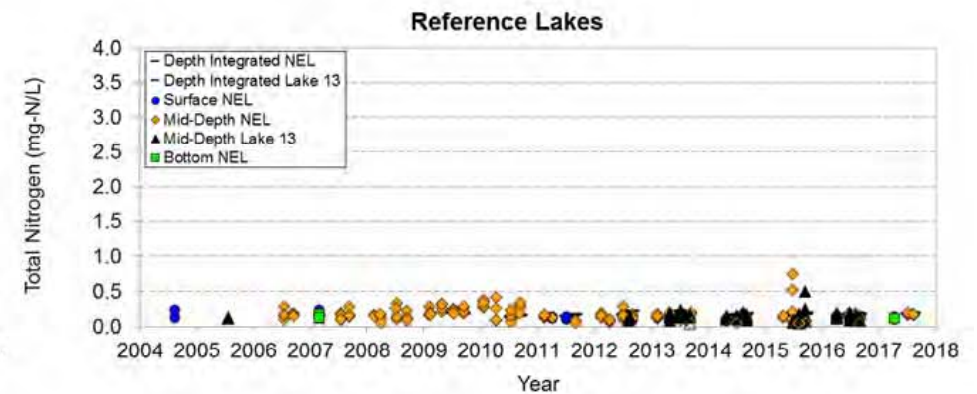
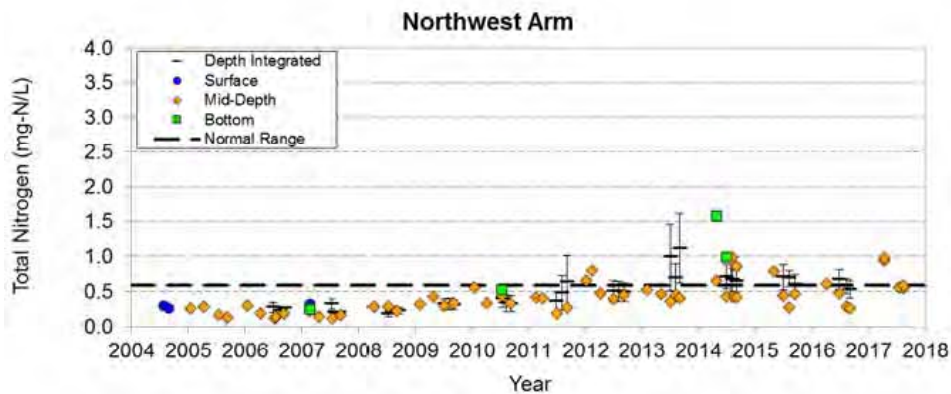
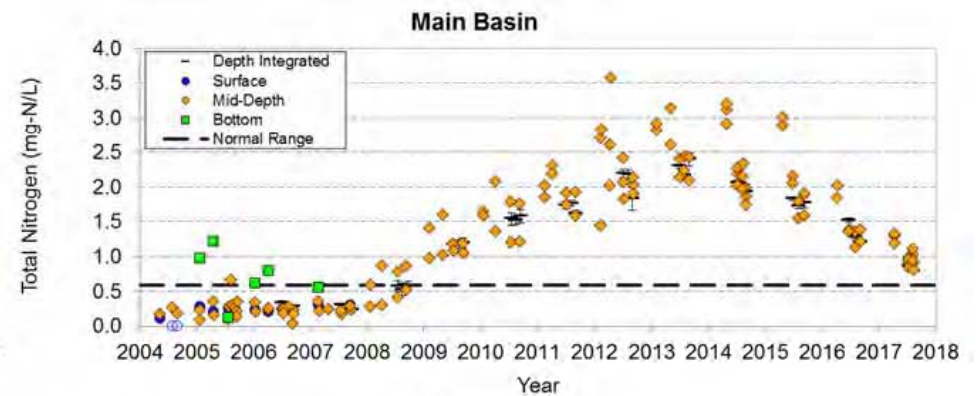
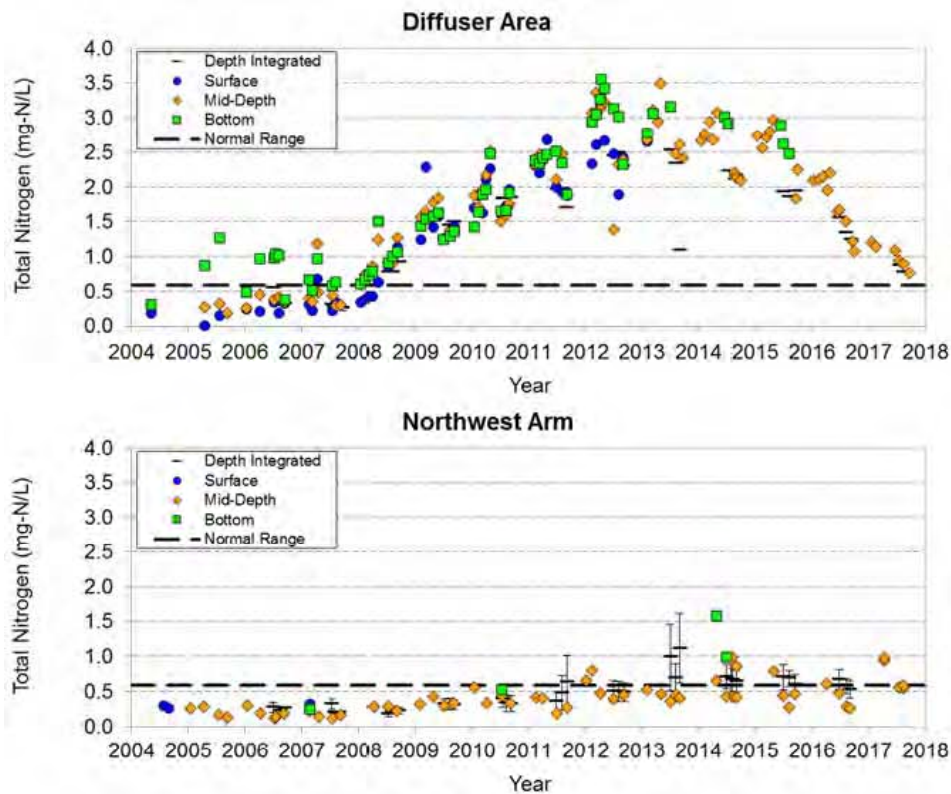
- The 2017 water quality from Snap Lake met AEMP benchmarks with the exception of DO
- Lower DO concentrations near the bottom of stations in Northeast Lake and in the northwest arm, and at SNP 02-20e, are likely due to natural processes in or near the sediment boundary that consume oxygen (e.g., microbial decomposition of organic matter in the sediments)



