AGNICO EAGLE

MELIADINE GOLD PROJECT

Dust Management Plan

MARCH 2019

VERSION 5

Executive Summary

Agnico Eagle Mines Limited (Agnico Eagle) will use best management practices to minimise dust generation from becoming airborne at the mine site, Itivia, and all access, service, and haul roads. This includes identification of major sources of dust, implementation of dust mitigation measures, inspections for unacceptable levels of dust, and recording dust monitoring data to document Agnico Eagle's success in controlling and reducing dust at the Meliadine Project. The Dust Management Plan focuses primarily on dust generated from roads, with some reference to other mining activities. Dust generated from other mining activities, such as the Tailings Storage Facility (TSF), are addressed in other plans, including the Mine Waste Management Plan and the Tailings Storage Facility Deposition Plan .

Dust could potentially be generated by such activities as road use, drilling, blasting, crushing, conveying, loading, hauling, unloading, stockpiling, and by wind erosion of dry, exposed mine areas. Dust emissions will be prevalent during late spring and summer, while being much reduced in fall and winter.

Mitigation measures to control dust include mine design and operational procedures. Operational practices, such as speed limits and road maintenance, will assist in reducing dust. Water and, if necessary, chemical dust suppressants such as calcium chloride, or another acceptable chemical, will be used to control and reduce dust on roads and other mine areas when airborne dust becomes a safety hazard or impacts on sensitive natural areas. The Itivia bypass road will not have any chemical dust suppressants applied. Only water will be applied on this portion of the road for dust suppression. Dust suppression measures will be in place during construction, operations, and closure.

ᓇᐃᓈᖅᓯᒪᔪᖅ

ᐊᒡᓃᑯ ᐃᒍ ᐅᔾᕿᒃᑕᕆᐊᓕᕆᔨᒃᑯᑦ (ᐊᒡᓃᑯᒃᑯᑦ) ᐊᑐᕐᓂᐊᖅᑐᑦ ᐱᐅᓛᓂᒃ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᓂᒃ ᐳᔪᖃᑖᓕᐅᓗᐊᒃᑭᑎᑦᑎᓂᕐᒧᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓄᐊᖅᑐᓂᒃ ᐱᔪᓂᒃ ᐅᔾᕿᒃᑕᕆᐊᕐᒥᑦ, ᐃᑎᕙᐊᓂᑦ, ᐊᒻᒪᓗ ᐊᐅᑉᕐᑯᑕᐅᔪᓗᒃᑖᓂᑦ, ᐊᒻᒪᓗ ᐅᓯᑲᑦᑕᖕᓂᕐᒧᑦ ᐊᑉᕐᑯᑎᓂᑦ. ᐃᓚᐅᔪᑦ ᐃᓕᑕᕆᓗᒋᑦ ᐱᔾᔪᑕᐅᓗᐊᖅᑐᑦ ᐳᔪᖃᑖᖕᒧᑦ, ᐊᑐᕐᓗᑎᒃ ᐳᔪᖃᑖᖃᓗᐊᖅᑕᐃᓕᓂᕐᒧᑦ ᐱᓕᕆᐊᓂᒃ, ᖃᐅᔾᔭᐃᓅᑦ ᓈᒻᒪᙱᑦᑐᓄᑦ ᓇᓅᓐᓂᐅᔪᓄᑦ ᐳᔪᖃᑖᖕᒥᑦ, ᐊᒻᒪᓗ ᑎᑎᕋᐅᓯᕆᓗᒋᑦ ᖃᐅᔾᔨᐊᖃᑦᑕᕐᓂᐅᔪᑦ ᑎᑎᕋᐅᓯᕆᓂᐊᕐᓗᒋᑦ ᐊᒡᓃᑯᒃᑯᑦ ᐱᐊᓂᑦᑎᐊᕐᓂᖕᒐᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐊᒻᒪᓗ ᒥᒃᓵᒋᐊᕐᓂᕐᒧᑦ ᐳᔪᖃᑘ ᑕᓯᕐᔪᐊᕐᒥᑦ. ᐳᔪᖃᑖᖕᒥᒃ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᑕᐅᑐᒐᖃᓗᐊᖅᑐᖅ ᐳᔪᖃᑖᓕᐅᖅᑐᑦ ᐊᑉᕐᑯᑎᓂᒃ ᐃᓚᖕᒋᓪᓗ ᐅᔾᕿᒃᑕᕆᐊᓕᕆᓂᕐᒥᑦ. ᐳᔪᖃᑖᓕᐅᕐᓂᖅ ᐊᓯᖕᒋᓐᓂᒃ ᐅᔾᕿᒃᑕᕆᐊᓕᕆᓂᕐᒧᑦ, ᓲᕐᓗ ᕿᒪᒃᑎᑦᑐᓄᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕙᖕᒥᑦ (TSF), ᐱᓕᕆᐊᖑᔪᑦ ᐊᓯᖕᒋᓐᓂᑦ ᐸᕐᓇᐅᑎᓂᑦ, ᐃᓚᐅᑉᓗᑦ ᐅᔾᕿᒃᑕᕆᐊᕐᒥᑦ ᐊᒃᑕᑯᓂᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᐊᒻᒪᓗ ᕿᒪᒃᑎᑦᑐᓄᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕙᐅᑉ ᐃᓂᖓᓄᑦ ᐸᕐᓇᐅᑎ.

