

DATE December 03, 2014**PROJECT No.** 14-1349-0004/ 3300/ 3340**TO** Alexandra Hood, Environment and Permitting Superintendent, Snap Lake Mine
De Beers Canada Inc.**CC** Lasha Young**FROM** Mackenzie Cator, Chris Madland**EMAIL** Mackenzie_Cator@golder.com;
Chris_Madland@golder.com**SNAP LAKE AIR QUALITY ACTION LEVEL III EXCEEDANCE EXTERNAL REVIEW AND ACTION PLAN**

De Beers Canada Inc. (De Beers) completed an air quality monitoring program in 2013 at the Snap Lake Mine (Mine) and reported the results in the 2013 Annual Snap Lake Air Quality and Emissions Report (De Beers 2014). A number of pre-defined, highly conservative Action Levels defined in the De Beers Snap Lake Air Quality and Emissions Monitoring and Management Plan (AQEMMP) (De Beers 2008) were exceeded in 2013. Action Levels are part of a proactive management system described in the AQEMMP. Action Levels are triggered on the basis of the 2007 Air Modelling Update predictions (De Beers 2007), applicable ambient air quality criteria, and percent change (year-to-year) of measured concentrations. The Action Levels system assists in recognizing potential issues so that they can be resolved before Ambient Air Quality Standards (AAQS) are reached.

This document provides the plan to address the exceedances, including an evaluation of the data and further suggested actions.

1.0 EVALUATION

An external review of the air quality monitoring data from 2013 was conducted. It included a review of the data quality and a review of data over time.

Data Quality Review

The air quality data collected in 2013 were carefully reviewed during the development of the De Beers Snap Lake Mine Air Quality Meteorological Monitoring and Emissions 2013 Annual Report (De Beers 2014) (Annual Report) and were reviewed again in the context of preparing this technical memorandum. Golder expects some degree of natural variability in observed concentrations over the course of a given year and from year-to-year. The AQEMMP Action Levels help to discern when either absolute or relative changes in observed concentrations year-to-year may be attributable to De Beers' activities. The expected variability in the data includes not only observed natural variability, but variability inherent in the measurement and data analysis techniques that could foreseeably lead to concentrations varying by a few micrograms per cubic metre. There do not appear to have been meaningful changes in the operation or monitoring at the Snap Lake Mine in 2013 that differentiate it from previous years, and a trend in the data is not apparent.



Review of 2013 Data

As identified in the Annual Report, four Action Levels were triggered in 2013: sulphur dioxide (SO₂); nitrogen dioxide (NO₂); particulate matter (PM)₁₀; and, PM_{2.5} (Table 1). In each case, the observed percent increase exceeded the allowable year-to-year percent increase defined in the AQEMMP. Monitoring was undertaken; however, Northwest Territories (NWT) AAQS were not exceeded for any of the compounds.

Table 1: Snap Lake Triggers to Air Quality and Emissions Monitoring and Management Plan Level III Air Quality Action Levels in 2013

Compound	2012 Average Annual Concentration [$\mu\text{g}/\text{m}^3$]	2013 Average Annual Concentration [$\mu\text{g}/\text{m}^3$]	% Change			Territorial Guidelines			Action Level Triggered
			% Year-to-Year Change	Level III Action Level Year-to-Year % Change	Exceedance of Acceptable % Year-to-Year Change	NWT Annual AAQS ^(a) [$\mu\text{g}/\text{m}^3$]	NWT 24-hr AAQS ^(a) [$\mu\text{g}/\text{m}^3$]	Exceedance of NWT AAQS	
Sulphur Dioxide, SO ₂	0.3	0.5	+67	+20	Yes	30	—	No	III
Nitrogen Dioxide, NO ₂	2.0	2.3	+15	+10	Yes	60	—	No	III
Particulate Matter $\leq 10\mu\text{m}$, PM ₁₀	2.3	6.8	+195	+20	Yes	—	50 ^(b)	No	III
Particulate Matter $\leq 2.5\mu\text{m}$ PM _{2.5}	0.9	4.5	+400	+20	Yes	—	30	No	III

^(a) Northwest Territories Ambient Air Quality Standards (GNWT 2011).