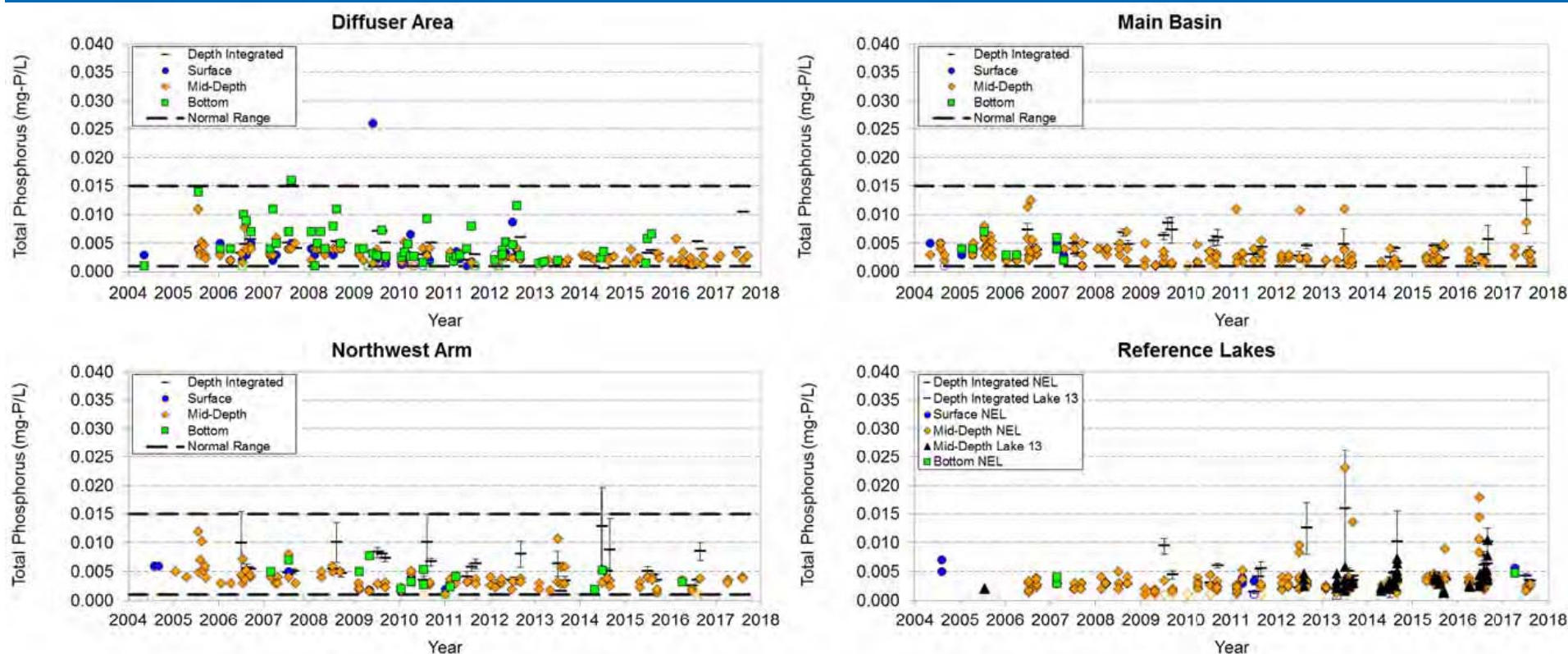
Total Dissolved Solids Concentrations in Snap Lake, 2004 to 2017



