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Environmental Monitoring Advisory Board

PEER REVIEW OF THE 2017 ENVIRONMENTAL AIR QUALITY MONITORING REPORT

DIAVIK DIAMOND MINES (2012) INC.

October 2018

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PEER REVIEW OF THE 2017 ENVIRONMENTAL AIR QUALITY MONITORING REPORT DIAVIK DIAMOND MINES (2012) INC.

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1 INTRODUCTION

As requested by the Environmental Monitoring Advisory Board (EMAB), Arcadis Canada Inc. (Arcadis) undertook a review of the *2017 Environmental Air Quality Monitoring Report* (AQMR) [ERM 2018] prepared by ERM Consultants Canada Ltd. (ERM) for Diavik Diamond Mines (2012) Inc. (DDMI). The report summarizes the air quality monitoring activities conducted at the DDMI diamond mine during 2017. The components of DDMI's AQMR include the following:

- total suspended particulate (TSP) monitoring;
- dustfall monitoring;
- snow core sampling program;
- National Pollutant Release Inventory (NPRI) reporting; and,
- Greenhouse Gas (GHG) reporting.

The aspects of the AQMR contained within Arcadis' scope of review specifically included:

- Implications resulting from A21 Kimberlite Pipe and associated construction and operational activities;
- Adequacy of monitoring locations;
- Effectiveness of dust suppression techniques;
- QA/QC practices and Standard Operating Procedures (SOPs);
- Integration of meteorological data and operational information;
- Modelled versus monitored Total Suspended Particulate (TSP) and dustfall;
- Adequacy and effectiveness of TSP samplers used;
- ERM recommendations on the TSP and dustfall programs in Appendices A and B; and,
- How well DDMI addressed comments and recommendations on the 2016 AQMR.

Arcadis completed a review of each of the above components of the air quality monitoring program in place at the DDMI diamond mine, as described in the 2017 AQMR. In addition, it is understood that the Environmental Air Quality Monitoring Program (EAQMP) for the site will be re-evaluated during 2017-2018. Arcadis has provided recommendations for consideration during the EAQMP evaluation. The following sections outline the findings of the review. The report concludes with a summary of key findings and recommendations.

2 DISCUSSION

2.1 Continuous TSP Monitoring

Continuous air monitoring (CAM) was commissioned in April 2013 at two sampling locations: 1) the communications building adjacent to the accommodations complex; and 2) the A154 dike along the southeast corner of the A154 pit. The locations were selected based on the results of an updated air dispersion modelling analysis, the proximity to the Project footprint and power requirements. A beta attenuation monitor (BAM) is used to measure TSP at the CAM stations.

Our comments with respect to the 2017 continuous TSP monitoring program are presented in Table 1.

Table 1 Review of Continuous TSP Monitoring

No.	Comment
1.	**AQMR, Page 2-1: "***Two TSP monitors were installed at the Mine in April 2013. The locations of the monitors were selected based on proximity to the Mine boundary, with careful consideration of the TSP results form the updated air dispersion modelling assessment and in consideration of the availability of power (Figure 2.1-1; DDMI 2013)"* There is a general lack of detail in the report discussing the siting of the TSP monitoring stations relative to the 2017 wind and operating conditions at the Mine. It is unclear as to whether the updated dispersion modelling assessment completed in 2012 for the site is representative of current activities being undertaken at the Mine and whether the meteorology used in the assessment is consistent with the reporting year wind patterns presented within the AQMR. In concept, the siting of the monitoring stations should align with where maximum concentrations are expected to occur especially since the primary sources of fugitive dust (as indicated in Section 3.4, page 3-9 of the AQMR) are associated with unpaved roads, airstrip usage and construction activities at A21 kimberlite pipe. The wind rose presented in Figure 2.1-1 of the AQMR shows that the prominent wind direction is from the southeast. Since all of the primary emission sources are located predominantly upwind from the TSP monitoring stations, the stations may not have captured maximum TSP concentrations in 2017. Arcadis recommends that the updated air dispersion modelling assessment, or portions thereof, be appended to the AQMR such that the statements made can be verified and clarity can be obtained regarding the representativeness of the modelling assessment to existing operating conditions at the Mine. Additionally, Arcadis recommends that an updated air dispersion modelling assessment be completed during review of the EAQMP to evaluate the current Site-wide operations (i.e. inclusion of operations at A21) and update the monitoring locations, as required.

