De Beers

Group of Companies

Gahcho Kué Mine

March 2018 Water Licence Amendment Applications (MV20015L2-0015 and MV2005C0032) Environment and Climate Change Canada

July 2018

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1 INTRODUCTION

De Beers Canada Inc. (De Beers) submitted a Water Licence (WL) and Land Use Permit (LUP) Amendment Application Package to the Mackenzie Valley Land and Water Board (MVLWB) for the Gahcho Kué Mine on March 15, 2018, to amend the existing WL (MV2005L2-0015) and LUP (MV2005C0032).

The WL and LUP amendments are required to accommodate necessary changes to the mine plan resulting from a geotechnical issue within the pits (i.e., joint sets) that will result in additional mine rock to be extracted from each of the three pits. It is not possible to mine the ore bodies safely without making these adjustments. The additional mine rock must be extracted in order to ensure the pits remain safe for workers and equipment throughout the life of mine. It is expected that up to 100 Mt of additional mine rock may be removed. This mine rock will be stored on the West Mine Rock Pile resulting in a small increase in the footprint of the project. Most of the increase in the size of the West Mine Rock Pile will be within the water management pond, an area already designated for disturbance. Adjustments to the mine schedule and water management will also be required.

Review comments on the Amendment Application and the associated documents were received on May 8, 2018, and De Beers provided responses to these review comments on May 21, 2018. Following this, as part of the MVLWB permitting and licencing process, De Beers participated in a Technical Session held in Yellowknife on May 30 and 31, 2018.

On June 27, 2018, Environment and Climate Change Canada (ECCC) submitted their final intervention (ECCC 2018) for the WL and LUP Amendments containing recommendations on the remaining topics of concern. The following provides responses to those recommendations outlined in the ECCC intervention, with the intent of resolving the remaining topics of concern prior to the Public Hearing scheduled for July 25 to 26, 2018.

2 RECOMMENDATIONS AND RESPONSES

2.1 Effluent Quality Criteria

2.1.1 ECCC Recommendation 4.1a

Evaluate water volumes to be transferred from the WMP to Area 7 based on monitoring data for water quality in the WMP and Area 7, and evaluate water volumes within Area 7 and 8, to confirm that EQC are achievable and SSWQOs will be maintained in Area 8.

2.1.2 Proponent Response

De Beers is in agreement with ECCC's recommendation; De Beers will use the Mine's existing processes for tracking water movement at site, monitoring water quality, and evaluating if EQC can be met.

In the event that water from the water management pond (WMP) is transferred to Area 7 as a contingency measure under the water management plan, preliminary work will be conducted to determine the volume of water that could be transferred from the WMP into Area 7 and still meet EQC for discharge. To make sure that the proposed contingency EQC would be met in Area 7 (i.e., the EQC listed in Table 2 of the response to Outstanding IR#1 submitted to the MVLWB on June 20, 2018), the water chemistry in the WMP, the water chemistry in Area 7, and the volume of water present in Area 7 at the time of transfer from the WMP would be used to determine the volume of water that could practically be transferred from the WMP. Pre-discharge monitoring at the SNP Station 04 in Area 7 and confirmation by the Inspector will verify water quality meets the contingency EQC outlined in the amended Water Licence. As already stipulated in the Water Licence, Inspector authorization will be required prior to discharge to the receiving environment.

2.1.3 ECCC Recommendation 4.1b

Report April sampling results for Area 8 with the SNP data in order to confirm water quality during the time when ice cover is at its maximum thickness.

2.1.4 Proponent Response

De Beers does not agree with this recommendation due to the constraints related to timing of the under-ice program and availability of the final analytical data report.

Under-ice sampling as part of the Aquatics Effects Monitoring Program (AEMP) occurs in late-April to mid-May; the actual timing for each year is dependent upon winter weather conditions and crew scheduling. The sampling requirements for the under-ice program are as per the AEMP Design Plan (De Beers 2015). The variability in timing of the under-ice sampling and the subsequent laboratory reporting (including follow-up to confirm laboratory results, which can further delay final reporting) provides some uncertainty in determining how and when these AEMP results would be reported under the SNP reporting framework

(the monthly reporting schedule of the SNP is a condition of the Water Licence). The stringency of the SNP reporting under the Water Licence makes providing the under-ice AEMP data for Area 8 potentially challenging to manage under the SNP. De Beers will, however, continue to report the under-ice water quality sampling results for Lake N11 as part of the AEMP annual report.