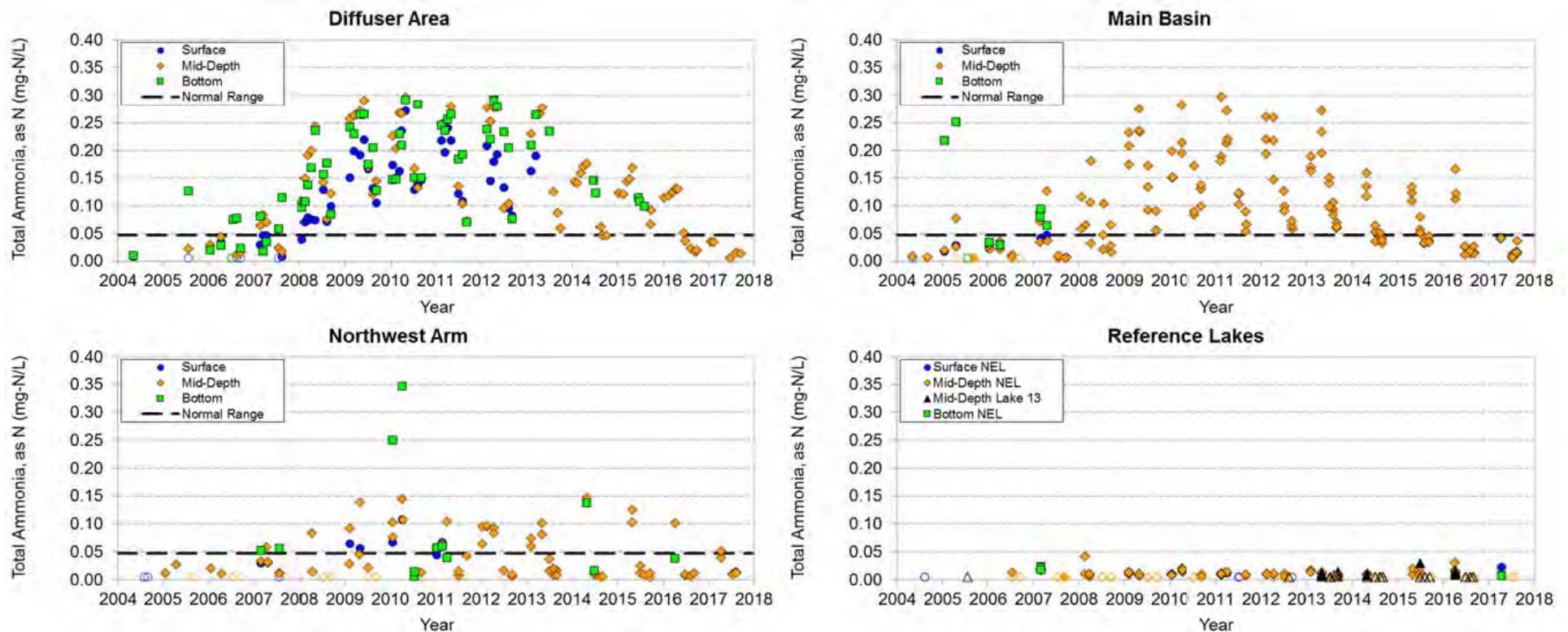
Total Nitrogen Concentrations in Snap Lake and the Reference Lakes, 2004 to 2017



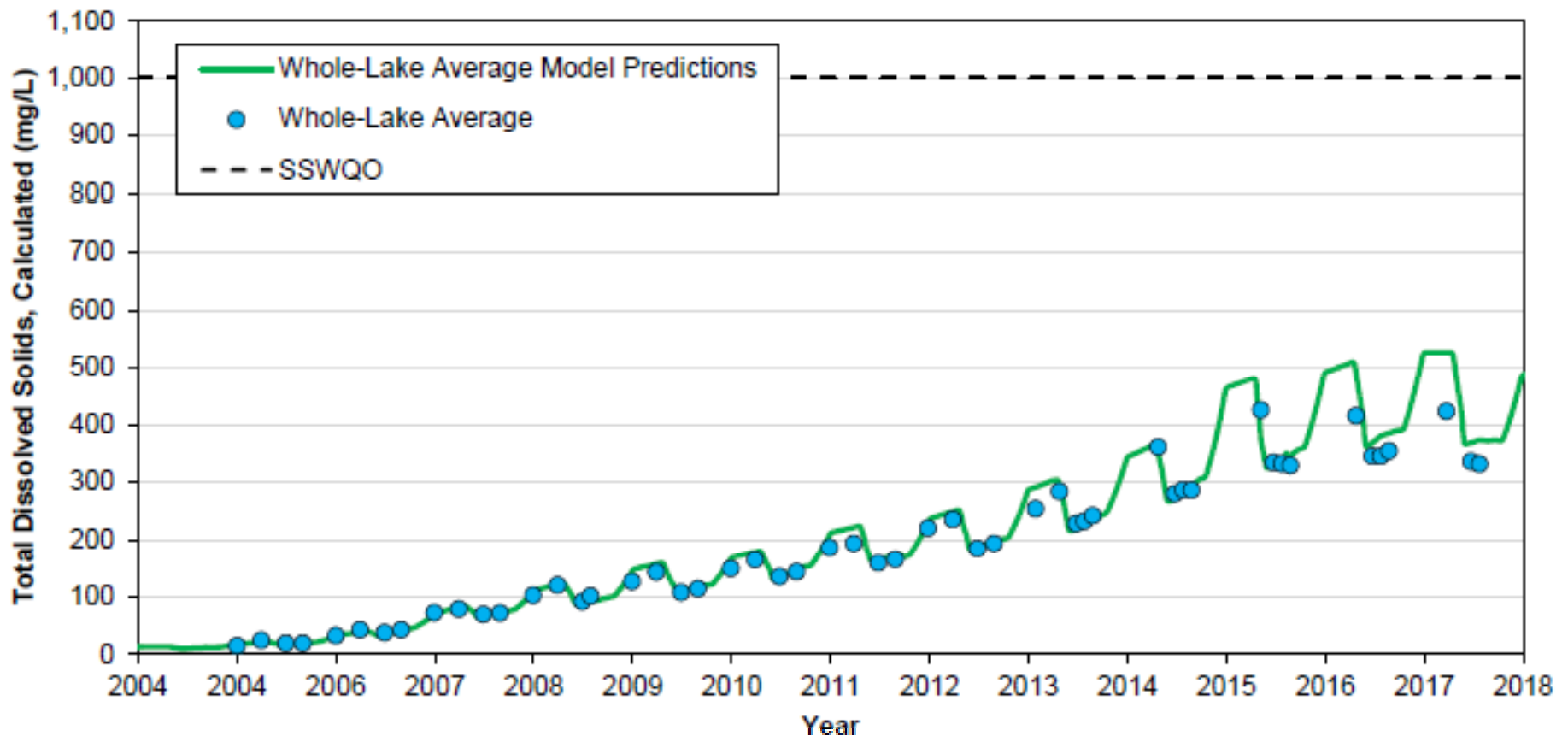
Total Phosphorus Concentrations in Snap Lake and the Reference Lakes, 2004 to 2017



Total Ammonia Concentrations in Snap Lake and the Reference Lakes, 2004 to 2017



Measured and Predicted Whole-Lake Average Total Dissolved Solids Concentrations in Snap Lake



Answer to Key Question 3: Which Water Quality Parameters Are Increasing Over Time in Snap Lake, and How Do Concentrations of these Parameters Compare to AEMP Benchmarks, Concentrations in Reference Lakes, and Predictions?