Table 1 Review of Continuous TSP Monitoring (Cont'd)

No.	Comment
2.	**AQMR, Page 2-3: "***Quality assurance and quality control (QA/QC) procedures applied to TSP monitoring included the following:* • *adherence to the revised DDMI TSP Monitoring SOP ENVI-801-0613 R4 (DDMI 2016)* • *incorporation of the DDMI TSP into the DDMI Environmental Management System; and* • *review of monitoring data and retention of calibration and maintenance records."* Arcadis acknowledges that the 2017 calibration records for the TSP monitors were provided within the AQMR Appendix C. Arcadis recommends that the corresponding DDMI TSP Monitoring SOP ENVI-801-0613 R4 [DDMI 2016] also be provided for reference within the AQMR to ensure compliance with the SOP and QA/QC practices detailed within the SOP.
3.	**AQMR, Page 2-6: "***In 2017 there was one exceedance of the 24-hour average guideline (120 µg/m^3), measured at the A154 Dike station on August 13 (241.1* µg/m^3*). Elevated TSP concentrations were measured by both stations from August 13 to 15 as forest fire smoke was observed at the Mine site on these dates (Figure 2.3-1)."* On August 13, the measured TSP concentration at the A154 dike station was approximately 3.5 times higher than the CB station. While there was a spike in TSP concentrations at the CB station on the same date, it was not the highest observed concentration (97.9 µg/m^3), which occurred on January 7. It would be expected that forest fire smoke would have a similar impact at both stations (i.e. large spikes in recorded concentrations) unless there is localized impact due to proximity of fire to one area, or specific wind conditions, etc. A discussion of the forest fire location, supporting meteorological data and operational activity would have been useful information to include in the analysis of the event. Arcadis recommends that additional discussion or evidence be presented to validate the cause of the exceedance and the variance between the TSP concentrations measured at the two stations.
4.	**AQMR, Appendix A, Page 7:** *"From the calibration records provided by site personnel, it has been observed that equipment checks and audits are occurring more frequently than in the past."* Based on the information provided within the AQMR Appendix C: TSP Monitoring Station Calibration and Maintenance Records, it is not possible to confirm whether the frequency of checks, maintenance, and calibrations are being completed in accordance with the DDMI TSP Standard Operating Procedure (ENVR-801-0613 R4). An incomplete set of calibration records are included within Appendix C for the CB station including one (1) quarterly calibration record completed in September, five (5) monthly calibration records from September to December 2017, one (1) annual calibration record, one (1) record from December 2016, and one (1) dated July 2017. Records provided for the A154 Dike station includes one (1) annual calibration completed in December, four (4) monthly calibrations from September to November, and one (1) record dated July 2017.

Table 1 Review of Continuous TSP Monitoring (Cont'd)

