MAY 31 2017

Mackenzie Valley Environmental Impact Review Board
c/o Ms. JoAnne Deneron
@ jdeneron@reviewboard.ca

Dear Ms. Deneron: JoAnne

Environmental Assessment of Dominion Diamond Ekati Corporation's Jay Project (EA1314-01) – Measure 6-4, Interim Dustfall Objective

The Department of Environment and Natural Resources (ENR) of the Government of the Northwest Territories (GNWT) was assigned Measure 6-4 by the Mackenzie Valley Environmental Impact Review Board in the *Report of Environmental Assessment and Reasons for Decision* for Dominion Diamond Ekati Corporation's Jay Project (EA1314-01). Measure 6-4 requires the GNWT to develop an interim dustfall objective for all types of dustfall that impact caribou and caribou habitat within the Jay Project zone of influence.

ENR recommends an interim dustfall objective of 1.53 mg/dm^2/day, based on a seasonal average of dust deposition applicable at 300m from a dust source. This value is an objective that applies to the Ekati mine site operations only, and is intended to improve on dust deposition realized at this site over the past eight years. Please see the attached Reasons for Decision for details on ENR's response to Measure 6-4.

ENR trusts that the information in the attached Reasons for Decision meets the intent of Measure 6-4. Please contact Ms. Kate Witherly, Manager of Environmental Impact Assessment at (867) 767-9236, ext. 53095 or kate_witherly@gov.nt.ca with any questions relating to the interim dustfall objective or associated rationale.

Sincerely,

Dr. Joe Dragon
Deputy Minister
Environment and Natural Resources

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Attachment

c. Ms. Jaida Ohokannoak, Chairperson
Independent Environmental Monitoring Agency

Ms. Claudine Lee, Head of Environment and Communities
Dominion Diamond Ekati Corporation

Ms. April Hayward, Superintendent – Environment
Dominion Diamond Ekati Corporation

Mr. Mark Cliffe-Phillips, Executive Director
Mackenzie Valley Environmental Impact Review Board

Ms. Lisa Dyer, Director, Environment Division
Environment and Natural Resources

Mr. Joel Holder, Director, Conservation, Assessment and Monitoring Division
Environment and Natural Resources

Ms. Lorraine Seale, Director, Securities and Project Assessment
Lands

Reasons for Decision

Environment and Natural Resources' Response and Rationale for Measure 6-4, Interim Dustfall Objective from the Dominion Diamond Ekati Corporation Jay Project Environmental Assessment (EA1314-01)

Background and Interpretation

The *Report of Environmental Assessment and Reasons for Decision* for Dominion Diamond Ekati Corporation's (Dominion) Jay Project (EA1314-01) (Report of EA), adopted on May 19, 2016, included a measure directed at Department of Environment and Natural Resources (ENR) to conduct the following:

> *Measure 6-4*
> *Prior to construction, the GNWT will develop an interim dustfall objective for all types of dustfall that impact caribou and caribou habitat, including impacts on lichen and other caribou forage within the Jay Project zone of influence. The objective will reduce dust-related sensory disturbances to caribou to the greatest extent practicable.*
>
> *Dominion will use the interim dustfall objective to inform its actions to reduce impacts to caribou and caribou habitat from dustfall*.

For the purposes of clarity, ENR presents the following definitions/interpretations of the terminology used in the Measure and throughout this document, relating to the Ekati mine site:

- Dustfall – solid particles in the air that settle down over a given area and time, under the influence of gravity, represented as mass/area/time.
- Dust[1] – larger size fraction of solid particles that quickly fall out of the air in relative proximity to the source, compared to particulate matter that tend to stay entrained/airborne for longer periods of time (e.g. $PM_{2.5}$ and PM_{10} may remain suspended for an indefinite period of time).
- Dust Source – locations where emissions of dust are generated, including primarily gravel roads, stockpiles, blasting sites, earthworks or rock transfer locations.

[1] Note that a definition for "dust" is not presented in the Report of EA or the DAR for the Jay Project, or in the Air Quality Emissions Monitoring and Management Plan (AQEMMP). Therefore the definition is based on ENR's understanding of the term, and further referenced from examples such as the Port of Prince Rupert Dustfall Monitoring program: http://www.rupertport.com/port-authority/sustainability/dustfall-monitoring; and from the Trenton Canyon Mining Project Environmental Impact Statement, 1997.

