Appendix G

Dustfall Monitoring Program

4-3 VEGETATION MONITORING: DUST FALL

The potential impacts of dust deposition on soil and vegetation has been identified as an issue of concern for the Project. In particular, other studies have shown dust deposition to have a detrimental effect on vegetation health, and dust deposition on caribou forage (i.e., lichen) has been suggested as a potential mechanism causing caribou to avoid habitat at a distance of up to 14 km (Boulager et al. 2012). The main sources of dust emissions are fugitive sources, specifically bulk handling operations, crushing, blasting, storage, and dust emissions from vehicle and equipment traffic, although natural sources of dust fall also exist (e.g. wind erosion). The largest amount of dust fall generated by the Project is expected to be associated with use of the existing Tote road linking the Mine site with the port at Milne Inlet; however, there will also be dust fall generation from the railway and from point source locations at both the Mine site and ports.

The Mary River dust fall monitoring program was initiated in the summer of 2013 with sampling stations set up at the Mine site, Milne Port, along the Tote road, and at reference sites within the RSA. At this time, the railway and Steensby port are not included in the dust fall monitoring program, due to access issues. Future construction of the railway linking Steensby port with the Mine site will initiate dust fall monitoring for the southern section of the RSA. The dust fall monitoring program was developed using knowledge gathered from other similar air monitoring programs (Ekati Mine, High Lake Project, Rescan 2006), as well as applicable caribou research. The monitoring program is in accordance with the American Society for Testing and Materials (ASTM) ASTM D1739-98 sampling method (ASTM 2004).

Objectives

There are three main objectives of the dust fall monitoring program:

2. To quantify the extent and magnitude of dust fall generated by Project activites;
3. To determine seasonal variations in dust fall at all sampling locations; and
4. To determine if annual changes in dust fall at sampling locations exceed identified thresholds associated with isopleth dispersion models.

Thresholds

There are no known dust deposition thresholds specific to effects on vegetation. Health Canada/Environment Canada's national ambient air quality objectives for particulate matter (CEPA/FPAC Working Group 1998) state that for the lack of quantitative dose-effect information, it is not possible to define a reference level for vegetation and dust deposition. In the absence of published thresholds for dust effects on vegetation, the High Lake Project (Wolfden Resources Inc. 2006), a proposed base metal mine in western Nunavut, developed thresholds in consideration of effects to vegetation health ranging from 4.6 g/m^2/a for a low magnitude effect to ≥50 g/m^2/a for a high magnitude effect (Table B-2). These values were based on a combination of the Alberta (AB) and Ontario (ON) ambient air quality criteria for human health purposes, and values reported by Spatt and Miller (1981) specific to effects of road dust on vegetation.

In addition to the consideration of thresholds developed by the High Lake Project, isopleth dispersion models (CALPUFF dispersion models) were used to predict deposition patterns from all sources during the operations phase of the Project. The CALPUFF dispersion model was recommended by a number of regulatory agencies and has been the *de facto* standard for environmental assessments in Canada's North. To refer to activities that are included in the assessment of the operations phase refer to the *ERP Addendum to FEIS Volume 5*.

To align with results of the isopleth dispersion models and the thresholds described above (Table B-2), the following annual TSP depositions thresholds will be used for the Mary River Project:

Low: 1–4.6 g/m²/a;

Moderate: 4.6–50 g/m²/a; and

High: ≥ 50 g/m²/a.

Table B-2 Dust (TSP) Deposition Rates and Criteria for Potential Effects on Vegetation Health.

Source of Information	Dust (TSP) deposition rate	Equivalent annual dust deposition rate (g/m²/a)	Comments
High Lake Impact Assessment (Wolfden 2006)	1.0–4.6 g/m²/a	1.0–4.6	Predicted low magnitude effect on vegetation health
	4.6–50 g/m²/a	4.6–50	Predicted moderate magnitude effect on vegetation health
	50–200 g/m²/a	50–200	Predicted high magnitude effect on vegetation health
Spatt and Miller (1981)	0.07 g/ m²/ d	26	Some effects to Sphagnum species
	1.0-2.5 g/ m²/ d	365-913	Decline in Sphagnum species abundance
Alberta	5.3 g/m²/30 d	64	Alberta Guidelines for Residential and Recreational Areas (human health)
Ontario	4.6 g/m²/a	4.6	Ontario Ambient Air Quality Criteria (human health)