2.2 Cadmium Site-Specific Water Quality Objective

2.2.1 ECCC Recommendation 4.2

Use the CCME Protection of Aquatic Life guideline, rather than the Health Canada Drinking Water Guideline as the objective for cadmium in Lake N11 and Area 8.

2.2.2 Proponent Response

De Beers has agreed to use the CCME Protection of Aquatic Life guideline, rather than the Health Canada Drinking Water Guideline, as the site specific water quality objective (SSWQO) for cadmium in Lake N11 and Area 8.

De Beers acknowledges the discussion with the MVLWB technical advisor during the Technical Sessions for the Water Licence amendment describing the origin for the use of the Health Canada Drinking Water guideline for cadmium as the SSWQO for these lakes, and then reaching an outcome that the CCME guideline would be the appropriate SSWQO to use. The CCME Protection of Aquatic Life guideline was subsequently used as the SSWQO in De Beers' responses to IRs from the Technical Sessions. As a result of updating the cadmium SSWQO to the CCME guideline, cadmium does not screen in as a proposed EQC parameter in either lake (with the exception of the contingency EQC for Area 7 discharge following water transfer from the WMP).

2.3 Additional Discharge to Lake N11 in Year 5

2.3.1 ECCC Recommendation 4.3a

Validate predictions which have been used in developing the EQC once further operational data are available, prior to proceeding with a fifth year of discharge to Lake N11.

2.3.2 Proponent Response

De Beers will continue to monitor water quality in the WMP under the SNP and Lake N11 under the SNP and AEMP and will determine based on water quality monitoring data whether the EQC in the Water Licence can be met.

De Beers also reiterates that should EQC not be limited to Year 4 (2020 Calendar Year) but should be approved for the life of Mine; no discharge will occur in Year 5 (2021) or in any subsequent year if EQC are not met.

2.3.3 ECCC Recommendation 4.3b

Compare data from under-ice (i.e. worst-case) water quality monitoring in Lake N11 to modeled under-ice predictions to validate model accuracy and inform water management planning.

2.3.4 Proponent Response

The ECCC recommendation is already addressed through the AEMP.

As part of the AEMP analysis, annual data, which include the under-ice water quality data (collected between late-April and mid-May), are compared to SSWQO, modelled projections, and previous AEMP and operational monitoring data. The comparison to modelled projections is summarized in the responses to two of the six key questions for the surface water quality component of the AEMP (Section 5.1 of the AEMP):

- Are concentrations or loads of key water quality parameters in discharges to receiving waterbodies consistent with EIS predictions and below Water Licence limits (i.e., EQCs)?
- Are spatial and seasonal patterns in water quality in the core lakes consistent with the predictions made in the EIS?

For the 2018 AEMP, any reference to modelled projections as they relate to the two key questions above will be to projections represented by the water quality model update for the Water Licence amendment.

A more detailed comparison of AEMP data to modelled projections will be included as part of the Mine's first AEMP Re-evaluation report due to the MVLWB in 2019. Measured data in Lake N11 and Area 8 collected since the initiation of the AEMP will be compared to EIS projections, which have been updated as part of the Water Licence amendment application, consistent with the requirement in the Water Licence (Schedule 6, Part I, Item 2c).

2.3.5 ECCC Recommendation 4.3c

Calibrate and update modeling if real-world data differ appreciably from predictions.

2.3.6 Proponent Response

De Beers will continue to collect detailed operational water quality monitoring data, which can be used to validate water quality model predictions. If actual conditions are tracking such that there is expected to be an appreciable and consistent deviation from projected concentrations, a water quality model update would be completed.

2.4 Response Framework and Action Levels

2.4.1 ECCC Recommendation 4.4a

Review Action Levels in the AEMP taking into account the revised predictions for water quality and water management which have been provided for the water licence amendment application.