- Objective – non-statutory limits on the acceptable presence of parameters in the environment, generally expressed as a quantitative value[2]
- Zone of Influence (ZOI) –ENR recognizes two definitions of this term that could be applied to this measure:
    - a) The ZOI as it relates to caribou would be the distance at which caribou change their behavior, habitat selection or distribution due to the influence of an anthropogenic disturbance such as a mine or a road. For the Ekati and Diavik complex of mines, the caribou ZOI has been measured as the area of lower caribou abundance surrounding the mine sites than would be expected, given available habitat.
    - b) The ZOI as it relates to dust would be the area that is affected by measurable dustfall from the Ekati mine site[3].
- Seasonal Average – for the purposes of this measure, the seasonal average represents the mean dustfall sample results collected from June through to September in a given year.

It is first and foremost important to call attention to the scientific basis of this Measure. The impacts of dustfall on caribou and caribou habitat, including lichen and other caribou forage, is in general, unquantifiable at this time given limited scientific evidence/research on this particular subject matter. ENR understands that during the EA for the Jay Project, some parties identified a qualitative relationship between the impacts of dust to caribou forage and possibly in changes to caribou migration, but parameters such as composition of dust, the amount of dust, and the spatial extent of the dust were poorly defined. As such, developing an interim dustfall objective is challenging. ENR is aware of the correlation between caribou ZOI and "dust" in the 2012 Boulanger et al paper[4]; however, the relationship it suggests is not causative, is based on modeled results rather than actual measurements, and while it provides an interesting basis to further examine this

[2] From BC's Ambient Air Quality Objective Information Sheet, Dec 2016: non-statutory limits on the acceptable presence of parameters in the environment, generally expressed as a concentration.

[3] Dustfall monitoring from multiple diamond mines in the NWT have demonstrated that measurable dust levels return to background levels within 1 to 2 km of the emission source (ref: Ekati and Diavik dustfall monitoring programs). Further support is contained in the following:

- Report to DDMI: Risk Assessment of Caribou Exposure to Metals from Dust Deposition to Lichen, Golder Associates, March 2011
    - No observation that lichen were of poor quality due to dust deposition (pg 17/239)
    - Risk assessment showed lichen in the near field are within safe levels for caribou

  Within that report, reference to 2009 DDMI Permanent Vegetation Plots for Habitat Analysis indicated that no statistically or ecologically significant differences in vegetation and ground cover were evident between Mine and far-field permanent vegetation plots (Naeth and Wilkinson, 2009).
- CALPUFF modeling from DAR for Jay project predicted TSP levels along haul roads achieving <30ug/m^3 (max annual ambient) at approx. 1 km from source.

[4] Boulanger et al. "Estimating the zone of influence of industrial developments on wildlife: a migratory caribou *Rangifer tarandus groenlandicus* and diamond mine case study." Wildlife Biology, 18(2): 164-179 (2012)

potential relationship, it is not sufficiently strong evidence on which to base a quantitative dustfall objective. Furthermore, ENR finds that some evidence associated with potential dust effects is conflicting[5], which emphasizes the need for further study on the subject.

ENR has not included deposition limits in the proposed NWT Air Regulatory Framework at this time for the same reason; there is insufficient scientific evidence to support a quantitative value that would be protective of the environment and/or human health. Select jurisdictions[6] in Canada maintain a dustfall standard; however, the intention of those standards are for aesthetic or soiling purposes rather than environmental protection. ENR has therefore elected to not mirror those standards for the purposes of this Measure.

Given this paucity of evidence, ENR is actively pursuing scientific research with academic partners to better inform deposition limits, of both particulate matter and other emission parameters in the NWT. The research is anticipated to be a multi-year project with potential supplementary studies. The first stage of this project, a literature review to inform direction, is currently underway.

Given the current gap in the scientific understanding of effects of dustfall on caribou and caribou habitat within the Jay Project zone of influence, ENR has investigated alternate approaches to addressing the Measure. ENR has determined that if dustfall has direct effects to lichen health, and concurrently, indirect effects to caribou, then it is logical and reasonable to assume that reducing dustfall would reduce those potential effects. Therefore ENR's approach is to establish an interim dustfall objective that improves on historic dustfall realized at the Ekati mine site in order to meaningfully address the intent of Measure 6-4.

Note that the objective presented in this document is a site-specific approach, strictly associated with the Ekati operations, and is interim in nature until such time that ENR's research, or peer-reviewed research conducted outside of ENR, supports a final objective for all of the NWT.