Methods

The Mary River dust fall monitoring program is based on passive dust fall monitoring methods. A total of 26 sampling sites were installed July 2013 at the Mine site, Milne Inlet, Tote road and reference sites within the RSA (Figure B 4.3-1). Sample site locations were chosen with consideration of the direction of prevailing winds within the RSA, excluding areas of future infrastructure development, and to represent areas of various expected dust fall concentrations based on isopleth dispersion models. The 26 dust fall sample sites include:

- Four reference sites (two located southeast and upwind of the Baffinland Mine Site; two located 14 km south and west of the road centerline with no prevalent wind direction to direct location effort).
- Three sample sites located in dust generating areas of the Baffinland Mine Site (identified via isopleth models);
- Three sample sites in Milne Inlet (two within the port area itself, and one northeast and upwind of the port); and
- Two road stations, each composed of eight sample sites located at 30 m, 100 m, 1 km and 5 km to either side of the centreline along Tote Road (prevalent wind direction roughly parallel to the roadway as opposed to perpendicular, therefore no ‘upwind’ and ‘downwind’ directions from the road are identified).

Each site is comprised of one sampling apparatus, which is made up of a hollow post (~ 2m long) and terminal bowl shaped holder for the dust collection vessel (Photo B-1). The terminal bowl is topped with bird spikes to prevent contamination by bird fecal matter. The sampling apparatus was installed by pounding 5-foot rebar into the ground, placing the post over the rebar, and then stabilizing with guy wires. Dust collection vessels are placed in the holder, pre-charged with 250 mL of algaecide in summer and 250 mL of alcohol in winter. Collection vessels are changed out every month (28–31 days) and shipped to ALS Environmental Laboratory (ALS) in Vancouver for analysis of total, fixed and volatile insoluble particulate matter.

Caribou present in the area of the Baffinland Mine site are sedentary and are present year-round. Therefore, sampling of the dust fall monitoring stations will occur on a year-round basis; however, during the winter, the sampling program will be limited to a subset of the sampling sites (at present, 14 out of 26) as access to remote sites is limiting.