ᐳᔪᖃᑖᓕᐅᕈᖕᓇᖅᑐᖅ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᑦ ᐊᑉᕐᑯᑎ ᐊᑐᖅᑕᐅᑎᓪᓗᒍ, ᐃᑰᑕᐃᑎᓪᓗᒋᑦ, ᖃᖅᑎᕆᑎᓪᓗᒋᑦ, ᓯᖃᓪᓕᑎᕆᑎᓪᓗᒋᑦ, ᓅᑎᕆᑎᓪᓗᒋᑦ, ᐅᓯᓕᖅᑐᐃᑎᓪᓗᒋᑦ, ᐊᒡᔭᖅᑐᐃᑎᓪᓗᒋᑦ, ᐅᓯᖕᒋᔭᐃᑎᓪᓗᒋᑦ, ᑲᑎᑎᕆᑎᓪᓗᒋᑦ, ᐊᒻᒪᓗ ᐊᓄᕆᒧᑦ ᓱᕿᒃᑕᐅᔪᓂᒃ ᐸᓂᖅᑐᓂᒃ, ᑕᑯᒃᓴᐅᔪᓂᑦ ᐅᔾᕿᒃᑕᕐᕕᐅᑉ ᖃᓂᑕᖓᓂᑦ. ᐳᔪᖃᑖᒃ ᑕᐃᒪᐅᓗᐊᖃᑦᑕᖅᑐᑦ ᐅᐱᕐᙲᖅ ᓄᖑᑉᐸᓪᓕᐊᓂᖓᓂᑦ ᐊᒻᒪᓗ ᐊᐅᔮᒃᑯᑦ, ᐅᑭᐊᒃᓵᒃᑯᑦ ᐊᖏᓗᐊᖏᓐᓂᖅᓴᐅᓕᖅᓗᓂ ᐊᒻᒪᓗ ᐅᑭᐅᒃᑯᑦ.

ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᕐᒨᖓᔪᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐳᔪᖃᑖᖕᒥᑦ ᐃᓚᐅᔪᑦ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒧᑦ ᒪᓕᒃᑕᐅᔫᓴᐃᑦ. ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᑦ, ᓲᕐᓗ ᑭᒡᓕᖅᑎᑦᑎᓂᖅ ᓇᑭᖅᓴᕆᐊᖃᕐᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐊᑉᕐᑯᓯᐅᕆᓃᑦ, ᐃᑲᔪᐃᖃᑦᑕᖅᑐᑦ ᐳᔪᖃᑖᖃᓗᐊᖕᒋᑎᑦᑎᓂᕐᒧᑦ. ᐃᒪᖅ ᐊᒻᒪᓗ, ᐱᔭᕆᐊᖃᖅᐸᑦ ᐳᔪᖃᑖᖃᓗᐊᖅᑕᐃᓕᔾᔪᑎᑦ ᓲᕐᓗ Calcium Chloride, ᐅᕝᕙᓘᓐᓃᑦ ᐊᓯᖕᖓ ᓈᒻᒪᒋᔭᐅᔪᖅ ᐊᑐᖅᑕᐅᔪᖕᓇᖅᑐᖅ, ᐊᑐᖅᑕᐅᓂᐊᖅᑐᖅ ᐳᔪᖃᑖᖃᓗᐊᖅᑕᐃᓕᑎᑦᑎᓂᕐᒧᑦ ᐊᑉᕐᑯᑎᓂᑦ ᐊᓯᖕᒋᓐᓂᒡᓗ ᐅᔾᕿᒃᑕᕆᐊᑉ ᖃᓂᑕᖕᒋᓐᓂᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓄᐊᖅᑐᖅ ᐳᔪᖃᑖᖅ ᐅᓗᕆᐊᓇᖅᓯᒃᐸᑦ ᐅᕝᕙᓘᓐᓃᑦ ᐊᒃᑐᖅᓯᓗᓂ ᐃᒃᐱᒋᓯᕿᐃᓐᓂᖅᖢᓄᑦ ᓄᓇᒥᑦ. ᐃᑎᕙᐊᓂᑦ ᐊᑉᕐᑯᑎ ᐊᑐᔾᔮᙱᑦᑐᖅ ᐳᔪᖃᑖᖃᓗᐊᖅᑕᐃᓕᔾᔪᑎᓂᒃ. ᐃᒪᖅ ᑭᓯᒥ ᐊᑐᖅᑕᐅᖃᑦᑕᕐᓂᐊᖅᑐᖅ ᐃᓚᙱᓂᑦ ᐊᑉᕐᑯᑎᐅᑉ. ᐳᔪᖃᑖᖃᓗᐊᖅᑕᐃᓕᑎᑦᑎᓂᕐᒨᖓᔪᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᑦ ᓴᓇᕚᓪᓕᐊᓂᕐᒥᑦ, ᐊᐅᓪᓚᖅᑎᑦᑎᓂᕐᒥᑦ, ᐊᒻᒪᓗ ᐅᒃᑯᐊᖅᐸᓪᓕᐊᓂᕐᒥᑦ.