[5] Caribou ZOI Technical Task Group. "Draft guidance for monitoring the zone of influence of anthropogenic disturbance on barren-ground caribou." Mar 10, 2015.

- Vegetation monitoring at the Diavik mine has shown that mine construction and operation activities can change plant communities and it is suggested that dust may be one of the contributing factors (Naeth and Wilkinson 2008; Golder 2011). This conflicts with footnote 3.

Wenjun Chen et al. "Does Dust from Arctic Mines Affect Caribou Forage?" *Journal of Environmental Protection*, 8, 258-276. March 16, 2017.

- Results indicated that the amount of dust on leaves in a zone of ~1000m from the Misery Haul Road was 3-9 times that of background sites. The zone of reduced lichen percent cover was also about 1000 m.

[6] Ontario's Ambient Air Quality Criteria, Apr 2012; Alberta Ambient Air Quality Guidelines, June 2016; BC Ambient Air Quality Objectives, Oct 2014

Applicability

Although the Measure is directed specifically at the Jay Project ZOI, it is important to note that an estimate of the caribou ZOI for the Jay Project has yet to be made and in fact, when such a determination is made, it will not be independent of the ZOI of the Ekati site. Therefore in order to establish a dustfall objective for the Jay Project ZOI, it is logical that it also apply to the entire Ekati site.

Measure 6-2(a) from the Report of EA requires Dominion to undertake an enhanced dust mitigation study that is aimed at reducing dust on a site-wide basis as an offset to the impacts of the Jay Project. Therefore it is logical to develop a dustfall objective that is also applicable site-wide to ensure consistency with related measures.

Furthermore, air quality and emissions management for the Jay Project and the original Ekati project site are to be merged in the spring of 2017 as committed to during the review of the Jay Air Quality Emissions Monitoring and Management Plan (AQEMMP), under a comprehensive AQEMMP. Standards, objectives and protocols used throughout the air program are generally applicable to all components of the Ekati project, and as such, it's important to ensure the proposed interim dustfall objective is also applicable site wide.

As such, ENR has developed the proposed interim dustfall objective to be applicable to the entire Ekati site rather than exclusively for the Jay project.

Approach / Method

Improvement Objective

The approach of selecting an improvement goal, in the absence of having a measurable risk-response, must be based on other practical considerations. ENR determined that a percentage improvement must be measurable given the resolution of the technology and it must be an achievable goal given the deposition values realized in the current monitoring network. Achievability takes into consideration possible modifications to dust suppression efforts underway on-site, and expected changes in dust generating activity levels at site compared to anticipated Jay Project activity levels.

Considering the above, ENR recommends an improvement of 10% from Ekati's current measured dustfall deposition as an interim approach to reducing dust-related sensory disturbances to caribou. This 10% (1.53 $mg/dm^2/day$) improvement is to be applied 300m from the dust source

Additional discussion on the rationale is presented further in this report.

Technology

Monitoring dustfall in a remote area is limited by the availability of electricity and accessibility, and as such, dustfall canisters are typically deployed for broad spatial coverage in such situations. Dustfall canisters are passive units which can be deployed broadly with no requirement for electricity, or generally, for any calibrations or technical attention. However, they yield relative results, useful for trend indicators with a lower degree of accuracy compared to ambient monitoring technology. Dustfall canisters have been employed at Ekati since 2007. They are, and have been, the only systems in place to monitor dustfall at the Ekati mine site.

ENR does not have any recommended alternative technology to achieve dustfall monitoring across a broad spatial network with limited access to electricity, and as such, dustfall canisters are the recommended technology for this application.

The standard operating procedure for dustfall canisters is an exposure/monitoring period of 30 days. Dustfall canisters use a liquid medium and therefore are only operable during the above-freezing months. Ekati has historically conducted dustfall monitoring within the months of June until September of the calendar year, resulting in three samples per station over the sampling season. Therefore, for the purposes of this Measure, ENR uses the term 'season' to refer to the months of June to September.

Seasonal Monitoring

Setting an objective for the summer season only is driven by the technology (i.e., dust canisters) in use to measure dustfall, as indicated earlier. Further rationale for setting a dustfall objective for the summer season only includes the following:

- Dust generation is higher in the summer than winter, and therefore addressing dust generation in the summer months will result in mitigation that addresses the major source of dust.
    - ENR refers to a 2012 study conducted by Golder Associates[7], indicating that dust generation levels on haul roads at the Snap Lake Mine are reduced by up to 96% by natural mitigation associated with winter conditions (i.e., snow cover and freezing temperatures) when compared to similar operations in the summer. The study was limited in scope/approach; however, it does give an indication that dust generation from roads is higher in the summer compared to winter.
    - Ambient particulate monitoring from the Hi-vol and partisol monitoring program at the Ekati site have demonstrated reduced

[7] Golder Associates. "Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada." Sept 2012.

ambient TSP concentrations in the winter months relative to the summer season[8], further emphasizing this point.