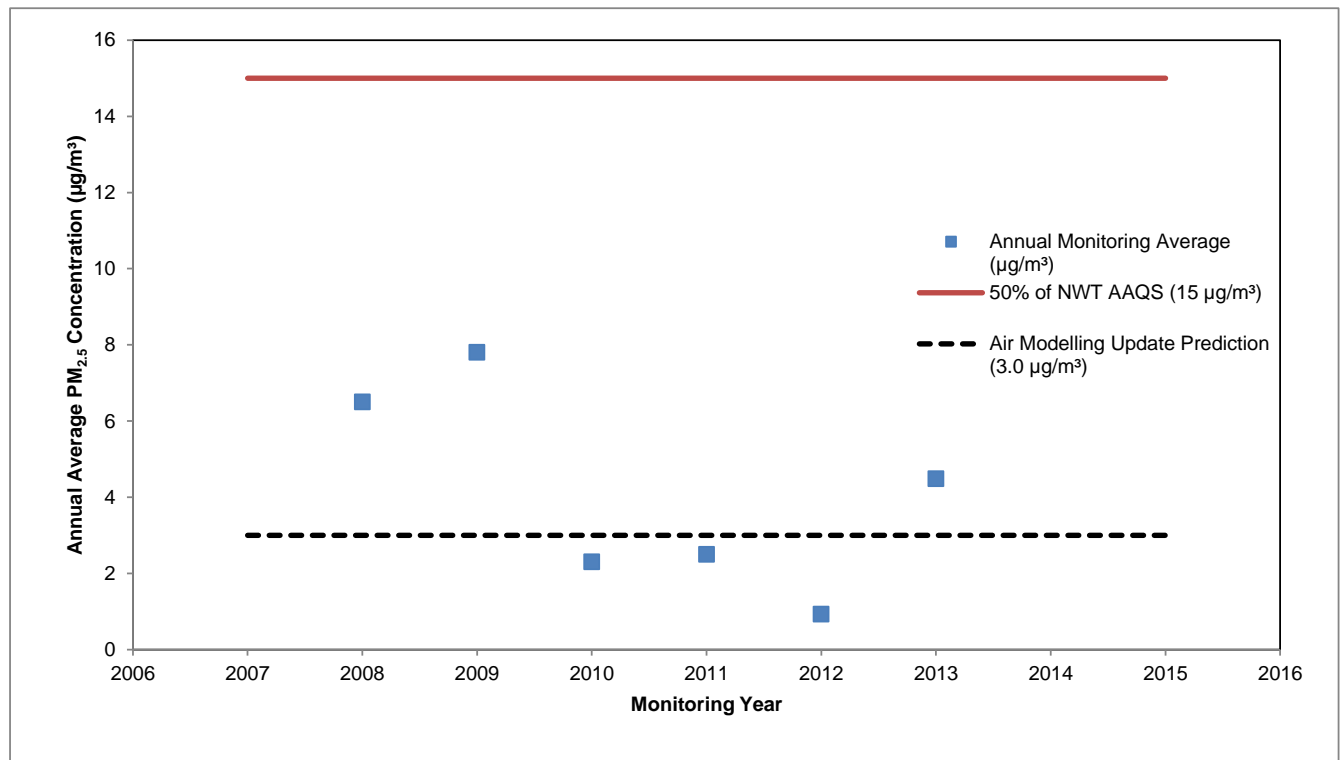
^(b) Objective of British Columbia (Government of British Columbia 2014).

— = not applicable; $\mu\text{g}/\text{m}^3$ = micrograms per cubic metre; % = percent; AAQS = Ambient Air Quality Standards; NWT = Northwest Territories; \leq = less than or equal to; + = plus; PM = particulate matter.

While the percent change is high, there is no trend and the actual measured values are well below the NWT AAQS, are not considered significant or of concern.

The percent changes observed range from 15 percent (%) to 400%, but the observed concentrations remain low relative to each of the respective guidelines (AAQS) (Table 1). The concentrations for each compound remained well below the applicable NWT AAQS in 2013. As well, there is little overall change in concentrations since monitoring began and in some cases, such as $PM_{2.5}$, lower concentrations were observed in 2013 than data collected in 2007 (Figure 1; De Beers 2014).