TABLE OF CONTENTS

List of Tables

Document Control

Version	Date	Section	Page	Revision	Author
1	April 2014			Version 1 of the Dust Management Plan	John Witteman, Env. Consultant, Agnico Eagle
2	April 2015	7.2	11	Update plan for Water Licence application - Added EK-35 and DUST-STOP to chemical dust suppressants approved for use in Nunavut	John Witteman, Env. Consultant, Agnico Eagle
3	April 2017			General review of the plan	Environment Department, Agnico Eagle Mines
4	March 2018			Minor modifications	Environment Department, Agnico Eagle Mines
5	March 2019			General update of the document to reflect going into production	Terry Ternes, Sean Arruda, Environment Department, Agnico Eagle Mines
		5	7	Saline water trucked to Itivia	
		6.2	8	Removed sentence indicating transport on bypass road would be maximized in late summer and fall.	
		7	9-14	Calcium Chloride as dust suppressant	

1. Introduction

The Dust Management Plan (the Plan) is a framework for the management and control of dust[1] (airborne particulate matter) arising from traffic related to mine activities. Best management practices are identified to minimize and reduce the impact of dust on the natural and human environment.

The Plan identifies the sources of dust along with measures for their control during operation and closure.

2. Climate

The Meliadine Gold Project (Project) is located in the low Arctic eco-climate characterized by long cold winters and short cool summers. The frost-free period can be as short as 90 days and have prolonged periods with no precipitation. The 30-year climate normals for Rankin Inlet (1971 to 2000) indicate that wind speeds are relatively high, averaging more than 19 km/h every month.

Dust can be a problem at certain times of the year. During the winter and early spring, dust does not pose a significant problem as snow and ice cover most surfaces. However, surfaces that are exposed to the wind can result in dust, especially if ice resulting from fall rains is not present to bond fine particles together. However, in the late spring and summer, and under the right conditions, dust generation could present an issue at the mine site and along its roads. In late spring when temperatures remain below freezing, sublimation tends to cause mine surfaces, including roads, to be dry leading to a potential for dust generation. In summer, when evaporation is high and with little rain, mine surfaces and roads can be dry. The combination of low precipitation and drying winds promote dust generation from developed areas where work is underway and where vehicle traffic is present, especially if mitigation measures are not employed. High winds by themselves can also erode dust from exposed mine surfaces.

3. Related Documents

3.1 Environment Management and Protection Plan

The Environmental Management and Protection Plan (EMPP) provides Agnico Eagle with overarching direction to environmental and socio-economic management for the Project throughout its life (i.e., across all Project phases). It is a site-specific plan that describes the systematic means by which Agnico Eagle will consistently manage and control potentially adverse impacts, and enhance potential project benefits identified through the Environmental Assessment process and the subsequent licensing and permitting of the Project.