2.4.2 Proponent Response

Water quality action levels for the AEMP will be updated as part of the AEMP re-revaluation process, which is underway and planned for submission to the MVLWB for review in 2019. The 2019 AEMP Re-evaluation will account for the revised water quality model projections and the updated operational water management plan.

2.4.3 ECCC Recommendation 4.4b

Conduct periodic updates (audits) of the water quality modeling, with the model inputs calibrated with monitoring data, and revised predictions compared to the previous ones. Any differences should be evaluated and the results considered in reviews of the AEMP and Response Framework.

2.4.4 Proponent Response

De Beers is generally in agreement with ECCC's recommendation but would limit the model update to where operational monitoring data differ substantially (over an annual basis) from modelled projections. As per the response to ECCC Recommendation 4.3c, De Beers will update the water quality model, which will include updating model calibrations using available operational data in the event that operational water quality monitoring data in Lake N11 are appreciably and consistently tracking above modelled projections.

2.5 Canadian Ambient Air Quality Standards for NO_2 and $PM_{2.5}$

2.5.1 ECCC Recommendation 4.5

Consider how NO_2 and $PM_{2.5}$ emissions from the Project may affect ambient air quality as compared to the CAAQS for NO_2.

2.5.2 Proponent Response

An initial inquiry was made by ECCC on this matter earlier in permitting process and De Beers responded indicating that using the Canadian Ambient Air Quality Standards (CAAQS) as a valid basis for comparison to modelled concentrations of air quality compounds in a permitting scenario is inappropriate and inconsistent with the intent of the CAAQS. The CAAQS were intended to be used to protect population centres from poor air quality and the basis for comparison was to be against data produced from monitoring at

the National Air Pollution Surveillance certified stations. The Mine is not near a population centre and modelled data should not be expected to reasonably approximate monitored data. The modelling is designed to be conservative.

In response to ECCC's recommendation, modelled predictions for $PM_{2.5}$ and NO_2 from the water licence amendment application, including background concentrations, are provided at monitoring stations located along the northeast and southwest air quality transects adjacent to the Mine site, which are used in the existing air quality monitoring program. These monitoring stations allow for an evaluation of the predicted concentrations against the new CAAQS for $PM_{2.5}$ and NO_2 at varying distances from the Mine (Table 2.5-1). All monitoring station predictions along each transect are included for modelled $PM_{2.5}$ and NO_2 projections; however, it should be noted that neither $PM_{2.5}$ nor NO_2 are routinely measured at all monitoring stations in each transect (most monitoring stations only measure dustfall; some monitor NO_2). For the comparison of CAAQS to the modelled projections of $PM_{2.5}$ and NO_2, the $PM_{2.5}$ CAAQS set to be in effect in 2020 and the NO_2 CAAQS that will be in effect in 2025 have been selected for use in this response as they represent the most stringent standards available for comparison during the Mine's operational life.

The context of the comparison of modelled $PM_{2.5}$ and NO_2 data to the CAAQS is very important because the purpose of developing CAAQS, as indicated by ECCC in the development of the CAAQS, was to help to manage air quality at an air-zone level, primarily in areas where people live (e.g., cities), with the primary source of data for managing the airshed being the National Air Pollution Surveillance (NAPS) monitoring stations. De Beers respectfully suggests that comparing modelled predictions of air quality for a mine in a remote area to the CAAQS, regardless of apparent compliance, is of little utility. Monitored data collected during Mine operation are more relevant for this purpose; however, comparisons of these data to CAAQS should still be interpreted with caution, as the monitoring stations that collect the data are not NAPS stations.

The CAAQS have been set up with a series of response-level concentration thresholds (Green, Yellow, Orange, and Red) beyond which particular action to improve or maintain air quality at an airshed level may be required. Green requires essentially no changes in the airshed, and along the response continuum, red response levels may compel proactive action to improve air quality in an airshed. De Beers reiterates it is not an appropriate use of the standards to compare them to modelled predictions that are inherently conservative at or even near a development. Nonetheless, modelled data are provided as requested.