No.	Comment
	Arcadis recommends that compliance with DDMI SOP ENVR-801-0613 R4 be clearly demonstrated within the AQMR to ensure that each monitoring station is operating correctly and to demonstrate due diligence is being taken to remedy any issues with the monitors.
5.	**AQMR, Appendix A, Page 8:** *Recommendations* Arcadis agrees with the recommendations provided by ERM which will assist with troubleshooting and maintenance of the monitors. Complete records for maintenance, calibrations, and audits for each monitor is necessary for demonstration of compliance with DDMI's TSP Monitoring SOP and to ensure issues with the monitors are addressed in a timely manner. It is noted that data completeness from the monitors has been a historical concern and the implementation of a complete maintenance regime and calibration by a qualified technician will provide an opportunity to correct any recurring issues. This maintenance coupled with the preventative maintenance, routine audits and calibrations, and record keeping practices identified by ERM should provide an opportunity to effectively maintain the monitors and increase the data completeness during the reporting periods.
6.	**AQMR, Appendix B, Page 1:** *"The A154 dike sampler was received from CD Nova at the beginning of January 2017 and initiated sampling on January 23, 2017 and operated well until December 29, 2017. No data have been collected from the A154 dike sampler after December 29, 2017.* *This memorandum provides a summary of the data collected form October 1, 2017 through May 15, 2018 from the Communications Building (CB) TSP sampler and recommendations for ongoing maintenance and servicing."* It is unclear as to why data from the A154 Dike sampler has been omitted from the Biannual Data Memorandum. It is indicated that the sampler was performing well and it is noted that data has not been collected from the sampler after December 29, 2017. Arcadis recommends that rationale for the exclusion of the A154 Dike sampler be provided and that the recommendations provided on Page 6 of the Biannual Data Memorandum be applied to the A154 Dike sampler as per the Memorandum provided in Appendix A of the AQMR.
7.	**AQMR, Appendix B, Page 6:** *Recommendations* Arcadis agrees with the recommendations provided by ERM which are consistent with those provided in the TSP Monthly Data Memorandum provided as Appendix A within the AQMR. The recommendations as provided by ERM, if adhered to, are imperative to ensuring the monitors are operating effectively and to also achieve maximum data completeness from the monitors for the reporting period.
8.	**AQMR, Appendix C:** *TSP Monitoring Station Calibration and Maintenance Records* As noted in comment no. 4, an incomplete set of calibration records have been provided for each monitor and it is not possible to determine whether all maintenance, audits, and calibrations have been completed in accordance with DDMI SOP ENVR-801-0613 R4. Arcadis recommends that validation of compliance with all maintenance and calibrations in accordance with the SOP be provided within the AQMR.

2.2 Dustfall and Snow Core Sampling

The dustfall monitoring and snow core sampling programs were implemented in 2001 under the Aquatic Effects Monitoring Program (AEMP) as a means of collecting information on dust deposition with distance from mining activities. A summary of the 2017 AEMP results is provided in the AQMR, while details are provided in Appendix E, *Diavik Diamond Mine 2017: Dust Deposition Report* (DDMDDR) prepared by ERM [2018]. With no local guidance for dustfall, the AQMR compares DDMI dustfall levels to former objectives used by the Province of British Columbia (B.C.) for the mining industry (1.7 to 2.9 mg/dm^2/day, based on a 30-day average). This is consistent with the assessments completed for the previous AQMRs.

Our comments with respect to dustfall and snow core sampling are presented in Table 2.

Table 2 Review of Dustfall and Snow Core Sampling

No.	Comment
9.	**AQMR, Page 3-1:** *"Dustfall gauges were placed at 14 stations (including two control stations) around the Mine at distances ranging from approximately 25 to 4,852 m from mining operations (Table 3.1-1 and Figure 3.1-1). Each gauge collected dustfall year-round, with samples being collected for analysis approximately every three months, except for the two new stations (Dust 11 and Dust 12) that were first installed in early October 2017. The median total sampling period for the 12 existing locations was 367 days, and for the two new stations was 92 days."* Arcadis acknowledges that the dustfall gauge sampling program was set up to satisfy the aquatic sampling requirements. As historically identified by Arcadis, from an air quality perspective the sampling frequency does not follow current guidelines and does not provide information that may be useful for an air quality analysis. While it is likely that the mean annual dustfall rate is not significantly affected by using quarterly sampling, a reduced frequency will make it difficult to analyze monthly or seasonal trends in dustfall, as well as the effectiveness of dust suppression. It is also not appropriate to compare quarterly samples against the B.C. dustfall objective [B.C. MOE, 2013] which is intended to assess the mean daily dustfall rate averaged over a one-month period. A high reading in one month that may have exceeded the B.C. dustfall objective may be counterbalanced with lower readings in the other two months of the quarterly dustfall sample. This may result in the apparent attainment of the dustfall objective over the quarter, while entirely missing the monthly exceedance of the objective level. Quarterly sampling also does not follow the ASTM International D1739-98 (2010) Standard Test Method for Collection and Measurement of Dustfall (Settable Particulate Matter). While it is understood that quarterly sampling is the agreed frequency in the current EAQMP, Arcadis recommends that the sampling frequency be reviewed and reconsidered during review of the EAQMP.
10.	**AQMR, Page 3-9:** *"To supress fugitive dust generation, roads, parking areas and laydown areas were watered during the summer as needed. Between May and September 2017, approximately 1668 m^3 of water was applied on the Mine site and 55,948 m^3 of water was applied on haul roads. The exact impact of dust suppression could not be determined form the data collected in 2017; however, it is expected that road watering reduced the amount of dust generated at the Mine in 2017."*