The EMPP offers enough flexibility to respond to changes, for example, in the mining development plan, the regulatory regime, the biophysical and socio-economic environments, technology, research results, best management practices, and the understanding of traditional knowledge. Thresholds and indicators

to trigger management actions are provided in the sub plans embedded in the EMPP, along with a system of accountability.

3.2 Air Quality Monitoring Plan

In the Air Quality Monitoring Plan (Agnico Eagle 2015), dust monitoring is expected to occur throughout all phases of the mine, during all seasons, at various locations on the mine site, along the All-weather Access Road (AWAR), the bypass road, and at the Rankin Inlet Itivia land-based facilities area (Itivia). The principle monitoring means are to be particulate fallout measurements.

The Air Quality Monitoring Plan outlines how dust monitoring data helps in verifying if the actual effects from air emissions are less than those predicted in the Final Environmental Impact Statement (FEIS). The data collected provides feedback for continuous improvement in dust mitigation measures. If the dust monitored indicates more dust than expected, adaptive management will be used to understand the reason for the elevated levels and recommend mitigation measures to reduce it.

4. Environmental, Safety and Operational Effects of Dust

The Project is anticipated to generate dust representative of local overburden and rock type. There should not be enrichment of any metal in the dust. Agnico Eagle will use all reasonable and practicable measures to minimise dust generated from the Project.

4.1 Environmental Concern

Physical and chemical stresses on the tundra environment are commonly associated with unpaved roads. Dust generated by vehicle traffic along the roads is carried by the prevailing wind onto the surrounding tundra where it is deposited onto the vegetation and waterbodies.

Chemically inert dust can have negative effects on sensitive receptors such as vegetation. It can accumulate on leaf surfaces and negatively affect leaf physiology. Dust has a shading effect, which reduces the amount of photosynthesis and increases the leaf temperature through incident solar radiation being absorbed by the dust, thus increasing the transpiration rate (Agnico Eagle 2008). Adverse impacts might occur on the wildlife that depend upon the vegetation as a food source. Dust carried off the roads can eventually wash into the local waterbodies adding suspended solids to the water, which can adversely affect water quality and possibly the health of aquatic species.

4.2 Safety Concern

Dust generated by vehicle traffic along roads and other mine surfaces is typically fine, inorganic particulate matter. It reduces visibility along roads, thereby increasing the risk of vehicle accidents. Inhalation of fine particulate matter can potentially cause adverse health effects, especially in persons with pre-existing respiratory problems.

4.3 Operational Cost Concern

Excessive dust when drawn into a vehicle's engine can result in rapid clogging of vehicle air filters, diminishing engine performance and increasing maintenance costs. While the engines are equipped with air filters, the finer sized particulate matter can pass through these filters, getting into the engine where it can cause premature scouring and wear on the pistons and other moving components, thereby leading to a need for more frequent maintenance and shortening the life of the engine.

5. Sources of Dust

The greatest source of dust at mine sites is vehicle traffic on unpaved roads (Thompson and Visser 2001). Dust emissions will vary by the time of week, as well as the time of year. Dust will be more prevalent during the late spring and summer than during winter. Dust emissions are anticipated to be greatest during the operation of the AWAR, when traffic along the road will be at its peak (e.g., on days when additional road traffic is required due to barge unloading, saline water transport to Itivia, and transport to the mine site).

The most significant sources of dust during operations, and closure include the following:

- Preparation of ground surface for construction through stripping, excavating, covering, and/or stockpiling;
- Wind erosion of exposed mine surfaces – e.g., roads, ore stockpiles, waste rock storage facilities, and dry stack tailings;
- Vehicle traffic on unpaved roads and other mine surfaces – haul, service and access roads, pit ramps, other vehicle travel areas (e.g. waste rock storage facilities, storage pads, laydown pads, parking lots);
- Material handling and transfer – loading, hauling, unloading, crushing, conveying;
- Open pit mining activities – drilling, blasting; and
- Closure activities such as covering the tailings, decommissioning of other mine areas, and scarification of roads.

Dust from buildings where people are working such as the mill, maintenance shop and warehouse is expected to be minimal due to the use of bag houses or equivalent means to control dust.

6. Dust Suppression

Dust suppression measures, which are considered to be typical of current mine practices and consistent with best management practices, are expected to achieve desired results through design, operations, and closure.