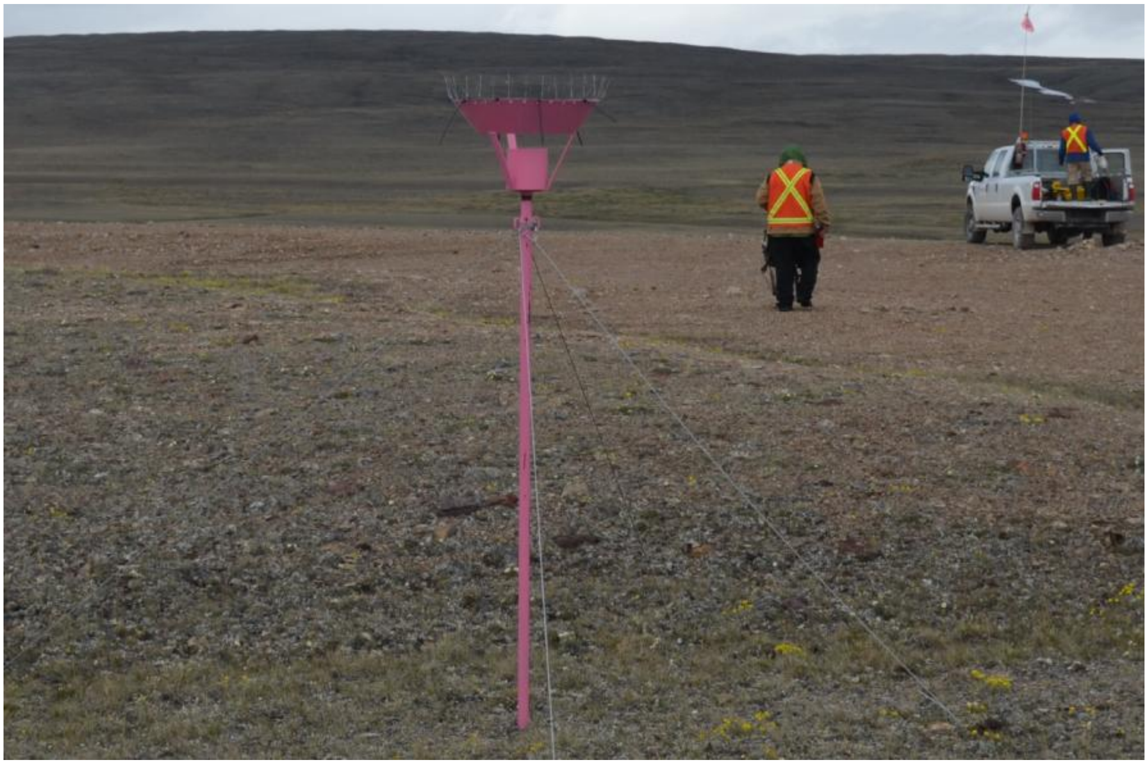


Photo B-1. Dust fall collector sampling apparatus, July 10, 2013.

Laboratory results are analyzed against the predicted dust deposition thresholds for the Project to determine if concentrations are exceeding the applicable indicator threshold. Results are also reviewed to investigate concentrations on a temporal and spatial scale relative to background concentrations with focus on seasonal differences in dust fall data. As of January 2014, three months of sampling results have been received back from the lab; in addition to the analyses described above, a power analysis is also being completed based on these results to determine the level of variability among the sampling stations and assess whether the current monitoring program is sufficient or if additional sampling stations are required to accurately capture Project effects.

References

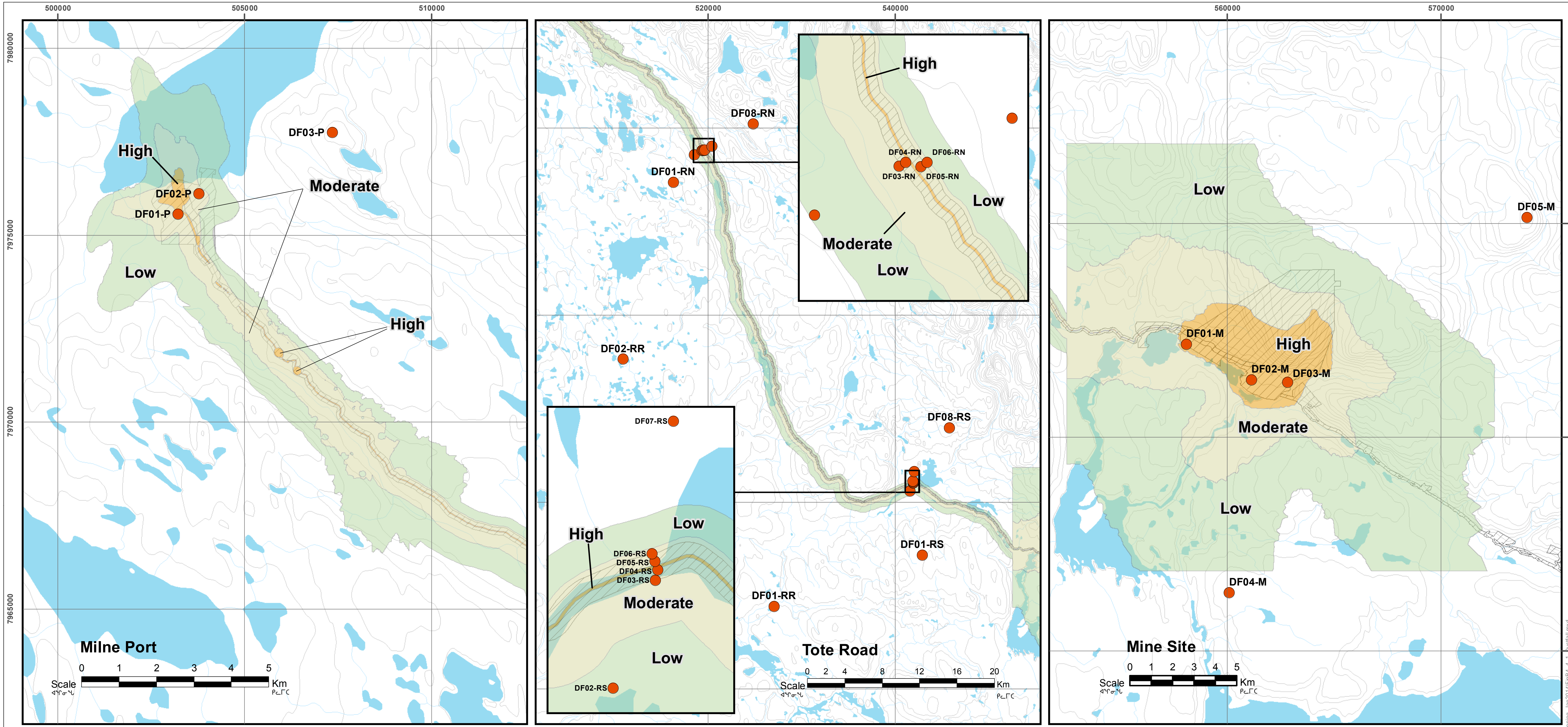
American Society for Testing and Materials (ASTM). 2004. Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter) Designation D 1739-98 Reapproved 2004, West Conshohocken, PA.