- Concentrations of total dissolved solids (dissolved salts in the water), nutrients (specifically nitrogen related primarily to explosives), and some metals have increased from baseline concentrations in Snap Lake due to the discharge of treated effluent. However, in 2017 concentrations of most water quality parameters related to the Mine's treated effluent decreased in Snap Lake relative to 2016
- In 2017, water quality concentrations in and downstream of Snap Lake were within AEMP benchmarks or historical ranges

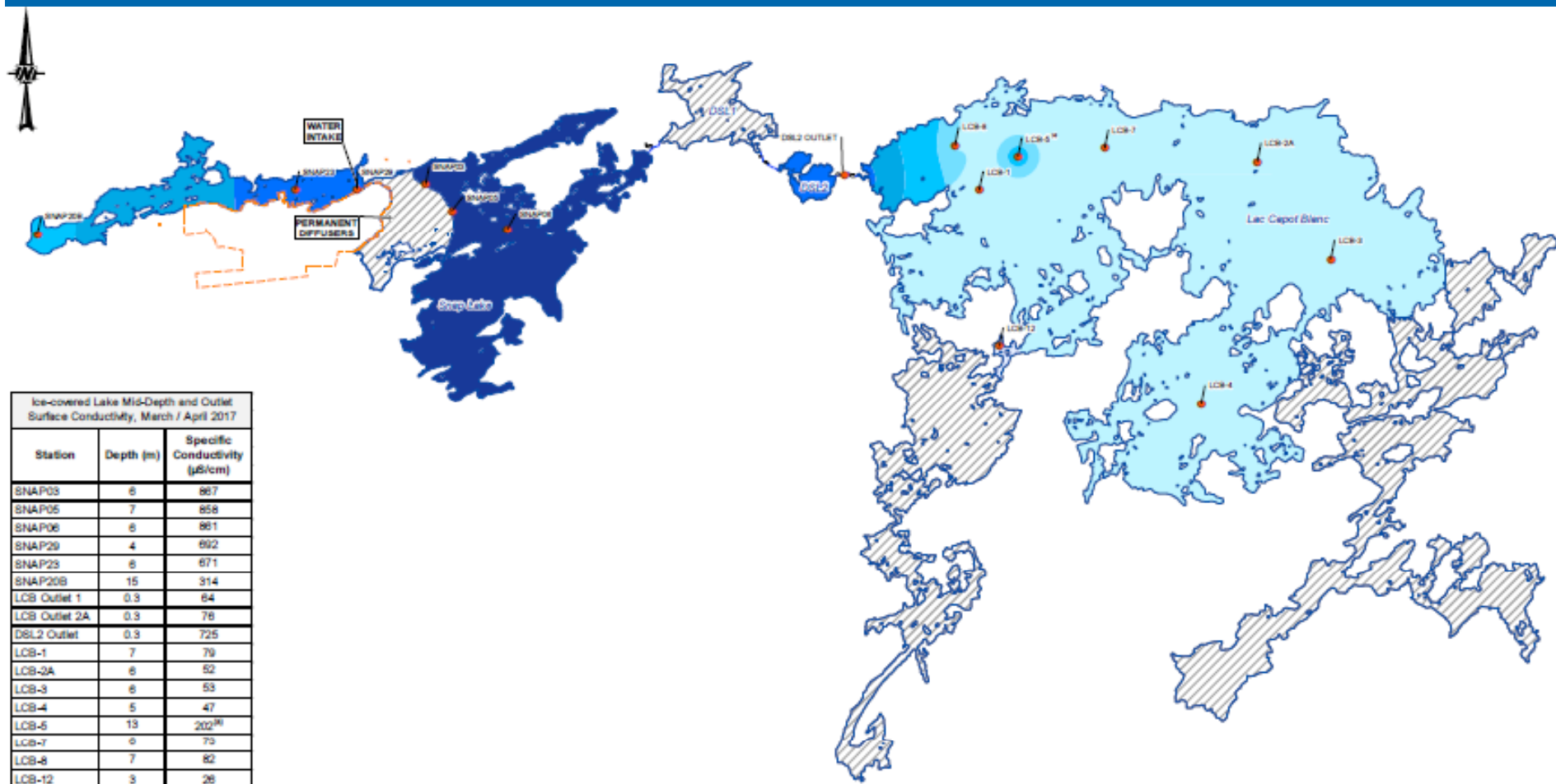


Comments from the Environmental Analyst (III)