Table 2 Review of Dustfall and Snow Core Sampling (Cont'd)

No.	Comment
	Considering the impact of fugitive dust from the airstrip as seen in the results from the Dust 1 gauge (936 mg/dm^2 /y in summer months), it would be beneficial to provide discussion with respect to the application of EK35 dust suppressant to the airstrip as mentioned in Section 1 of the AQMR, in addition to the discussion provided with respect to the water application. Results from the dust monitoring program can be a useful tool to evaluate the effectiveness of current Fugitive Dust Management programs and can provide opportunities for improvement to existing programs to ensure fugitive dust is effectively controlled at the site.
11.	**AQMR, Page 3-9:** *"Fugitive dust generation is expected to be greatest during snow-free periods where and when there is site activity. It was expected that the highest fugitive dust generation and resulting dustfall occurred in areas closest to the roads and the airstrip and mine footprint such as near A21 and the country rock pile between May and September."* As noted within Arcadis' review of DDMI's 2016 AQMR [Arcadis 2017] TSP is strongly correlated to dustfall. Considering the impact noted on TSP monitor A154 Dike in the month of August from forest fire smoke, it would be beneficial to note the potential impact, or lack thereof, of the smoke on dustfall gauges for the summer months. It would be expected that if the TSP monitors experienced extremely high concentrations of TSP during this time that dustfall around the site would be impacted as well. As noted in comment no.4, the quarterly dustfall program makes it difficult to analyze the monthly or seasonal trends however the lack of correlation between the dustfall and TSP results at A154 Dike indicates that while smoke may have been observed, other factors could have been instrumental in the high concentrations seen in August. Arcadis recommends that that the frequency of dustfall collection be reviewed during review of the EAQMP, so as to capture data that would be significant in analysing and validating the impact of both natural and operational events on fugitive dust both monitored and collected as deposition around the site.
12.	**AQMR, Page 3-9:** *"Dust 1 (Adjacent to the airstrip) recorded the highest dustfall during the summer months (936 mg/dm^2/y) compared to the winter months (230 mg/dm^2/y)."* An editorial comment, per Appendix B within the Diavik Diamond Mine 2017 Dust Deposition Report (attached to the AQMR as Appendix E), Dust 1 total recorded dustfall was 480 mg/dm^2/y. There appears to be a discrepancy in the results presented in the above noted text and Appendix B results.
13.	**AQMR, Page 3-9:** *"The 2017 predominant wind directions at the site were from the southeast, although this was not very pronounced and in fact in general the winds can be described as omni-directional (see wind rose in Figure 3.1-1). The expectation is that airborne material would be deposited in all directions around the mine with a slight northwest emphasis. The results show that the direction from the mine is not the strongest indicator of dust deposition, rather proximity to mine activities and roads and the airstrip show a stronger influence."* As noted within Arcadis' review of DDMI's 2016 AQMR [Arcadis 2017] TSP is strongly correlated to dustfall. If mine activities are the strongest indicator of dust deposition then it is reasonable to expect the maximum TSP values to occur in those areas as well, which based on 2017 dustfall

Table 2 Review of Dustfall and Snow Core Sampling (Cont'd)