- Caribou forage for lichen in the vicinity of the Ekati mine primarily in the early summer and early fall[9], whereas their presence is limited in the winter months. Therefore, measuring dustfall reductions the summer season is most effective from a caribou exposure perspective.

- The most common dust mitigation measures, including the application of dust suppressants, are most effectively conducted in the snow-free, above-freezing months.

Historic Dust Generation/Measure at Ekati

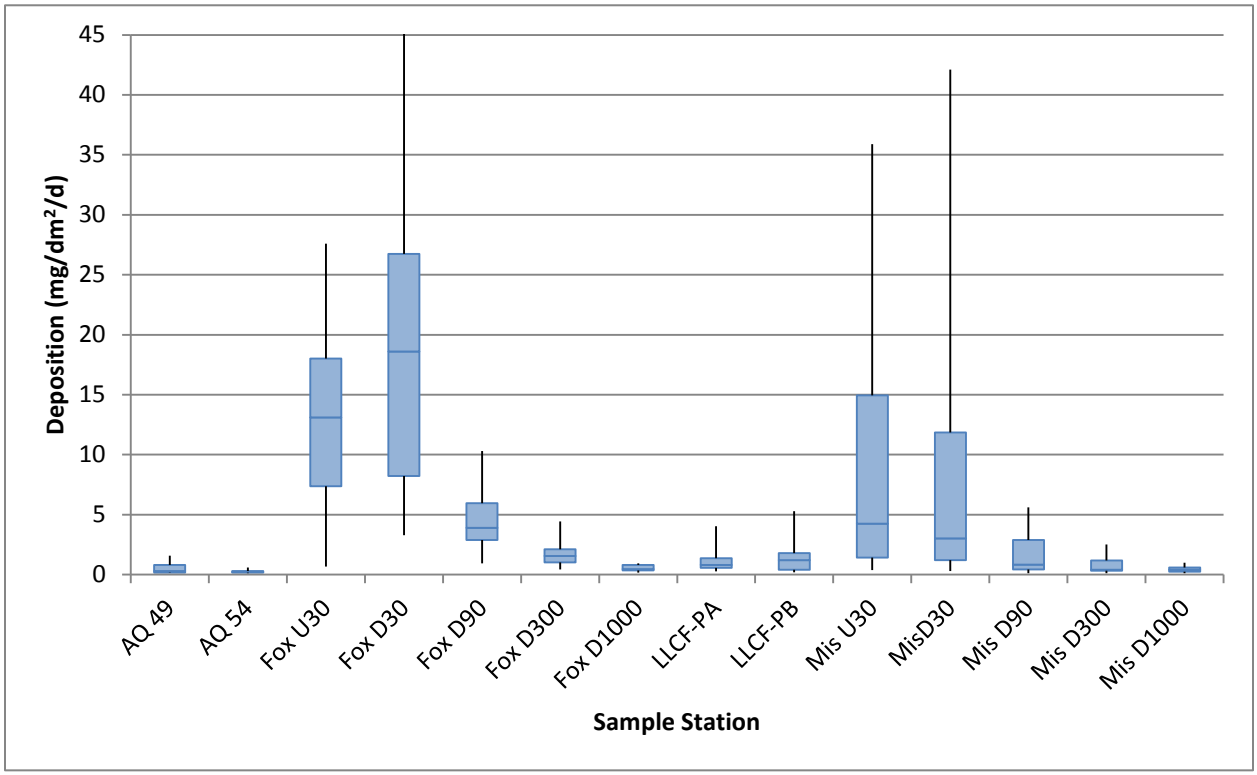
ENR has reviewed the dustfall results measured at the Ekati site to date, obtained from Ekati's air quality monitoring program reports, with measurements starting in 2007. The most consistent/frequently measured sites within the monitoring network are the transect sampling stations associated with the Fox haul road and the Misery haul road, and Ekati's two background station locations. The dustfall canisters for the transect stations are set up 30m upwind from the roads, and 30m, 90m, 300m, and 1km downwind from the roads. The two background sites are located 21km and 36km WNW from the Ekati site. Refer to Tables 1 and 2 of Appendix 1, attached.