6.1 Design-Based Dust Suppression Measures

In assessing dust emissions associated with the Project, consideration was given to those mitigation measures that were considered integral in the mine design. Design-based means of dust suppression include:

- The mine site is compact thereby reducing the area where dust generation can occur;
- Dry stack tailings were selected as the preferred form of tailings. These will be trucked from the mill to a tailings storage area northwest of the mill[2];
- Roads were designed as narrow and short as possible while maintaining safe construction and operation practices. This reduces the surface area of roads and the potential to generate dust;
- To minimize dust during construction and operations, coarse sized rock is be used as much as possible in building roads, pads, and laydown areas;
- If possible, road construction will largely occur during the winter when the generation of dust is at its lowest;
- Sheds, enclosures, covers, and/or bag houses will be used on most crushing and processing equipment to limit dust emissions; and
- Most outside conveyer belts will have covers.

6.2 Operation-Based Dust Suppression Measures

Best management practices will be used to control and suppress dust emissions from the Project. Dust suppression during operations include:

- Overburden stripped in opening the open pits is anticipated to be prone to wind erosion, and will be stored within the core of the waste rock storage facilities;
- During landfill activities such as topping and capping, visual monitoring will occur and if necessary, water will be applied
- Roads will be regularly graded to mix excessive silt found on the road surface with the coarser materials located deeper in the roadbed. This will reduce the percentage of silt in the road surface with the benefit of reducing related dust;
- As needed, roads and travel areas will be topped with aggregate and stabilized, which will minimize erosion and dust emissions;
- Where appropriate, larger sized aggregate will be used on the road surface to replace material lost due to wind and water erosion;
- Water, Calcium Chloride, or an equivalent approved dust suppressant, will be applied as needed to reduce airborne dust and improve visibility on access, service, haul roads, pit ramps and other travel areas. This will remove a safety hazard;
- Communication with Rankin hamlet will occur every year to ensure the entire length of the AWAR is treated with dust suppression;
- The Itivia bypass road will not have any chemical dust suppressants applied. Only water will be applied on this portion of the road for dust suppression;
- Dust aprons will be used on open pit, production drills, where practical during all open pit drilling to control dust emissions;
- Should further rock crushing occur in the quarries along the access roads, the crushers location will be best shielded from the prevailing wind, preferably behind a high wall in the quarry so as to

[2] Details on the use of dry stack tailings and how dust arising from them will be mitigated can be found in Mine Waste Management Plan

reduce the quantity of wind-blown dust, and to have as much dust as possible fall within the bounds of the quarry;
- The maximum speed limit on the AWAR will be 50 km/hr but will be lower where required for safety reasons (e.g., approaches to bridges, intersections, etc.);
- The number of mine vehicles on the AWAR will be kept to a minimum (e.g., vans and buses are to be used to transport employees to and from the Rankin Inlet airport);
- Maximize the transport of materials from Itivia to the mine site in late summer when rain events are more common, and in the fall when the road surface is frozen and less susceptible to dust generation;
- Regularly inspect the road and undertake timely repairs to minimize the silt loading on the road surface;
- Avoid multiple handling of materials that have the potential to generate dust, where possible;
- Conveyor loads will be kept within designated load limits, and conveyor covers used, where practical;
- Stockpiles will be of a suitable height, width and slope to minimise wind effects;
- Employees and contractors will be encouraged to report excessive dust to their supervisor; and
- Contractors for activities that have the highest potential for dust generation are required to submit detailed work plans that indicate dust mitigating practices and procedures. This may include the modification of activities to reduce the dust created by their activities.

6.3 Closure-Based Dust Suppression Measures

Closure will include the following dust suppression measures:

- The tailings storage facility will be covered progressively, with an engineered cover, thereby isolating it from the environment and preventing dust generation;
- Other exposed mine areas subject to wind erosion will also be covered with waste rock;
- Open pits will be flooded;
- All roads will be scarified and bridges and culverts removed thereby making the roads impassable to large vehicles and associated dust generation. Scarification will also allow plants to establish on the former roads and, in doing so, prevent wind and water erosion; and
- During operations, obsolete roads will be closed and scarified.

7. Access, Service and Haul Roads

For the Phase 1 AWAR, Agnico Eagle committed to apply active controls on the road surfaces to reduce dust. These controls could include actions such as using water or applying chemical dust suppressants such as Calcium Chloride. Although literature does not provide a control efficiency for regular maintenance of the road surfaces, the commitment by Agnico Eagle to maintain the road surface is expected to have benefits with respect to the amount of dust generated (Agnico Eagle 2011b).