Table 2.5-1: Air Quality Monitoring Station Locations at Gahcho Kué Mine

Station	Distance from Mine Boundary (m)
0 m NE Dustfall and NO_2 Station	0
50 m NE Dustfall Station	50
150 m NE Dustfall Station	150
500 m NE Dustfall Station	500
1 km NE Dustfall and NO_2 Station	1,000
0 m SW Dustfall and NO_2 Station	0
50 m SW Dustfall Station	50
150 m SW Dustfall Station	150
500 m SW Dustfall Station	500
1 km SW Dustfall and NO_2 Station	1,000
5 km SW Dustfall Station	5,000
10 km SW Dustfall Station	10,000
15 km SW Dustfall Station	15,000
20 km SW Dustfall and NO_2 Station	20,000
Particulate Monitoring Station	0

$PM_{2.5}$ Predictions

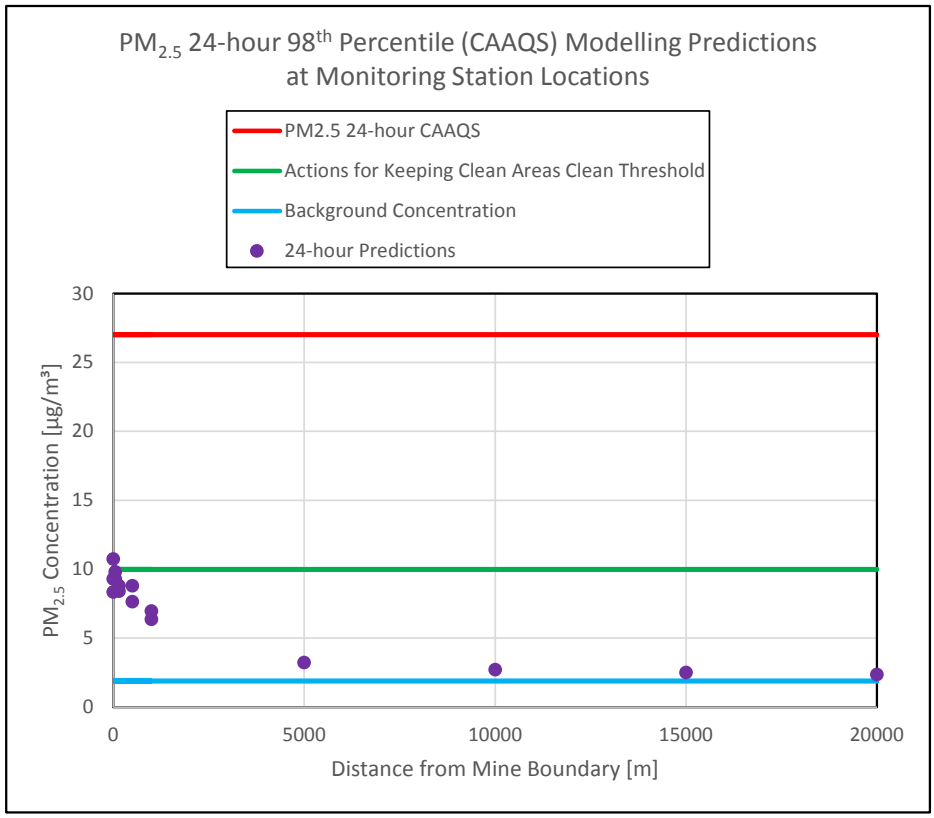
$PM_{2.5}$ 24-hour model predictions are presented in Table 2.5-2 and Figure 2.51.

Table 2.5-2: Modelled $PM_{2.5}$ 24-hour (CAAQS) Predictions at Air Quality Stations

Station	Numerical Limit (µg/m³)	Predicted Concentration (µg/m³)
0 m NE Dustfall and NO_2 Station	27[(a)]	10.7
50 m NE Dustfall Station		9.8
150 m NE Dustfall Station		8.4
500 m NE Dustfall Station		7.7
1 km NE Dustfall and NO_2 Station		6.4
0 m SW Dustfall and NO_2 Station		9.3
50 m SW Dustfall Station		9.3
150 m SW Dustfall Station		8.8
500 m SW Dustfall Station		8.8
1 km SW Dustfall and NO_2 Station		7.0
5 km SW Dustfall Station		3.2
10 km SW Dustfall Station	27[(a)]	2.7
15 km SW Dustfall Station		2.5
20 km SW Dustfall and NO_2 Station		2.4
Particulate Monitoring Station		8.3