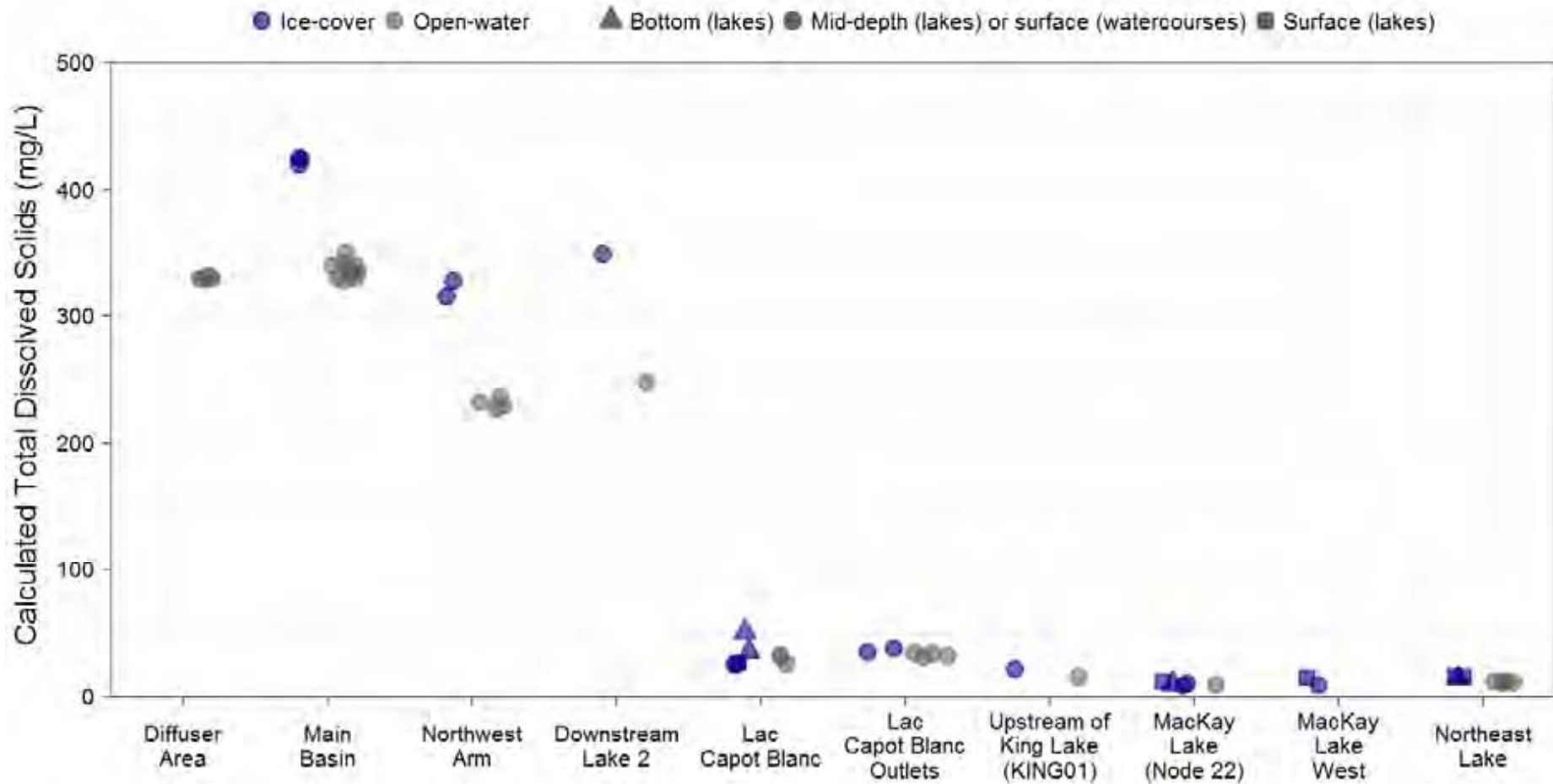
- After two years of care and maintenance, TDS levels in Snap Lake just pass the turning point, and it is expected that TDS levels in Snap Lake will be going down further in future years
- No concerns are raised



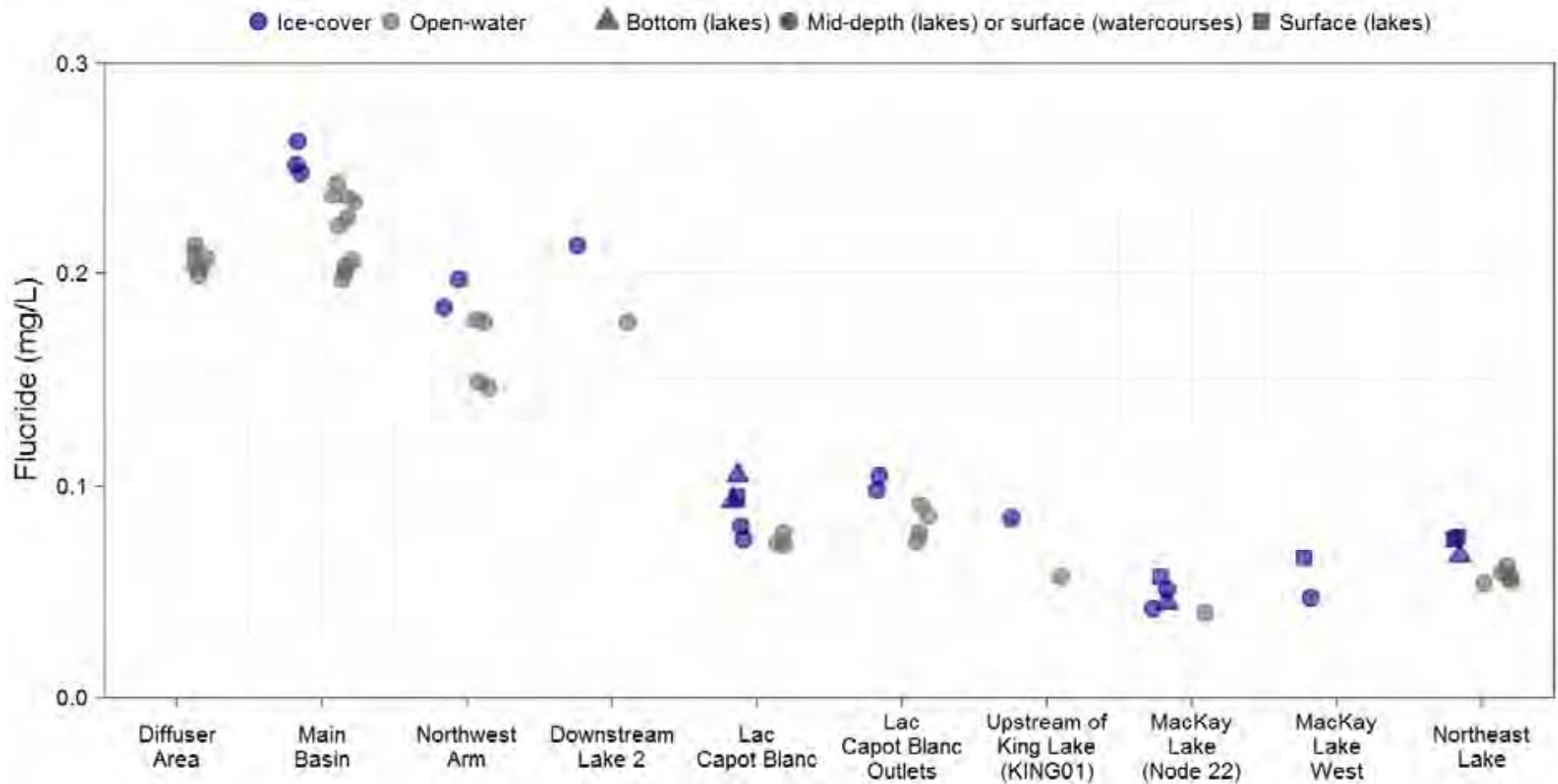
Ice-covered Lake Mid-Depth and Outlet Surface Conductivity, March / April 2017