No.	Comment
	results indicate to be at the north of the site and the southwest of the site near A21 (Dust 10 gauge). Therefore, as identified in comment no. 1, the lack of correlation between the dustfall and TSP results indicate that the TSP monitoring stations may not be appropriately sited to capture the worst-case emissions from the current site operations. It is important to highlight that Arcadis identified similar concerns with the siting of the TSP monitors during review of the 2014-2015 AQMR [Arcadis, 2016] and 2016 AQMR [Arcadis 2017]. The results of the 2012 modelling assessment should be presented within the report to allow for the review of the modelled versus monitored results to ensure the monitors are sited correctly for current site conditions. Arcadis recommends that the 2012 modelling assessment be updated during the review of the EAQMP so as to reflect current operations, evaluate the appropriate locations for TSP monitors, and assess the observed dustfall observations with predicted concentrations within the updated assessment.
14.	**AQMR, Page 3-11:** *"Dustfall rates at stations SS1-1, SS1-2, Dust 2A, SS3-4, Dust 7, SS4-4, SS4-5, and Control 3 were greater than the upper limit of the 95% confidence interval for their respective zones in 2017. These high dustfall rates, compared to the overall distribution of dustfall rates within each zone, indicated that higher dustfall rates were observed in the vicinity of the airstrip and to the west and southeast of the mine."* Monitoring data can be useful to validate or evaluate air dispersion modelling, therefore it would be useful to present the 2012 modelled deposition results to validate that monitored results remain consistent with the predicted modelled concentrations. Since monitored data are now assumed to include impacts from the A21 construction activities it would be useful to discuss whether these assumptions are accurately represented in the 2012 modelling assessment. If not, the 2012 modelling assessment may need to be updated to reflect these operational changes to provide a better comparison to monitored data. As indicated by Arcadis in previous reviews, there is not enough information provided in the report to compare monitored values to modelled values nor any operational data comparisons to validate potential deviations from monitored and modelled predictions. Arcadis recommends that the dispersion modelling report be attached as an Appendix, such that the reader can view it when it is referenced in the AQMR.
15.	**AQMR, Table 3.4-2:** *Snow Water Chemistry Results, Diavik Diamond Mine, 2017* Table 3.4-2 presents the snow water chemistry results for ammonia as "-" for zone 0-100 m with no explanation within the main body of the AQMR or as a footnote to the table. It appears within Table 3.1-1 within the Diavik Diamond Mine 2017 Dust Deposition Report (attached to the AQMR as Appendix E) that a sample was analysed for station SS3-6 within the zone however no results are reported for ammonia. It is recommended that a brief explanation be provided for missing chemistry results within future reports to clarify rationale for missing analytical or as to whether corrective actions are required to ensure data is collected in the future.

Table 2 Review of Dustfall and Snow Core Sampling (Cont'd)

No.	Comment
	Arcadis highlights that this oversight may be in contravention to DDMI's Water License (W2015L2-0001) and recommend that the details of the corrective action be integrated into DDMI's QA/QC SOP ENVR-303-0112.
16.	**AQMR, Page 3-11:** *"In general, average concentrations of snow water chemistry variables of interest decreased with increasing distance from the Mine. However, high parameter concentrations were recorded at Station SS3-4, located in the 251-1,000 m zone (615 m southeast of the closest Mine infrastructure). SS3-4 is located to the southeast of the Mine (Figure 3.1-1) where higher measured dustfall was observed at stations along the same transect compared to other transects.* *All 2017 sample concentrations were less than their associated reference levels as specified by the "maximum concentration of any grab sample" specified in Water Licence W2015L2-0001 (Table 3.1-2), except for sample SS3-4 that had aluminum, chromium, nickel and zinc exceedances."* From review of Table 3.4-2., it appears that the highest concentrations of ammonia are observed in the 1,001 – 2,500 m zone and the maximum concentrations of aluminum, arsenic, cadmium, chromium, copper, lead, nickel, phosphorous, and zinc are higher in the 251-1,000 m zone than the 100-250 m zone. As mentioned on page 3-11 in the AQMR, in general average concentrations of snow water chemistry variables decrease with increasing distance from the Mine however, no explanation is provided as to why these trends are observed for these parameters and whether the results are anomalous compared to the historical data record. It is important to note that Arcadis noted a similar anomalous trend upon review of the 2016 AQMR [Arcadis 2017], and the 2017 data appears to follow the same pattern with more analytes showing maximum concentrations within the 251 – 1,000 m zone and typically from station SS3-4 or within its vicinity. In addition, considering exceedances of aluminum, chromium, nickel and zinc are observed within the 251 – 1,000 m zone at SS3-4, it would be important to provide as much rationale as possible for the potential reason for these results which appear to be anomalous to expected historical data trends. Arcadis recommends that the 2012 modelling assessment be updated deposition of metals during the review of the EAQMP so as to reflect current operations and evaluate the observed metal deposition observations with predicted concentrations within the updated assessment.
17.	**DDMDDR, Appendix A:** A review of the Annual Changes to the Dustfall Program indicates that July samples from Stations Dust 3, Dust 4, Dust 8, and Dust 10 were compromised and an indeterminate amount of sample was lost. This sampling issue does not appear to be identified within the report nor is it clear the impact on the results for these stations. Arcadis recommends that any issues during sample collection or analysis be discussed within the DDMDR and AQMR with attention made to the potential impact on the results and any corrective actions implemented as a result.