[(a)] 98th percentile of modelled $PM_{2.5}$ 24-hour average concentration predictions

Figure 2.5-1: Modelled $PM_{2.5}$ 24-hour Predictions at Air Quality Stations Relative to CAAQS, the Keeping Clean Areas Clean Threshold, and Background Concentrations



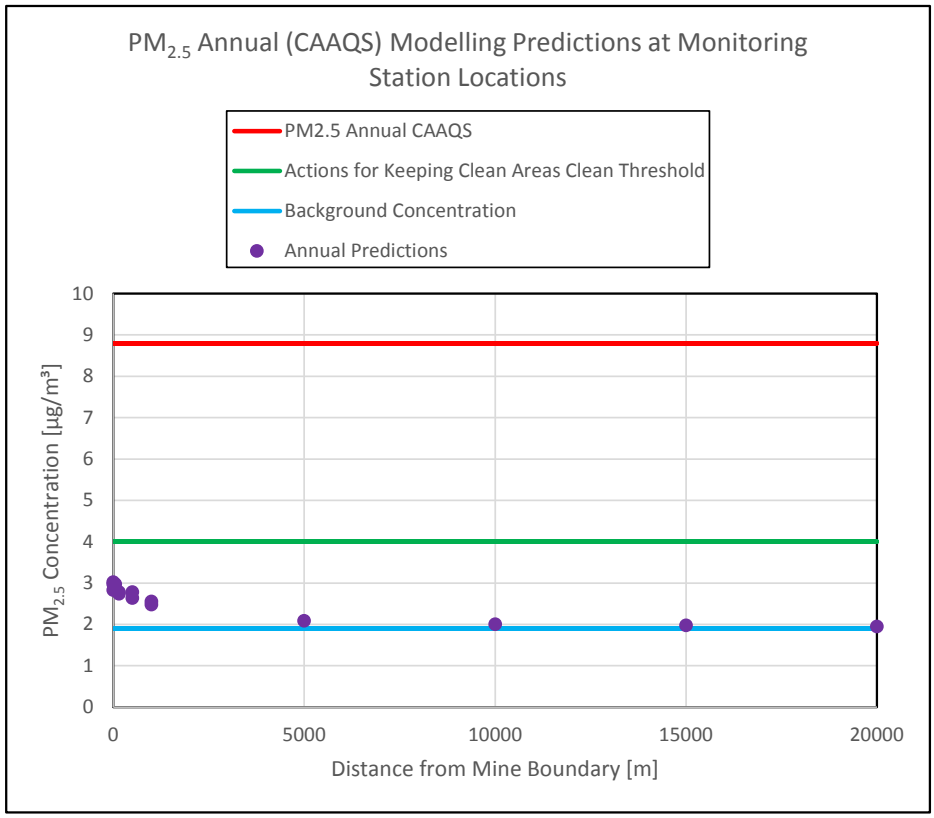
$PM_{2.5}$ annual model predictions are presented in Table 2.5-3 and Figure 2.5-2.

Table 2.5-3: Modelled $PM_{2.5}$ Annual (CAAQS) Predictions at Air Quality Stations

Station	Numerical Limit (µg/m³)	Predicted Concentration (µg/m³)
0 m NE Dustfall and NO_2 Station	8.8[(a)]	3.0
50 m NE Dustfall Station		2.9
150 m NE Dustfall Station		2.7
500 m NE Dustfall Station	8.8[(a)]	2.6
1 km NE Dustfall and NO_2 Station		2.5
0 m SW Dustfall and NO_2 Station		3.0
50 m SW Dustfall Station		3.0
150 m SW Dustfall Station		2.8
500 m SW Dustfall Station		2.8
1 km SW Dustfall and NO_2 Station		2.6
5 km SW Dustfall Station		2.1
10 km SW Dustfall Station		2.0
15 km SW Dustfall Station		2.0
20 km SW Dustfall and NO_2 Station		2.0
Particulate Monitoring Station		2.8

[(a)] Average of modelled $PM_{2.5}$ Annual concentration predictions

Figure 2.5-2: Modelled $PM_{2.5}$ Annual Predictions at Air Quality Stations Relative to CAAQS, the Green "Keeping Clean Areas Clean Threshold", and Background Concentrations