The data results for the above-noted stations were deemed to be the most complete of all the sites within the monitoring network and were further assessed for outliers and trends. Outliers were identified and removed from the dataset, consisting of 3 out of the 288 data points. The data was then plotted to demonstrate distribution, as presented in Figure 1.

[8] Ekati Diamond Mine 2014 Air Quality Monitoring Program Report, Air Fig 3.4.1: 2012-214 High Volume Air Sampling and Partisol Station Results, TSP and $PM_{2.5}$

[9] Wildlife Effects Monitoring Plan for the Ekati Diamond Mine, Nov 2016, Figure 2-1, Appendix C: Graph of Seasonal Abundance of Bathurst Caribou in the Ekati Mine Regional Study Area from Post-calving Aerial Surveys, 1998-2012.

Figure 1: Deposition Data Distribution: 2007 - 2014



As demonstrated in Figure 1, the variation in data results is indirectly proportional to the distance of the sampling station from the dust source. In other words, the highest variation in dustfall results occur at the stations closest to the roads (i.e., Fox U30, Fox D30, Mis U30, MisD30), and variation decreases as the distance from the road increases. The results from the sampling stations located at 1km from source (i.e., Fox D1000 and Mis D1000) are similar to the background sites (AQ 49 and AQ 54). The results from sample stations located 300m from source (i.e., Fox D300 and Mis D300) provide the smallest data spread (the least variability), while still measuring above background levels.

> *Therefore, the 300m sample stations are the ideal distance from source from which to establish a 10% improvement on measured/realized dustfall.*

The Fox D300 and Mis D300 sample stations had different overall dustfall levels; specifically, they realized 1.70 +/- 0.56 and 0.71 +/- 0.59 mg/dm^2/day overall averages from 2007 to 2014, respectively (refer to Tables 1 and 2 of Appendix 1, attached). Given the difference in the dust levels realized at these two stations, further assessment was undertaken to determine if a correlation could be established between the dustfall results and the primary factors affecting dust

generation. The primary factors considered were activity levels on the roads and weather conditions.

Activity levels on the roads, such as daily traffic volumes, vehicle types, and load weights, were not specific information that Dominion collected over the years. In an attempt to fill this gap, Dominion compiled information associated with annual ore production for both processing and waste rock, and annual site-wide motive diesel fuel use to assess against dust levels. Multiple analyses were conducted by Dominion's consultants, with linear regression establishing a positive relationship between motive diesel and dust levels for distances -30, 30, 90 and 300m for the Misery haul road stations; however, the resulting best-fit linear equation for the Mis D300 station was not robust. No significant, positive relationship was found for the Fox haul road stations. Dominion further carried out a linear regression analysis of rainfall data against dust generation, but again, the correlation analysis did not yield any conclusive findings. As such, a relationship was not possible to be established that could be applied to expected conditions with the Jay Project.

> *It's important to note that ENR has not reproduced these analyses, but does agree with the input variables used and the approach taken.*

Dominion and ENR then simplified the approach by looking at overall operational usage of the Fox and Misery haul roads over the 2007 to 2015 timeframe, attached as Appendix 2. It is evident that the Fox D300 dustfall results were higher than the Mis D300 results until 2015 due to more frequent and consistent usage, including waste rock and ore transport along Fox, whereas Misery had generally suspended or minimal mining and hauling activities over this timeframe. ENR concludes that the past operations on the Fox haul road will be more representative of the anticipated activities along the Misery and Jay Project roads than the past Misery haul road activity.

> *Therefore, the Fox D300 dustfall data set is the preferred basis from which to establish a 10% improvement on measured/realized dustfall.*

The existing dustfall network is not a robust experimental design as it generated a relatively small data pool, and it was not planned to be able to determine variability both within and between sample distances. Despite this, it can be considered a reasonable surveillance program. Statistically manipulating the data set would not necessarily improve the confidence in conclusions arising from the data though, such as employing the Bootstrap or Monte Carlo methods. As such, ENR has elected to not employ these methods of analysis. Therefore using the standard data set for Fox D300, ENR has considered that the running seasonal average for all years monitored (i.e., 2007 to 2014) would best capture the differences throughout a

season, as well as the variations that occur from year to year. The running seasonal average is the best available metric for this use. Using the mean value is a conservative representation of the data when considering an overall improvement of performance.

