Runoff Diversion and Management

1) Intercept and divert runoff from site (excavation or construction area)

Construction and excavation of the area not to begin until the site has sufficiently dried to allow equipment on site. This will protect the ground surface from the heavy equipment making ruts in the area. This will reduce the amount of water collecting and disturbing the natural drainage flow in the area.

Identifying areas of low elevation relative to the footprint of the construction area.

Delineating the watershed area will be conducted prior to construction. The watershed is an area of land where surface water from precipitation drains into a body of water. This area also contains drainage areas in which water from a smaller portion of land drains through a downstream point. A drainage area is bounded by a divide, a line made up of a group of high points around the drainage area. To delineate a drainage area, start with a contour map and draw a divide. The divide line runs through the highest points and is perpendicular to the contour lines on the map. At a smaller scale, delineation can be used to determine the drainage area for an infiltration trench or swale.

Identify the topographic grade of the area in order to allow constructed swales to the area to divert runoff around the footprint of the landfarm site. Swales are a type of structure that also promote groundwater recharge. Similar to a trench, swales are dug into the ground in order to retain or divert run-off water. The water then spreads and slows down allowing it to infiltrate into the subsurface. This creates a groundwater plume that replenishes underground aquifers and supports the growth of vegetation in areas down-gradient to the swale.

Swales should be constructed along contour lines. This ensures the water will flow into the swale and not around it. The soils in the area should also be semi-pervious to allow for infiltration. The swale should also be placed down-gradient of areas with high runoff rates. This may include impervious surfaces such as roads, pathways or soils of low permeability.

The landfarms will be constructed using berms around the perimeter of the footprint. A berm is an earth barrier separating two areas of land that can be built to serve a variety of purposes. Berms are often used to control erosion and sedimentation by reducing the rate of surface runoff. As a result, berms either reduce the velocity of the water or direct water to areas that are not susceptible to erosion. This helps reduce adverse effects of running water on exposed topsoil. Berms are typically small mounds composed of soil, gravel or rocks.

2) Sources of Water

i) Precipitation (snow and rain) Accumulations.

Cambridge Bay only receives on average 142 mm (5.6 inches) of combined rain and snow precipitation annually over approximately 110 days per year. Due to the low precipitation amounts, overland runoff during rain events will not likely have a significant effect on the footprint of the landfarm. However, the construction will take into account the direction of overland flow and swales to be constructed to allow for drainage around the footprint.

ii) Spring Melt Water

Cambridge Bay receives approximately 82 cm (32 inches) of snow accumulation each year. During the spring melt, the footprint of the landfarms will impede the overland flow. The berms of the landfarm and the addition of swales will allow the melt water to be effectively diverted around the footprint.

iii) Melting permafrost during excavation

Excavation of the contaminated soil will be monitored to ensure the permafrost is not exposed for long periods of time. The excavation will be backfilled as soon as practical so the permafrost is not exposed to sunlight or warm temperatures that may increase melting. If water is encountered during the excavation a mobile granular active carbon water treatment system will be on site to process the water, which will have a capacity of 10 gallons/minute. The processed water will be stored in barrels and tested for compliance with applicable criteria prior to release and with notification to the NWB and AANDC.

3) Identify areas of water accumulation

Delineating the watershed area will be conducted prior to construction. The watershed is an area of land where surface water from precipitation drains into a body of water. This area also contains drainage areas in which water from a smaller portion of land drains through a downstream point. A drainage area is bounded by a divide, a line made up of a group of high points around the drainage area. To deliniate a drainage area, start with a contour map and draw a divide. The divide line runs through the highest points and is perpendicular to the contour lines on the map. At a smaller scale, delineation can be used to determine the drainage area for an infiltration trench or swale.

4) Construction Practices for Runoff and Diverted Water

Construction site operators should identify waterbodies on site and adjacent to the site. If construction activities occur near a waterbody, clearing/grading activities should be minimal and silt fencing, hay bales, fiber rolls and/or and earthen dikes should be installed.

Prior to construction initiation, activities should be broken into phases. Grading activities should be limited to the phase immediately under construction to decrease the time that soil is exposed, which, in turn, decreases the potential for erosion. Additional phases should begin only when the last phase is near completion and preferably exposed soil has been stabilized. Construction scheduling should facilitate installation of erosion and sediment control measures prior to construction start, detail time limits for soil stabilization after grading occurs, and schedule maintenance.

Silt fence should be properly installed around the perimeter of the construction site if required. A fiber roll on the inside (site-facing) of the silt fence works to provide additional filtration.

5) Monitor for corrective action

The construction site will undergo regular inspections to ensure the landfarms and excavations do not impede water flow. Three types of inspections will be performed: routine inspections, inspections performed before rain events, and inspections performed after rain events.

Monitoring will also take place each year after spring freshet to ensure the landfarm is operating as it was designed. This will also require monitoring the sump thought the year to ensure water levels do not breach the berm. This may require the sump to be emptied as required under Part B of the water license.

- **Routine Inspections**

Routine inspections are an integral part of regularly performed maintenance activities--cleaning, repair, and replacement if necessary to ensure the integrity and effectiveness of the construction of berm, swales or silt fencing. Construction site activities can damage mitigation measures in place. Earthmoving equipment, for example, can easily dislodge an entrenched silt fence. Routine inspection and maintenance minimizes the work required to prepare a site before a rain event, and it helps protect a site from unforeseen rains.