Table 2 Review of Dustfall and Snow Core Sampling (Cont'd)

No.	Comment
18.	**DDMDDR, Appendix E and Appendix F** As noted in Arcadis' review of the 2016 AQMR [Arcadis 2017], SOPs for dust gauge collection and snow core sampling are provided in Appendix E and F, respectively, of the DDMDDR. While Section 6.4.2 of the snow survey SOP outlines QA/QC measures to follow in the field, including collecting duplicates and blanks, there is no mention of such QA/QC procedures in the dust gauge collection SOP. A QA/QC procedure should be adopted in the dust gauge collection SOP to ensure the field sampling does not contain any significant in-situ variability. The dust gauge and snow survey SOPs refer to an external SOP for the TSS laboratory procedure (SOP ENVI-403-0112). Without the TSS SOP or detailed laboratory records, Arcadis is unable to comment on whether the DDMI laboratory uses acceptable standards/methods on par with an accredited laboratory. For example, an accredited laboratory would adhere to a filter preparation method that requires calibration of the scale traceable to a National Institute of Standards and Technology (NIST) standard. This should be part of the DDMI TSS SOP. The TSS SOP and all laboratory calibration certificates and/or records should be included with the AQMR to demonstrate that laboratory calibrations and laboratory QA/QC have been completed as appropriate.

2.3 NPRI and GHG Emission Inventories

Emissions for CO, SO_2, NO_X, VOC, Ammonia (NH_3), TSP, PM, PM_{10} and $PM_{2.5}$ were estimated for 2017 and reported to Environment and Climate Change Canada (ECCC) under the NPRI reporting system. In addition, GHG emissions were calculated and reported to the federal system through ECCC.

Our comments with respect to NPRI and GHG emission inventories are presented in Table 3.

Table 3 Review of NPRI and GHG Inventories

No.	Comment
19.	**AQMR, Section 4 and Section 5** The results of the NPRI and GHG emissions inventories are discussed in Sections 4 and 5 of the AQMR, respectively. As indicated in Arcadis' previous reviews, the AQMR does not include any detailed information about the emission factors or calculation methodologies used for either of the inventories and, thus, Arcadis is unable to comment on the appropriateness of the calculations used in the inventories. However, based on the limited information presented within the AQMR regarding operating conditions at the Mine for 2017 and review of data for similar facilities (namely EKATI and Snap Lake mines), Arcadis considers the values reported by DDMI to be reasonable. Although a review of the methods used to derive these estimates would be required to confirm their appropriateness.