Figures 2.5-1 and 2.5-2 illustrate that the modelled $PM_{2.5}$ concentration predictions attenuate rapidly within 1 km of the Mine boundary, and are comprised primarily of background concentrations (i.e., non-Project ambient background concentrations) at and beyond 5 km from the Mine boundary. All predicted concentrations at the monitoring stations are well below the $PM_{2.5}$ CAAQS:

- 24-hour $PM_{2.5}$ concentration predictions are below the 'Green' Keeping Clean Areas Clean threshold immediately past the Mine boundary (Figure 2.5-1); and
- annual $PM_{2.5}$ concentration predictions are below the Keeping Clean Areas Clean threshold at and beyond the Mine boundary (Figure 2.5-2).

Air quality in the North Slave air zone with respect to $PM_{2.5}$ will not be significantly affected by Project emissions.

NO_2 Predictions

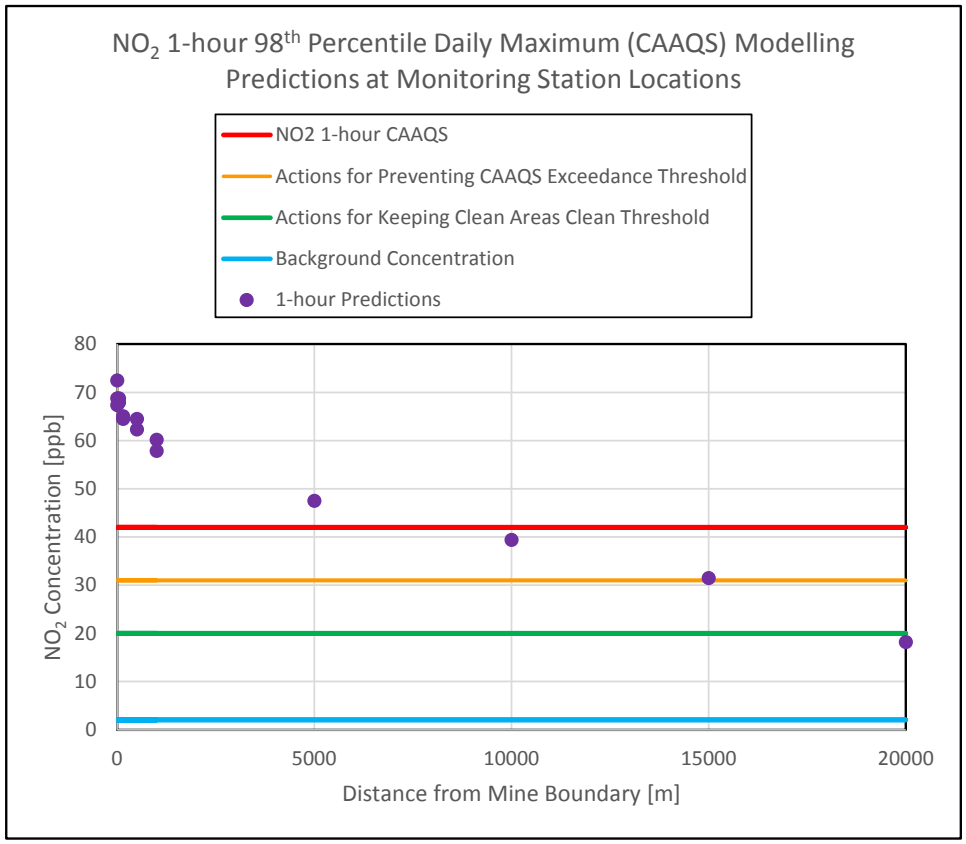
NO_2 1-hour model predictions are presented in Table 2.5-4 and Figure 2.5-3.