The nature of the road surface and the size distribution of the material, in particular the percentage content of silt and fine sand (2 µm to 75 µm), directly influences the potential to generate dust (Thompson

and Visser 2001). The greatest sources of dust on a mine site are the disturbance of granular surfaces, and this normally occurs when materials are handled or when vehicles pass over an unpaved surface[3]. Of the two, by far the largest source of dust is vehicle traffic on unpaved roads; this has been estimated to reach 70 percent in some instances (*Cecala 2012*). The mechanical grinding of surface materials on the road and their breakdown under the weight of vehicle wheels creates dust, while the air turbulence created by the vehicle causes dust to become airborne. The amount of dust generated along a road is dependent on the dryness of the road surface, the percentage of silt on the road surface, the number of vehicles, weight and vehicle speed, weather conditions[4], and maintenance of the driving surface.

The composition of the road surface will be analysed to determine what dust suppression measures will work best. Different types of road surfaces dictate different approaches to dust control. Kissel (*2003*) makes the following recommendations based on the particle size distribution of material on the road surface:

- *Gravel with few fines.* In gravel road surfaces with not enough fines, only watering will be effective. Chemical dust suppressants can neither compact the surface (because of the poor size gradation) nor form a new surface, and water soluble suppressants will thus leach.
- *Sand.* In compact sandy soils, bitumens, which are not water-soluble, are the most effective dust suppressant. Water-soluble suppressants such as salts, lignins, and acrylics will leach from the upper road surface. However, in loose, medium, and fine sands, bearing capacity will not be adequate for the bitumen to maintain a new surface.
- *Good size gradation.* In road surfaces with a good surface particle gradation, all chemical suppressant types offer potential for equally effective control.
- *Silt.* In road surfaces with too much silt (greater than about 20 to 25%), no dust suppression program is effective, and the road should be rebuilt. In high-silt locations, chemical suppressants can make the road slippery, and there is an inability to compact the surface or maintain a new road surface because of poor bearing capacity. Further, rutting under wet conditions requires that the road be graded, which destroys chemical dust suppressant effectiveness. If the road cannot be rebuilt, watering is the best option.

Optimally designed and maintained roads offer the best means of controlling dust but it does not remove the potential for dust generation completely. The potential for dust generation decreases significantly when road design and maintenance are combined with the application of water and/or chemical dust suppressants such as Calcium Chloride.

[3] Volume 5 of the Final Environmental Impact Statement Atmospheric, Environment and Impact Assessment, section 1.4 Emissions Estimation provides details on how dust emissions can be calculated for various mine sources (*Golder Associate 2013*).

[4]Humidity, frequency of days with rain, mean daily evaporation rates, and the prevailing wind speed and direction. Wind erosion contributes to road dust emissions, especially when strong winds combined with vehicle traffic moves the dust generated far afield.

7.1 Dust Suppression Using Water

Water remains the most readily available means of controlling dust in Nunavut. It is common at mine sites worldwide to apply water through fantail sprayers or spray bars attached to a haul truck or equivalent fitted with a large tank. Agnico Eagle recognises that water is only a temporary measure, and reapplications could be necessary to achieve the desired dust control efficiency[5]. The control efficiency of water applications is dependent on the amount of water applied, the time between re-applications, penetration depth of the water into the road surface, the traffic volume, prevailing weather conditions, and the state of the road surface (e.g., excessive fines over coarse material). All these variables need to be considered before selecting water to control dust from roads and other mine areas. If water is selected to suppress dust, Agnico Eagle will use it with a greater frequency near critical areas along the roads.

Watering the roads is only possible during frost-free days. In late spring, significant sublimation can be expected when the temperatures remain below freezing, which can lead to dry roads and significant dust potential. If water is applied while the temperature is below freezing, it will turn to ice on the road and pose a safety hazard for travel. Dust suppression using water or chemicals will not be possible at this time of the year.

7.2 Chemical Dust Suppression

Chemical dust suppressants offer advantages over water under the right conditions. They tend to have the benefit of a reduced treatment frequency over water. However, use of chemical suppressants under all conditions does not necessarily lead to improved dust suppression over that of water. Presently, only fresh water, seawater, DL10, calcium chloride, EK-35 and DUST-STOP are approved for use in Nunavut. Other chemical dust suppressants can be approved for use in Nunavut following their assessment by the Government of Nunavut's Environmental Protection Service.