> *Therefore ENR has elected to use the running seasonal average of the Fox D300 data set as a basis from which to establish a 10% improvement on measured/realized dustfall.*

Background Levels

The background monitoring stations, AQ49 and AQ54, operated over the same time frame as Fox D300 and yielded running averages of 0.51 +/- 0.28 and 0.25 +/- 0.10, respectively. The background sites are such a distance from the mine site that influences of 'dust' (i.e., large fraction particulate matter) from mine activities would not be expected, since those particulate would fall out over that span. Since the background sites realized dustfall levels from natural conditions, which would presumably have similar effects at the other monitoring stations within the influence of the mine's activities.

> *ENR determined to base the dustfall objective on the Fox D300 results without a correction for background levels*.

Conclusion

The running seasonal average of the Fox D300 sampling station, from 2007 to 2014, with one outlier removed, is 1.70 mg/dm^2/day. A 10% improvement on this value is 1.53 mg/dm^2/day, which is therefore the recommended interim dustfall objective for the Ekati site, to be applied 300m from the dust source.

Discussion / Response Measures

Setting a quantitative objective that is based on an improvement of dust generation requires that one consider the measures possible to achieve this improvement. From a dust generation perspective, the major activities that influence dust are vehicle movement, meteorological conditions, blasting activities, and stockpile conditions. Factors that Dominion can directly influence include the volume of vehicle traffic, as well as individual vehicles' speed and weight, or road dust suppression; dust suppression of ore/waste rock during handling and movement; blasting frequency and cover, and stockpile construction and suppression. Many of these factors would affect operations, and as such, the most realistic approach to achieving a reduction in dust generation is to focus first on suppression, which can include roadways and stockpiles and ore/waste rock movement. Although Dominion has historically employed dust suppression activities at these sources, ENR is aware that Dominion has undertaken a pilot study of a dust suppressant

called Envirokleen which is anticipated to achieve superior results compared to previous road dust suppression activities, and is intended for site wide use starting in the 2017 season. ENR is confident that if the seasonal dustfall objective is not realized, then additional mitigative actions can be taken by Dominion to further improve suppression efforts.

Linkages to Other Plans and Measures

This Measure is linked to Measure 6-3 which requires Dominion to finalize and implement the AQEMMP (for the Jay Project) prior to construction. Through the AQEMMP, Dominion will implement a dustfall monitoring program, and will report on whether the dustfall objective was met and the effectiveness of emissions mitigations, including the fugitive dust abatement program. The AQEMMP will be updated to incorporate the dustfall objective within six months of the objective being adopted and Dominion has committed to developing a series of appropriate thresholds and action levels consistent with the new dustfall objective.

Measure 6-2(a) of the Report of EA requires Dominion to undertake an enhanced dust mitigation study. Information on Dominion's dust mitigation study will be incorporated into the Caribou Offset and Mitigation Plan, which will be completed by May 19, 2017. Information on Dominion's dust management best practices with triggers for additional dust suppression is to be included in the Caribou Road Mitigation Plan, as required under Measure 6-1.

Measure 13-3 requires that annual reporting be conducted by Dominion on the implementation and effectiveness of measures associated with the Jay project, including Measure 6-4. ENR recognizes that the annual assessment on the effectiveness of the interim dustfall objective will act as a trigger for conducting a review of the interim dustfall objective in advance of the scheduled five year review timeline (i.e., 2022), in the event that more frequent reconsideration is required.

Next Steps

ENR is undertaking scientific research to investigate effects of atmospheric emissions on the terrestrial environment in the arctic. This research is looking beyond dustfall, and includes the transport and fate of fine particulate and chemical species, with the intention of linking effects from the terrestrial environment to wildlife. The research is intended to inform future contaminant limits in the NWT Air Regulations.

ENR notes that the initials findings of phase one of this research, (i.e., the literature review), is indicating many angles of investigation will be required to satisfy the overall objective. Therefore, ENR anticipates a minimum timeline of five years before more concrete standards can be considered from a regulatory perspective.

ENR will revisit the Ekati site-specific interim dustfall objective in 2022, based on information obtained from our research initiatives. If annual reporting on the effectiveness of the measures, by Dominion, is found to indicate that revisiting the objective sooner than 2022 is necessary, ENR will proceed accordingly.