Table 2.5-4: Modelled NO2 1-hour (CAAQS) Predictions at Air Quality Stations

Station	Numerical Limit (ppb)	Predicted Concentration (ppb)
0 m NE Dustfall and NO_2 Station	42[(a)]	72.5
50 m NE Dustfall Station		67.9
150 m NE Dustfall Station		65.0
500 m NE Dustfall Station		62.3
1 km NE Dustfall and NO_2 Station		57.8
0 m SW Dustfall and NO2 Station		68.8
50 m SW Dustfall Station		68.8
150 m SW Dustfall Station		64.5
500 m SW Dustfall Station		64.5
1 km SW Dustfall and NO2 Station		60.2
5 km SW Dustfall Station		47.5
10 km SW Dustfall Station		39.4
15 km SW Dustfall Station		31.5
20 km SW Dustfall and NO2 Station		18.2
Particulate Monitoring Station		67.3

[(a)] 98th percentile of maximum daily 1-hour average concentration predictions

Figure 2.5-3: Modelled NO_2 1-hour Predictions at Air Quality Stations Relative to CAAQS, the Keeping Clean Areas Clean Threshold, and Background Concentrations



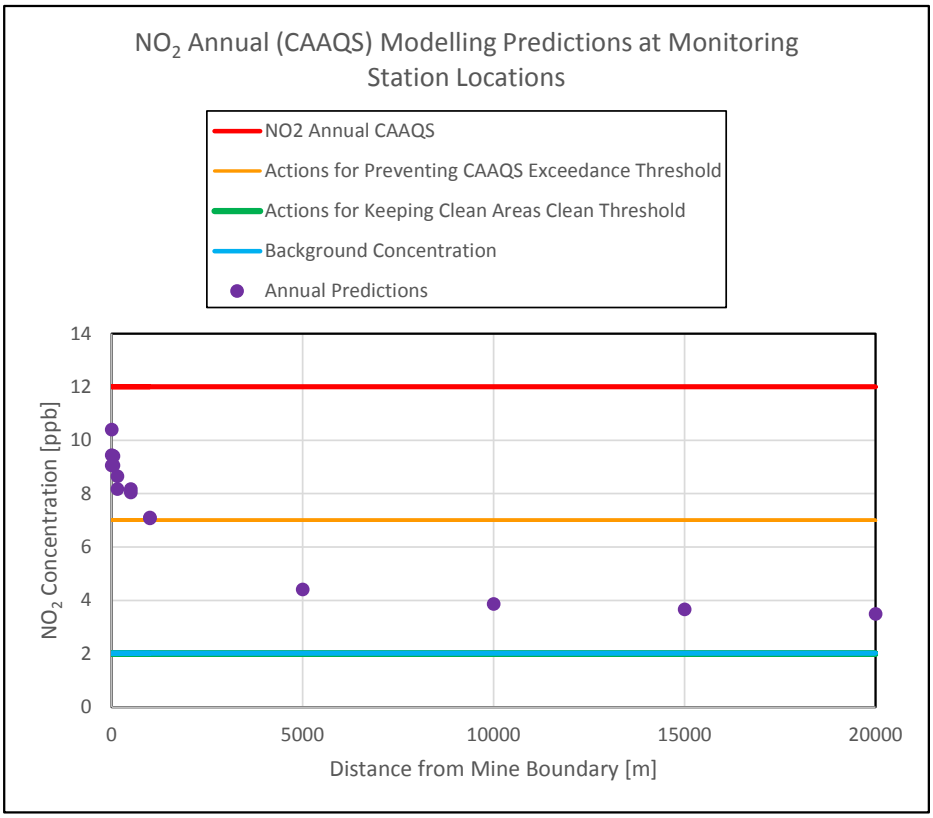
NO_2 annual model predictions are presented in Table 2.5-5 and Figure 2.5-4.

Table 2.5-5: Modelled NO_2 Annual (CAAQS) Predictions at Air Quality Stations

Station	Numerical Limit (ppb)	Predicted Concentration (ppb)
0 m NE Dustfall and NO_2 Station	12[(a)]	10.4
50 m NE Dustfall Station		9.4
150 m NE Dustfall Station		8.7
500 m NE Dustfall Station		8.0
1 km NE Dustfall and NO_2 Station		7.1
0 m SW Dustfall and NO_2 Station		9.1
50 m SW Dustfall Station		9.1
150 m SW Dustfall Station		8.2
500 m SW Dustfall Station		8.2
1 km SW Dustfall and NO_2 Station		7.1
5 km SW Dustfall Station		4.4
10 km SW Dustfall Station	12[(a)]	3.9
15 km SW Dustfall Station		3.7
20 km SW Dustfall and NO_2 Station		3.5
Particulate Monitoring Station		9.4