Numerous types of chemical suppressants are available; broad categories that encompass those approved for use in Nunavut are as follows:

- Wetting agents are designed to increase the ability of water to adhere to and spread over the dust particle. This increases the bulk density of the particle and leads to agglomeration. Calcium chloride ($CaCl_2$) is one such wetting agent.
- Binders hold particulates together and can provide long-term dust suppression on roads. DL10, EK-35, and DUST-STOP are examples of binders approved for use in Nunavut (*GN 2014*).
- Crusting agents work best on inactive storage piles. They are reasonably long lasting, rain resistant, and wind proof. None are approved for use in Nunavut.

[5] Regular light watering is more effective than infrequent heavy watering (Thompson and Visser 2007).

Table C.1 provides a comparison of the advantages and disadvantages of using water, wetting agents, and binders for dust suppression.

Analysis of the road surface is considered when the decision on whether to use chemical dust suppressants , such as Calcium Chloride, is made. Agnico Eagle usage of calcium chloride is kept to a minimum to prevent damage to vegetation adjacent to the road and to mitigate the risk of creating an attractant to wildlife (salt lick effect). It is used selectively where it's more effective than water alone, and where it doesn't adversely affect the environment immediately next to the road. As calcium chloride is susceptible to leaching, Agnico Eagle is not using it within 30 metres of waterbodies or sensitive plant communities.

Table C.1. Comparison of Dust Suppressants

Dust Suppressant	Advantages	Disadvantages
Water	- no environmental impacts - readily available	- short term dust suppression, requires frequent re-application - works better than chemical dust suppressants on roads having greater than 20 – 25 % silt on the driving service or having a majority of sand - can cause water erosion if too much is applied
Calcium chloride	-effective in climatic areas when relative humidity greater than 30% -less frequent applications required than water	- possible impact on water and aquatic species when washed from the road and into the environment - soil salinization and impact on plant life; attractant for wildlife - not effective when road surface has greater than 20 – 25 % silt or has a majority of sand on the driving surface
Oil based binders (DL10)	- effective and long lasting	- may have adverse impacts on vegetation, soil, water and aquatic life
Organic binders (EK-35, DUST-STOP)	- effective and applied directly to road surfaces- Less frequent applications than water	- significantly more expensive to use than water - limited effectiveness if road has greater than 20 to 25 % silt on the driving surface, it is better to use water under this condition -Requires specialize equipment

Adapted from Alberta Environment 2012

As part of its Meliadine Update Technical Study Phase 2, 2015 Agnico Eagle plans to use saline groundwater as dust suppressant (Agnico Eagle 2015) beginning in summer of 2019. If this proves not to be sufficiently efficient, Agnico Eagle will continue to use calcium chloride as the product is considered to work best at the Project. If another non-approved product is considered, AEM will request that the Department of Environment carry out an assessment.

7.3 Planned Dust Suppression

During the peak season where dust suppression is required, Agnico Eagle will complete daily inspections of the road and, on an as-needed basis, will apply water and a mix of $CaCl_2$ and water along the entire length of the AWAR. At the present time only water can be used on the Bypass Road.

Another chemical suppressant (Dust Stop) was tested to evaluate the performance in terms of dust suppression but it did not show to be as effective as calcium chloride. It is Agnico Eagle's intention to use best management practices concerning dust suppression along all of its roads.

7.4 Maintenance of the Road Surface for Dust Suppression

Agnico Eagle recognizes that inspection precedes maintenance and a good inspection program will lead to the early identification of areas of the roads where improvements are necessary. The early resolution of any deficiencies will result in less ongoing maintenance and repair of the driving surface (Agnico Eagle 2011a). It will also lead to less dust generation.

The amount of dust generated is a function of the composition of the road surface. If there is a significant percentage of silt size particles on the road surface, one can expect greater dust generation. Likewise, any reduction in the percentage of silt on the road surface leads to an equivalent reduction in dust. Grading roads provides relief from excessive dust by mixing silt sized material on the road surface with coarser road materials found deeper in the roadbed.

Unpaved roads and travel areas are topped with new aggregate and graded on an ongoing basis, with the goal of improving safety, minimizing erosion, and reducing dust emissions. This is required as unpaved road constantly lose surface material through wind and water erosion, and from vehicles throwing material off the road.

8. Thresholds for Initiating Dust Suppression

Table C.2 outlines the thresholds Agnico Eagle uses at the Project to initiate mitigation measures.