Appendix 1

Table 1 - Ekati Dustfall Canister Results, 2007-2014

	mg/dm^2/day	2007			2008			2009			2010			2011			2012			2013			2014		
Dustfall Station	**Distance from Source**	**Jul**	**Aug**	**Sept**	**Jun**	**Jul**	**Aug**	**July**	**Aug**	**Sept**	**July**	**Aug**	**Sept**	**Jun**	**July**	**Aug**	**Jun**	**Jul/Aug**	**Aug/Sept**	**Jun/Jul**	**Jul/Aug**	**Aug/Sept**	**Jun/Jul**	**Jul/Aug**	**Aug/Sept**
Air P125	airstrip				0.25	0.29	0.43	4.07	0.69	0.82	0.51	0.48	0.39	0.4	0.19	0.48	0.5	0.6	0.2	1.4	0.7	0.9	0.8	1.3	2.3
Air P162	airstrip				<0.1	<0.1	0.51	0.32	0.58	0.47	0.6	1.1	3.29	0.91	0.32	0.65	0.3	0.9	0.3	1.3	1.3	0.4	0.8	1.7	2.6
Air P280	airstrip				<0.1	1.61	0.75	0.25	<0.1	0.6	2.39	3.38	0.9	3.92	1.09	0.79	2	1.3	0.6	2.1	1.6	1.2	4.1	1.9	1.9
AQ 49	21km WNW	0.31	1.57	<0.1	11.3	0.13	1.38	0.14	0.79	<0.1	0.2	0.16	0.38	0.14	0.14	0.16	<0.1	0.5	0.2	1	0.8	0.5	0.3	0.8	0.2
AQ 54	36km WNW	<0.1	1.26	<0.1	0.33	0.12	0.21	0.22	0.29	0.11	0.14	<0.11	0.33	<0.10	0.13	0.13	<0.1	0.2	0.2	0.6	0.3	0.3	0.3	0.6	0.2
Fox U30	30 m upwind	19.6	17.9	10.2	4.88	0.66	2	14.8	8.14	7.34	14.7	16.1	4.7	7.37	6.1	7.39	27.6	23.8	16.4	17.2	18.3	25.1	19.5	11.5	9
Fox D30	30 m downwind	5.36	18.6	6.4	20.2	<0.1	3.29	62	8.84	40.1	36.6	19.6	17.6	21.4	30.5	16.3	7.6	21.9	17.9	23	12.4	35.7	32.3	7.4	3.4
Fox D90	90 m downwind	9.6	4.69	2.16	3.67	2.87	0.95	10.3	1.5	3.82	7.01	5.95	3.54	2.94	6.18	3.13	6.9	4.4	4	4.3	2.9	6	5.5	2.3	1.2
Fox D300	300 m downwind	35.2	1.77	1.03	1.54	1.03	0.46	4.42	0.57	1.82	2.04	2.34	2.05	0.94	1.39	0.89	2.73	1.55	1.45	2.72	1.13	3.42	2.17	1.47	0.42
Fox D1000	1km downwind				0.39	8.52	0.37	0.94	0.18	0.42	0.72	0.37	0.51	0.17	0.29	0.33	0.8	0.8	0.6	0.9	0.6	0.4	0.8	0.9	0.2
LLCF-PA	LLCF				0.46	0.31	0.72	0.78	0.26	0.82	1.54	0.95	4.03	0.3	1.09	4.03	0.4	0.7	1.7	1.3	0.8	2.3	0.8	7	0.6
LLCF-PB	LLCF				0.8	1.32	0.32	0.47	3.36	2.3	1.29	1.29	0.2	0.21	0.34	2.38	0.2	3.5	0.5	1.3	0.9	1.2	5.3	1.8	0.4
Mis U30	30 m upwind	15.1	25.1	14.9	0.81	1.03	0.38	1.33	1.51	0.97	1.44	3.1	1.45	1.06	3.77	2.15	5.5	7.8	7.1	4.7	35.9	14.9	27.7	25	20.1
MisD30	30 m downwind	42.1	21.6	16.2	0.46	0.39	0.57	1.59	0.56	0.31	1.26	2.63	1.01	1.47	1.92	2.27	3.4	6.9	3.5	5.9	11.2	7.5	40.1	13.8	18.1
Mis D90	90 m downwind	5.37	5.62	2.84	0.19	0.37	0.33	0.11	0.47	0.11	0.39	0.83	0.46	0.49	0.76	0.84	1.8	1.5	0.7	1.8	3	2	5.5	3.1	4.1
Mis D300	300 m downwind	1.41	2.51	0.69	0.35	<0.1	0.32	0.2	0.13	0.11	0.36	0.5	<0.2	0.32	0.24	0.33	0.4	0.4	0.2	1.5	1.1	0.5	2.4	1.2	1.2
Mis D1000	1km downwind				0.17	<0.1	0.26	0.19	0.53	0.14	0.48	2.04	0.56	0.25	0.23	0.97	0.1	0.3	0.4	1	0.5	0.4	0.6	0.6	0.6
MisNew D90	better aligned with ENE wind along Misery road																								6.3
MisNew D300																									1.2
MisNew D1000																									0.3
WasteRock 100	Fox Pit, 100 m downwind																	0.3	0.3						
WasteRock 300	300 m downwind																	0.4	0.4						
WasteRock 1000	1km downwind																	0.5	0.2						
SAB U30	Sable Road, 30m upwind	1.77	4.15	<0.1																					
SAB D30	30m downwind	5.33	2.41	<0.1																					
SAB D90	90m downwind	1.47	0.51	<0.1																					
SAB D300	300m downwind	0.66	0.52	<0.1																					