Figure 1 Action Levels for Annual Ambient $PM_{2.5}$ Concentrations, 2013



$\mu\text{g}/\text{m}^3$ = micrograms per cubic metre; $PM_{2.5}$ = particulate matter nominally less than or equal to 2.5 microns (μm) aerodynamic diameter; NWT AAQS = Northwest Territories Ambient Air Quality Standard.

2.0 ACTION PLAN

Action Level III as described in Section 4 of the AQEMMP requires the development of an Action Plan once triggered. Given that the differences in concentrations year-to-year that triggered the Action Levels III response in 2013 were minor and that ambient concentrations never reached 15% of the respective AAQS, no additional emissions mitigation measures beyond the existing air quality management protocols are recommended in response to the observed changes in 2013.

One action that will continue to be taken is to conduct a temporal review in the 2014 report to verify that there is no pattern of increase that is not obvious in the year-to-year comparisons. A second action will be to a review of the Action Level criteria. An unintended consequence of using a percent change criteria alone, independent of concentration, is that an Action Plan can be required for minor fluctuations in concentrations that are well below

the AAQS. A modification should be made to the AQEMMP to set an appropriate level of sensitivity in the Action Level criteria. Several years of monitoring indicate a consistently low measured concentrations and it is therefore recommended that the definition of Action Level Criteria in Section 4 of the AQEMMP be modified per it's "living document" status to read as follows for SO₂, total suspended particulate (TSP, PM₁₀, and PM_{2.5}):

- Action Level I – annual aggregate concentrations are above the 2007 Air Modelling update but remain below 50% of the applicable ambient air quality criteria;
- Action Level II – annual aggregate concentrations are above the 2007 Air Modelling update but remain below 75% of the applicable ambient air quality criteria; and,
- Action Level III – annual aggregate concentrations within 25% of the applicable ambient air quality criteria.

It is recommended that the definitions of Action Level threshold criteria in Section 4 of the AQEMMP be changed to read as follows for NO₂:

- Action Level I – annual aggregate concentrations are at or below 75% of the applicable ambient air quality criteria;
- Action Level II – annual aggregate concentrations are between 75% and 90% of the applicable ambient air quality criteria;
- Action Level III – annual aggregate concentrations are within 10% of the applicable ambient air quality criteria.

These changes will require action when the criteria are reached. With these changes, the Action Levels should only trigger when meaningful changes to air quality emissions are observed and there is potential for AAQS exceedance at the Mine.

3.0 CONCLUSION

The intent of Action Levels is to be 'early-warning' so potential issues can be resolved before AAQS are reached. However, the Action Levels initially developed in 2008 were too sensitive and overly conservative, in that they did not consider how large percent changes in air quality measurements could independently trigger a Response Plan despite the observed concentrations being very low and not indicative of meaningful changes to air quality. Therefore, it is recommended that the Action Level wording in the AQEMMP be revised to capture the appropriate level of change as suggested in this technical memorandum.

4.0 CLOSURE

We trust that this technical memorandum meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

GOLDER ASSOCIATES LTD.

Prepared By



Mackenzie Cator, B.Sc. Eng.
Air Quality Specialist, EIT



Chris Madland, B. Sc.
Associate, Senior Air Quality Scientist

Reviewed By:



Lasha Young, MSc.F., PMP
Project Manager

MC/CM/LY

5.0 REFERENCES

- De Beers (De Beers Canada Inc.). 2007. Snap Lake Diamond Project: Air Dispersion Modelling Update. Yellowknife, NWT, Canada.
- De Beers. 2008. Snap Lake Diamond Project: Air Quality and Emissions Management and Monitoring Plan. Yellowknife, NWT, Canada.
- De Beers. 2014. Air Quality, Meteorological Monitoring and Emissions Reporting 2013 Annual Report. Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.
- GNWT (Government of the Northwest Territories). 2011. Guideline for Ambient Air Quality Standards in the Northwest Territories. Yellowknife, NWT, Canada.
- Government of British Columbia. 2014. Air Quality Objectives and Standards. Available at: <http://www.bcairquality.ca/reports/pdfs/aqotable.pdf>. Accessed: August 27, 2014.