Dustfall measurements are regularly collected along the roads and other parts of the mine site using passive sampling methods to record the quantity of dust collected over time, and to allow the success of mitigation measures to be quantified. The monitoring data is used to adjust mitigation measures to improve dust management strategy

Table C.2. Thresholds and Mitigation Measures

Location	Frequency	Indicator	Threshold	Mitigation Measure
Itivia laydown and Oil Handling Facility	routine inspection by Itivia supervisor during summer period.	- measured dustfall. - deterioration of visibility along road.	- deterioration of visibility. - safety concern. - dust reaching Hamlet.	- use water and/or calcium chloride to control the dust.
AWAR and bypass road	regular weekly or more frequent inspection by road supervisor during the late spring and summer periods.	- measured dustfall. - deterioration of visibility along road.	- deterioration of visibility. - safety concern. - high dust levels evident near significant waterbodies.	- use water and/or calcium chloride (AWAR road only) in areas requiring attention. - grade the road surface. - add new granular material to the road surface.
Mine site, including travel areas, haul and service roads	regular weekly or more frequent inspection by site services supervisor during the late spring and summer periods.	- measured dustfall.	- deterioration of visibility. - safety concern. - dust reaching Meliadine Lake.	- use water and/or dust suppressant on exposed surfaces such as parking areas, pads, haul, access and service roads, dry stack tailings. - review mitigation measures in place. - add new granular material to surface, - if applicable, grade the surface. - temporarily lower speed limit on site.
Ramps in the open pits	regular inspection by pit supervisor during summer period.	- deterioration of visibility.	- deterioration of visibility. - safety concern.	- use water as a dust suppressant.

Table adapted from Baffinlands 2010

8.1 The Role of the Road Supervisor

The road supervisor[6] conducts periodic inspections (minimum weekly) of roads to ensure that they are maintained for safe travel of personnel, equipment, and supplies. These inspections are recorded and any deficiency recorded and followed up by a corrective plan.

In areas or times identified by the Agnico Eagle road supervisor as being prone to high dust levels, where safe road visibility is impaired, or in areas where dust deposition could impact waterbodies or the Hamlet, the road supervisor will arrange mitigation measures as appropriate. This could involve actions such as grading of the road surface, addition of aggregate to the road surface, watering of the road surface and/or using calcium chloride. The bypass road will receive special attention and extra dust suppression measures may be taken to avoid dust impinging on Nipissar Lake.

Adaptive management will be used when inspections or monitoring shows the generation of dust to be greater than anticipated and that additional mitigation measures are required. As well, if dust is unexpectedly generated where it was not anticipated, adaptive management will be used to understand the source and find ways to reduce or eliminate the same.

9. Dust Management Plan Update

The Plan will be reviewed annually and updated if there are changes in operations and/or technology.

[6] The open pit supervisor will do the same for the open pit ramps.

10. References

Agnico Eagle (Agnico Eagle Mines Limited). 2008. Dust Suppression Protocol for the Meadowbank Gold Mine Site Roads and for the All Weather Access Road to Baker Lake. (NIRB Project Certificate Condition #74

Agnico Eagle. 2011a. Meliadine Exploration Project, Operations & Maintenance Manual for the Phase 1 All-Weather Access Road.

Agnico Eagle. 2011b. Phase 1 – Meliadine All-weather Access Road Project Description and Environmental Assessment.

Agnico Eagle 2015. Meliadine Update Technical Study Phase 2, 2015. Internal company report by Agnico Technical Services group. *Petrucci F., Proulx M.,Larouche J.,Caron D. and all*, January 2015.

Alberta Environment. 2012. Used oil as a Dust Suppressant, Acceptable Industry Practices.

Baffinlands 2010. Environmental Impact Statement**,** Volume 10 – Environmental Management.

Cecala, A.B. 2012. Dust Control Handbook for Industrial Minerals Mining and Processing. Report of Investigations 9689.

GN (Government of Nunavut) 2014. Environmental Guideline for Dust Suppression on Unpaved Roads Department of Environment.

Golder Associates. 2013. m Final Environmental Impact Statement, Volume 5 Atmospheric Environment.

Kissel, F.N. 2003. Handbook for Dust Control in Mining. U.S. Department of Health and Human Services.

Thompson, R.J. and Visser, A.T. 2001. Mine Haul Road Dust Emission and Exposure Characterisation. Department of Engineering, University of Pretoria.

Thompson, R.J. and Visser, A.T. 2007. Selection, performance and economic evaluation of dust palliatives on surface mine haul roads. Volume 107**,** Journal of the Southern African Institute of Mining and Metallurgy.