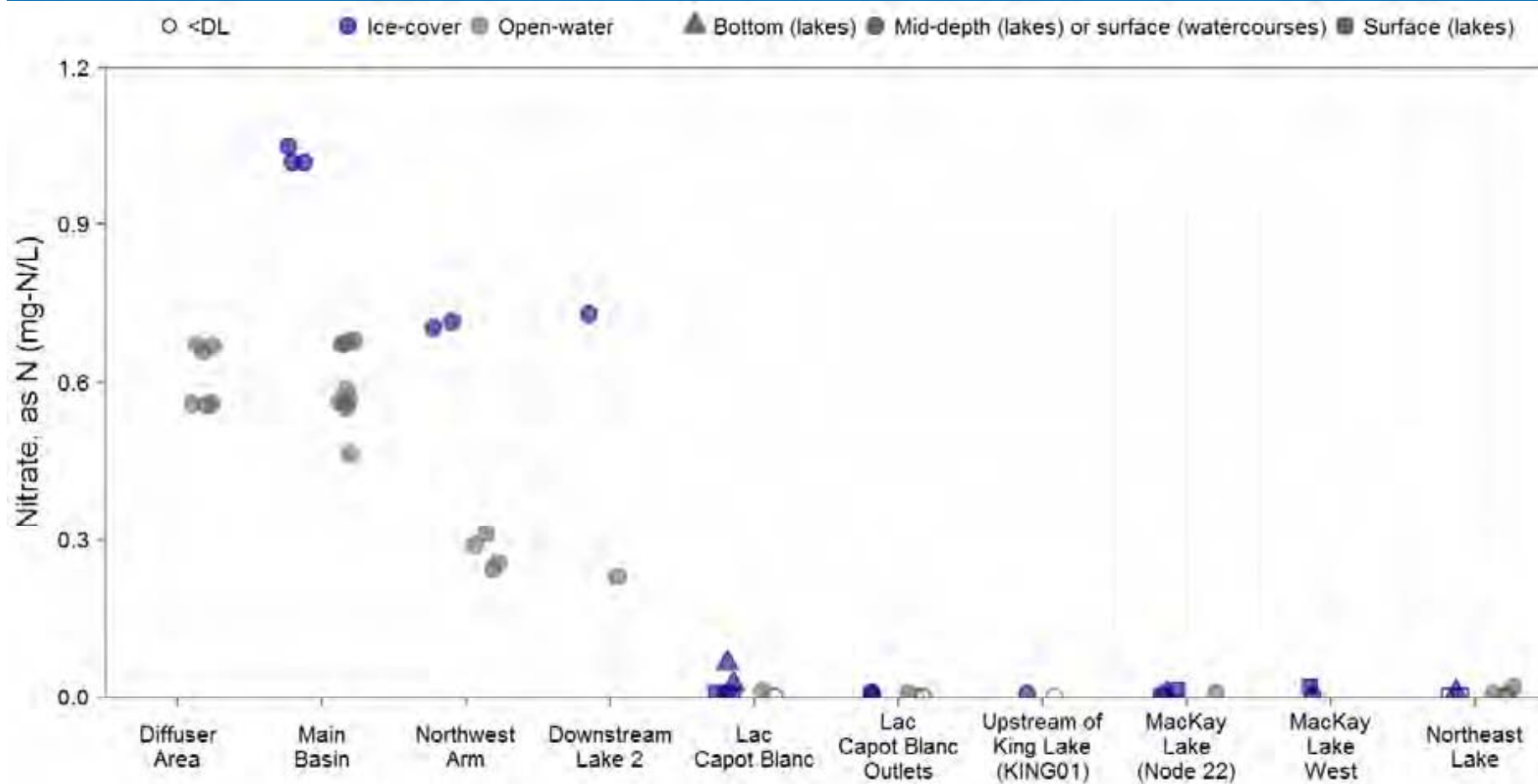
Calculated Total Dissolved Solids Concentrations in Snap Lake, Downstream of Snap Lake, and Northeast Lake, 2017