Legend: outlier - removed from calculations

blank cell - no data collected

Table 2 - Select Seasonal Averages

	mg/dm^2/day										
Dustfall Station	**Distance from Source**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Average**	**Stdev**
Fox D300	300 m downwind	1.40	1.01	2.27	2.14	1.07	1.91	2.42	1.35	**1.70**	**0.56**
Mis D300	300 m downwind	1.54	0.34	0.15	0.43	0.30	0.33	1.03	1.60	**0.71**	**0.59**
AQ 49	21km WNW	0.94	0.76	0.47	0.25	0.15	0.35	0.77	0.43	**0.51**	**0.28**
AQ 54	36km WNW		0.22	0.21	0.24	0.13	0.20	0.40	0.37	**0.25**	**0.10**
Fox D1000	1km downwind		0.38	0.51	0.53	0.26	0.73	0.63	0.63	**0.53**	**0.16**
Mis D1000	1km downwind		0.22	0.29	0.52	0.48	0.27	0.63	0.60	**0.43**	**0.17**

Appendix 2: Operational Usage of the Fox and Misery Haul Roads

FOX PIT

2005:

- Extended culvert across Fox Road near the AN Building
- Installed pumping system, two perimeter sumps, and geotechnical instrumentation at Fox Pit

2006:

- Waste rock was transported to Fox Waste Rock Storage Area

2007:

- Waste rock was transported to Fox Waste Rock Storage Area

2008 - 2013:

- Kimberlite ore was transported to the Process Plant
- Waste rock was transported to Fox Waste Rock Storage Area.

2014:

- Kimberlite ore was transported to the Process Plant; and
- Waste rock was transported to Fox Waste Rock Storage Area.
- Fox Pit mining activities were concluded and the pit placed on a care and maintenance basis to allow for future deeper exploration drilling.

2015:

- No mining of Fox Pit occurred

MISERY PIT

2005:

- April, 2005 mining operations suspended at Misery Pit, but ore hauling activities continued from Misery WRSA to the Process Plant throughout 2005.

2006:

- No mining operations took place in 2006
- Hauled stockpiled kimberlite from Misery WRSA to Process Plant

2007:

- No mining operations took place in 2007
- Hauled stockpiled kimberlite from Misery WRSA to Process Plant

2008:

- Mining activities remained suspended in 2008
- Delineation drilling occurred around Misery Pit from January through November.

2009:

- No operations occurred in Misery Pit in 2009

2010:

- Misery Pit was partially dewatered into King Pond Settling Facility (KPSF) in August and September 2010.

2011:

- Misery Pit was partially dewatered into King Pond Settling Facility (KPSF) in August and September
- Waste stripping for the Misery Pit pushback began in 2011
- Construction of Misery Camp occurred throughout 2011

2012:

- Waste stripping for the Misery Pit pushback continued through 2012.
- Construction of Misery Camp Completed

2013:

- Waste stripping for the Misery Pit pushback continued through 2013.

2014:

- Waste stripping for the Misery Pit pushback continued through 2014.
- Construction begins on Misery Powerline in August, 2014

2015:

- Kimberlite was stored on Ore Storage Pads at Misery Camp before being transported to the Main Camp Process Plant;
- Waste rock was hauled to the Misery Waste Rock Storage Area and the Misery Crusher Pad; and
- Water was pumped from Misery Pit into the King Pond Settling Facility from July 10 to October 5, 2015 for a total volume of 221,145 m^3.
- Misery Powerline construction occurred through 2015
- Crusher pad construction begins in September, 2015