Boulanger J., Poole K.G., Gunn A., and J. Wierzchowski. 2012. 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.

CEPA/FPAC Working Group on Air Quality Objectives and Guidelines. 1998. National ambient air quality objectives for particulate matter. Executive Summary. Part 1: Science assessment document. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/air/naaqo-onqaa/particulate_matter_matieres_particulaires/summary-sommaire/98ehd220.pdf.

Rescan Environmental Services Ltd. 2012. Ekati Mine 2011 Air Quality Monitoring Program. Produced for: BHP Billiton Canada Inc.

Wolfden Resources Inc. 2006. High Lake Project Proposal. Volume 6: Terrestrial Environment, Section 2.0 - Vegetation. Project proposal submission the Nunavut Impact Review Board, November 2006.



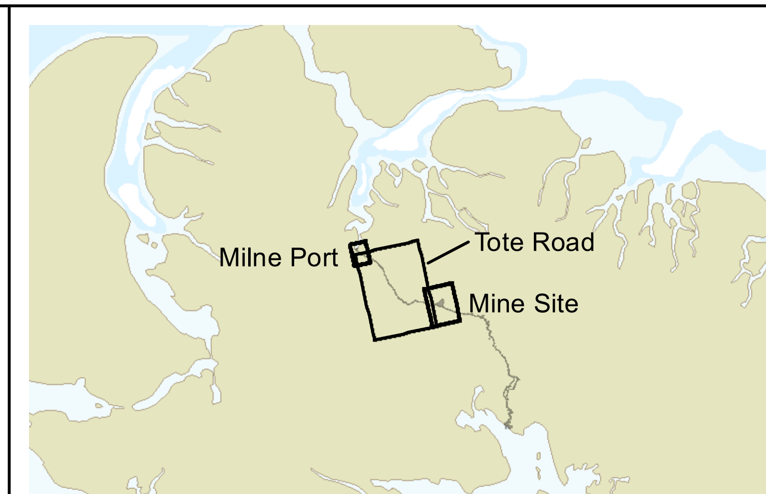
LEGEND

- Dustfall Sampling Sites
- Potential Development Area
- Topographic Contour (20m Interval)
- Watercourses
- Waterbodies

TSP Annual Deposition

- High (>50 g/m²/a.)
- Moderate (4.6–50 g/m²/a.)
- Low (1–4.6 g/m²/a.)

N E S W



NOTES

TSP deposition isopleths provided by RWDI Air Inc. (2013) and modified by EDI for display purposes.

Northern Land Cover of Canada (Circa-2000) courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Updated PDA provided by Hatch (25 April 2013).

Projection: North American Datum 1983 UTM Zone 17N.

Baffinland Iron Mines Corporation

2013 Dustfall Collector Locations within the Mary River Project Area

EDI

Date: 15/01/2014

FIGURE B4.4-1