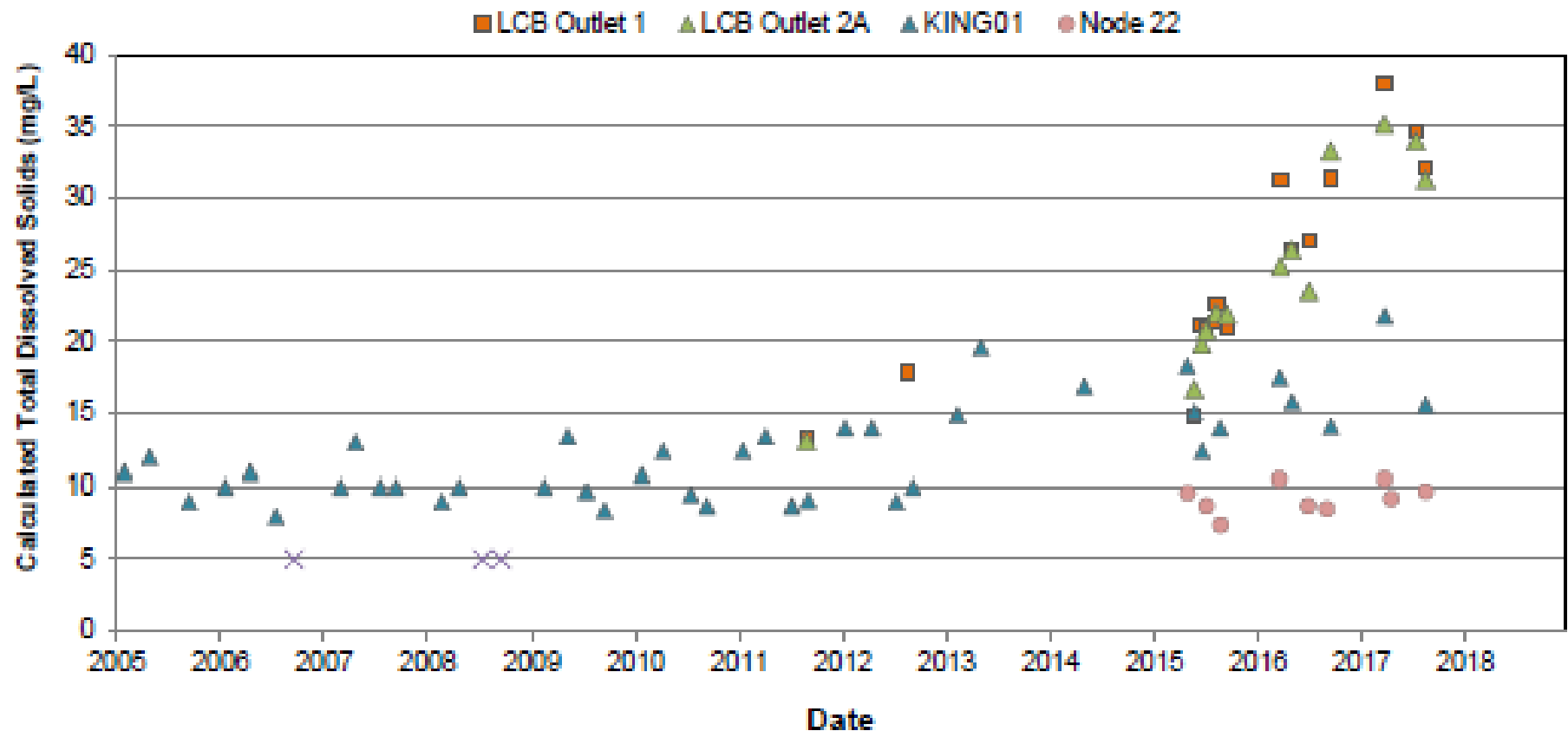
Fluoride Concentrations in Snap Lake, Downstream of Snap Lake, and Northeast Lake, 2017



Nitrate Concentrations in Snap Lake, Downstream of Snap Lake, and Northeast Lake, 2017



Concentrations of Total Dissolved Solids at Lac Capot Blanc Outlets, the Downstream Station (KING01), and Node 22, 2005 to 2016



Answer to Key Question 4: Are Spatial and Seasonal Patterns in Water Quality in Snap Lake and Downstream Waterbodies Consistent with Predictions? (I)

- Snap Lake spatial and seasonal water quality patterns in 2017 were consistent with predictions. Concentrations of many Mine-related parameters were higher in the main basin of Snap Lake relative to the northwest arm and Northeast Lake, and higher during late ice-covered conditions relative to open-water conditions



Answer to Key Question 4: Are Spatial and Seasonal Patterns in Water Quality in Snap Lake and Downstream Waterbodies Consistent with Predictions? (II)

- The water downstream of Snap Lake varied from slightly acidic to slightly alkaline and well-oxygenated. Field pH concentrations were within the optimal range for aquatic life. Major ions, TDS, nitrogen parameters and effluent related parameters concentrations were higher at stations closer to Snap Lake (i.e., DSL2 Outlet and LCB) compared to locations further away (i.e., KING01 and Node 22). All parameters measured downstream of Snap Lake were below AEMP benchmarks



Comments from the Environmental Analyst (IV)

- TDS levels in downstream waterbodies appear to be slightly up, the further away from Snap Lake, the less up
- There is a lag-effect of Snap Lake Mine to downstream waterbodies
- No concerns are raised



Answer to Key Question 6: Is Water from Snap Lake Safe to Drink?