3 CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

There are several improvements that could be made in monitoring procedures and analysis noted in the review of the DDMI *2017 Environmental Air Quality Monitoring Report* and some generalizations and comments made that are not supported by the data. The main points of concern are summarized below:

General Comments

- Many of the comments provided in the previous reviews of the 2014-2015 Air Quality Monitoring Report and 2016 Air Quality Monitoring Report were not sufficiently addressed in the 2017 report, particularly with respect to the TSP Continuous Monitoring Program.
- There was not enough information provided in the AQMR to validate the statements made with respect to the revised dispersion modelling, the effectiveness of dust suppression activities, or the implications of A21 operations.
- Even though there were some attempts to include QA/QC protocols and SOPs for some aspects of monitoring, based on information provided it appears that adherence to the SOPs, particularly the TSP Monitoring SOP, remains an issue and the SOPs lack detailed and final QA/QC procedures for the continuous TSP monitor and dustfall sampling program, as well as the laboratory procedures used to analyze TSS.

Continuous TSP Monitoring Program

- The AQMR provided little or no discussion about temporal variability in the TSP other than to say that there was decreased TSP due to decreased open mining operations and increased TSP due to airstrip usage. Detailed analysis would help to evaluate the effectiveness of dust suppression efforts at the mine as well as confidently validate impacts observed due to specific mining operations and/or natural occurring events such as forest fires.
- QA/QC issues are evident in the continuous TSP monitoring program. Calibration issues are apparent with both monitors as well as preventative maintenance schedules and audit frequencies. This is apparent through the low data completeness from both monitors.
- The locations of the TSP monitoring stations may not be adequately placed as dustfall monitoring suggested moderate to high values observed in the north and southwest. It is expected that TSP would follow the same pattern, however the lack of information with respect to the 2012 modelling assessment does not allow for correlation of monitored values against the predicted modelled concentrations.

Dustfall Monitoring Program

- Quarterly dust gauge sampling does not follow standard reference methods and makes it difficult to examine air quality trends in the data or evaluate the effectiveness of dust suppression.
- There was no attempt to evaluate or explain temporal/spatial trends in the dustfall data or use the dustfall results to evaluate the effectiveness of the dust suppression efforts or correlate to mining

activities, other than to state that it is expected that road watering reduced the amount of dust generated.

NPRI and GHG

- There was not enough information provided within the AQMR to validate the reported values to NPRI or GHG.

3.2 Recommendations

Based on the above conclusions of the review, Arcadis has the following recommendations for future EAQMP activities and reporting:

- It is recommended that DDMI include (and adhere to) a detailed summary of QA/QC practices in the AQMR for each aspect of the monitoring program, including all laboratory procedures.
- Complete and final calibration records be provided for all equipment (i.e., laboratory scale, continuous monitoring equipment, etc.).
- The dust gauge collection SOP be updated to include QA/QC requirements similar to the QA/QC procedure used for snow core sampling (i.e., field duplicates and blanks).
- Quality checking procedures need to be added to the TSS SOP (if not already) to ensure that they meet the same standard that an accredited laboratory would meet.
- Consider returning to monthly dustfall sampling or, at a minimum, perform monthly sampling during the snow-free periods, to evaluate effectiveness of dust suppression efforts.
- The current and historical dustfall monitoring results be used to evaluate the effectiveness of dust suppression efforts.
- Available meteorological data and records of on-site activity be used to document the cause/rationale for events of high TSP concentration measured by the monitors.
- A detailed comparison of monitored and modelled TSP/dustfall be included within the AQMR.
- Details of the NPRI and GHG calculations be included, or a reference to an external document containing such details, to allow for validation of methods and quantities reported.

Arcadis recommends that the following items be considered during the re-evaluation of the EAQMP for the site:

- The TSP monitor locations be re-evaluated using historical meteorology and dustfall results, as the TSP monitor results do not appear to be correlated with the 2017 meteorology or dustfall monitoring results presented.
- The dustfall sampling frequency be reviewed and considered to be completed on a monthly basis per ASTM International methods.
- The 2012 dispersion modelling assessment be updated so as to reflect current operations and be used to evaluate the appropriate locations for TSP monitors and assess the observed dustfall observations with predicted concentrations within the updated assessment.

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