(a) Average of modelled NO_2 Annual concentration predictions

Figure 2.5-4: Modelled NO_2 Annual Predictions at Air Quality Stations Relative to CAAQS, the Keeping Clean Areas Clean Threshold, and Background Concentrations



Note: The background concentration and the Keeping Clean Areas Clean threshold are the same value (2 ppb)

The NO_2 concentration predictions attenuate rapidly within 1 km of the Mine boundary, and continue to decrease in concentration with further distance from the Mine boundary:

- One (1)-hour NO_2 concentration predictions are below the Achieving Air Zone NO_2 CAAQS at 10 km from the Mine boundary and below the Keeping Clean Areas Clean threshold at 20 km from the Mine boundary.
- Annual NO_2 concentration predictions are below the Achieving Air Zone NO_2 CAAQS at the Mine Boundary, and below the Preventing CAAQS Exceedance threshold beyond 1 km from the Mine boundary.

Under the Water Licence amendment air quality modelling case, it is not possible to meet the annual Keeping Clean Areas Clean threshold. This is primarily due to the background concentration, which was sourced from measurements at the Yellowknife Airport station (2 ppb), which is the same as the threshold value. Based on 20 km NO_2 monitoring data at the Mine, the true non-urban ambient background is likely lower.

It is noted that existing monitoring data for the Mine show measured NO_2 concentrations well below the EIS model predictions. Further, the low passive NO_2 concentrations of NO_2 measured at the Mine boundary and beyond, met the Keeping Clean Areas Clean annual threshold in 2017 (Table 2.5-6). The Dispersion modelling used for the EIS and the Water

Licence amendment application is normally a conservative exercise, predicting worst-case scenarios for air emissions (e.g., $PM_{2.5}$ and NO_2) that are not expected to be measured on site during Mine operations. While NO_X emissions are predicted to increase in the Water Licence amendment from the EIS predictions (Section 4.6.4 and Appendix B of the Environmental Screening Assessment), the core emissions release location in the Water Licence amendment case has shifted away from the edge of the Mine footprint to be more centrally located within the Mine operation. It is, therefore, expected that monitoring data will continue to show NO_2 concentrations well below the updated NO_2 model predictions.

Table 2.5-6: Annual NO_2 Concentrations at Passive Monitoring Stations at the Mine

Annual 2017 NO_2 Concentration (ppb)				
NE0KM	**NE1KM**	**SW0KM**	**SW1KM**	**SW20KM**
1.1	0.7	0.7	0.4	0.1

Air quality in the North Slave air zone with respect to the NO_2, and to a lesser extent $PM_{2.5}$, is predicted (although not demonstrated) to be affected by Project emissions near the location of the Project. The modelled $PM_{2.5}$ predictions show that at the mine boundary, the 24-hour and annual $PM_{2.5}$ predictions are below the Green, Keeping Clean Areas Clean 2020 CAAQS for $PM_{2.5}$. NO_2 predictions show that further than 20 km from the Mine, the 1-hour concentrations will be lower than the Keeping Clean Areas Clean threshold, and at further than 1 km from the Mine boundary, for annual concentrations will be in the Preventing Air Quality Deterioration (Yellow) action level. De Beers reiterates that it is an inappropriate use of the CAAQSs to compare to modelled/predicted data, and if ECCC were to do so, that an abundance of caution be used in drawing conclusions based on the data, regardless of whether or not the standards and the predicted values showed similar numbers. It would also be unreasonable to expect that significant changes (e.g., either total elimination or doubling) in the Mine emissions profile would result in any meaningful change to the measured concentrations of NO_2 or $PM_{2.5}$ at the NAPS stations in the North Slave Air Zone, a zone that has been defined only by administrative boundaries.

3 REFERENCES

ECCC (Environment and Climate Change Canada). 2018. Environment and Climate Change Canada's Intervention to the Mackenzie Valley Land and Water Board Respecting De Beers Canada Inc.'s Gahcho Kué Land Use Permit and Water Licence March 2018 Amendment Application, June 27, 2018.