- Snap Lake water is safe for humans to drink, pending disinfection that is expected for all Canadian surface waters used for drinking water. Snap Lake water is also safe for wildlife to drink
- Concentrations of water quality parameters in Snap Lake and at the water intake were below drinking WQGs and wildlife health guidelines, with the exception of field pH, temperature and total coliforms
 - They were not considered to be a health concern or expected to affect palatability of the treated drinking water
- Drinking water at the Mine is filtered and chlorinated before consumption; thus, drinking water at the Snap Lake camp was acceptable from a microbiological perspective.



Sediment Quality

- The full AEMP sediment quality monitoring program for Snap Lake and the reference lakes is conducted every three years, last occurred during 2015, and will occur next in 2018. However, sediment quality monitoring occurs annually at the Snap Lake diffuser station at two sediment depths, to determine whether there are differences in more recently deposited sediments over time
- Concentrations of measured parameters in sediments near the diffuser were not at levels indicating likely toxicity, although the concentrations of some metals had been enhanced compared to natural concentration



Toxicity

- The laboratory toxicity tests were performed by exposing algae, water fleas, and fish to treated effluent and lake water samples collected from the edge of the mixing zone. The treated effluent samples were not toxic to Rainbow Trout, algae, or water fleas. The lake water samples were not toxic to water fleas or to sensitive Fathead Minnow or Rainbow Trout early life stages



Plankton

- Changes are occurring in the plankton community of Snap Lake. However, these changes have not adversely affected the function of this community as a key part of the food chain for fish
 - The number of small plants (i.e., the phytoplankton) in the main basin of Snap Lake in 2017 was greater than baseline values, the 2009 peak (previously the highest observed biomass in the main basin) and the normal range of natural variability
 - The number of small animals (i.e., the zooplankton) has fluctuated over time in Snap Lake and Northeast Lake



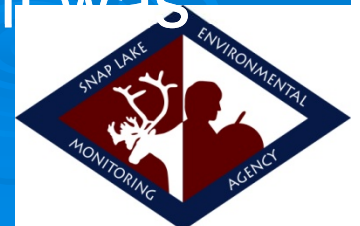
Weight of Evidence Integration (I)

- The weight of evidence integration process combined laboratory determinations of nutrients and substances that can cause toxic effects with measurements of the status of plankton communities in Snap Lake to estimate the strength of evidence for nutrient enrichment and toxicological impairment



Weight of Evidence Integration (II)

- For 2017, there was a link between nutrient concentrations in Snap Lake as a result of Mine activities, stimulation of phytoplankton (small plants in the water) growth (increase in biomass), and a resulting moderate-level shift in both the phytoplankton and zooplankton (small animals in the water) communities
- There was negligible evidence of toxicological impairment of the plankton community
- The AEMP findings for 2017 showed that it was more likely enrichment than toxicological impairment occurring in Snap Lake



Report Conclusions

- The functionality of the aquatic communities in Snap Lake has not been adversely affected by the Mine
- The fish in the lake have sufficient food to eat, and the water is safe to drink (with chlorination)



Comments from the Environmental Analyst (V)

- The report is well presented
- No concerns are raised



7.2 Tech Memo on Instrumentation and water level monitoring frequencies for the North Pile & Water Management Pond Dam

- De Beers has been planning for zero occupancy during the winter at Snap Lake Mine between approximately the beginning of September and the beginning of April
- The Engineer of Record, Jeffrey Kwok of Golder Associates Ltd. provided the Tech Memo for inspection and monitoring on June 11, 2018



Recommendations for Inspection and Monitoring during Zero Occupancy from the Engineer (I)

- Add thermistor and vibrating wire piezometers at the East Cell to the existing automated system before demobilizing from the site and prior to zero occupancy on site
- Carry out monthly visual inspections of the facilities and monitor the perimeter sumps and WMP water levels during the times of zero occupancy. Visual observations can be done on site, remotely, by drone or aerial flyover observations, or near real-time land-satellite imagery



Recommendations for Inspection and Monitoring during Zero Occupancy from the Engineer (II)

- Provide documentation of photographs and observations of the North Pile and WMP, and water level observations in the sumps and WMP with respect to their threshold values (e.g., 1/3 of sump operating water level) to De Beers key team members and the Engineer of Record
- Prepare access to each sump and the WMP during winter conditions that will be required to facilitate on-site inspection. De Beers should plan for snow clearance for inspections carried out in person



Recommendations for Inspection and Monitoring during Zero Occupancy from the Engineer (III)

- Continue to prepare the sumps to a practical minimum water or ice level prior to freshet to allow water management during the freshet
- Set up a contingency plan to allow de-icing or pumping to lower the sump or pond water levels if required based on the inspection or prepare to be on site earlier for snow removal and de-icing from the sump, if required



Recommendations for Inspection and Monitoring during Zero Occupancy from the Engineer (IV)

- Continue to pump the water level to practical minimum for each perimeter sump and decrease the WMP water level as much as practicable before demobilizing from the site
- Continue to monitor the instrumentation with respect to the response framework and to the frequency outlined in the Tech Memo



Comments from the Environmental Analyst (I)

- It is recommended in the Tech Memo that, for the monthly visual inspection during zero occupancy, visual observations can be done on site, remotely, by drone or aerial flyover observations, or near real-time land-satellite imagery
 - Further information is required for the remote approach



Comments from the Environmental Analyst (II)

- There is a paragraph in the MVLWB's decision letter (June 20, 2018) stating that
 - *“As was outlined in the Boards February 22, 2018 Decision Letter to De Beers, the Board requires De Beers to submit details about new remote monitoring systems at least 60 days prior to their implementation to replace a physical presence at Snap Lake, for approval, including, at a minimum, information on the new technology proposed, data and results of field trials, relevant studies, and rationale for the proposed program.”*



Comments from the Environmental Analyst (III)

- No concerns are raised except for the remote approach of monthly visual inspections
 - Further review will be conducted when De Beers submits details on remote monitoring systems as required by the MVLWB