- **Inspections Before Rain Events**

It is critically important that construction site operators pay attention to weather forecasts. To prepare for impending rains, operators should walk the construction site. Operators should also visually inspect the site each day to ensure the site is organized

and clean. This will help to prepare for rains that might occur when workers are off-site. Planning and preparation minimize the risk of on- or off-site property damage occurring because of inoperative or malfunctioning mitigation measures.

- **Inspections After Rain Events**

After a rain event, prepare the site for the next rain event. Typically within 48 hours after rain, inspect, clean, and repair the site. This will keep the site "clean". To prevent health and safety hazards, remove mud in traffic areas. Inspect berms of the landfarm to ensure they are not damaged and make repairs as required.

6) Contractor Requirements – Specification Package

Water Control

Maintain excavations free of water.

Protect site from puddling, ponding or running water. Grade site to drain.

Prevent surface water runoff from entering or leaving Work areas.

Do not discharge decontamination water, or surface water runoff, or groundwater which may have come in contact with potentially contaminated material, off the site.

Prevent precipitation onto Site from infiltrating or from directly running off stockpiled waste materials. Cover stockpiled waste materials with an impermeable liner during periods of Work stoppage, including at end of each working day and periods of heavy precipitation, and, as directed by the Departmental Representative's Authorized Personnel.

Direct surface waters that have not contacted potentially contaminated materials to existing surface drainage systems (away from the work area).

Dispose of water in manner not injurious to public health or safety, to property, or to any part of Work completed or under construction in accordance with applicable regulation. **Disposal of any water may only be completed once the water has been tested and with written approval from the NWB and the AANDC Enforcement Officer**.

Provide, operate, and maintain necessary equipment appropriately sized to keep excavations, staging pads, and other Work areas free from water.

Dewatering

Dewater various parts of Work including, without limitation, excavations, and work areas.

Employ construction methods, plant procedures, and precautions that ensure Work, including excavations, are stable, free from disturbance, and dry.

Dewatering Methods: includes sheeting and shoring; groundwater control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and other measures necessary to enable Work to be carried out in dry conditions. **The location must also meet the approval of the local Municipality requirements and the Airport Manager at the Cambridge Bay Airport.**

Provide sufficient and appropriate labour, plant, and equipment necessary to keep Work free of water including standby equipment necessary to ensure continuous operation of dewatering system.

Take precautions necessary to prevent uplift of structure or pipeline and to protect excavations from flooding and damage due to surface runoff.

Test and analyze water generated from dewatering activities and treat to meet required applicable discharge or disposal criteria.

Water generated from dewatering is to be stored in barrel(s).

Dust Management Plan

DUST AND PARTICULATE CONTROL

Execute Work by methods to minimize raising dust from construction operations.

Implement and maintain dust and particulate control measures as determined necessary by Departmental Representative's Authorized Personnel during construction and in accordance with Nunavut regulations. Contractor will be required to provide road sweeper/cleaning facilities at the Site and access roads during the transportation of excavated soils from the excavation to the LTU area.

Departmental Representative's Authorized Personnel will stop work at any time when Contractor's control of dusts and particulates is inadequate for wind conditions present at site.

If Contractor's dust and particulate control is not sufficient for controlling dust and particulate emissions into the atmosphere, the Contractor shall:

Stop work.

Contractor must discuss procedures with the Departmental Representative's Authorized Personnel that Contractor proposes to resolve problem.

Make necessary changes to operations prior to resuming excavation, handling, processing, or other work that may cause release of dusts or particulates.

The contaminated soil will be excavated using a heavy equipment excavator to the limits defined in the Specifications and as directed by the Departmental Representative. The contaminated soil will be removed in discrete zones and layers, and the work will be directed by the Site Superintendent. To avoid the spilling of contaminated soil, the contractor will not overfill the soil handling equipment so as to avoid soil falling due to excessive filling or blowing away in the wind. Also, to avoid the spread of soil by wind, dust will be controlled by spraying water on the soil as conditions warrant.

Contaminated soil will be transported on-site from the excavation of the Fire Training Area (FTA) to the landfarm with the use of several dump trucks. The trucks will be loaded by the excavator. The dump trucks will not be overfilled. Wherever practical, the dump trucks will have covers or tarps to avoid the loss of soil from the trucks during transportation on-site and to reduce the amount of dust in the air. Vehicle speeds will be strictly controlled to avoid the spilling of soil from the truck box during transport and to reduce the amount of dust created. The gravel roads will be monitored for the amount

of dust that is generated and will require the application of water to suppress dust if needed.

The Nunavut Guideline for Dust Suppression on Unpaved Roads, January 2002 (revised April 2014) is included for this plan to increase the awareness and understanding of the risks, hazards and best management practices associated with dust suppression on unpaved roads.

Environmental Guideline for

Dust Suppression on Unpaved Roads

Department of Environment
Government of Nunavut

GUIDELINE: DUST SUPPRESSION ON UNPAVED ROADS

Original: January 2002
Revised: April 2014

This Guideline has been prepared by the Department of Environment's Environmental Protection Division and approved by the Minister of Environment under the authority of Section 2.2 of the *Environmental Protection Act.*

This Guideline is not an official statement of the law and is provided for guidance only. Its intent is to increase the awareness and understanding of the risks, hazards and best management practices associated with dust suppression on unpaved roads. This Guideline does not replace the need for the owner or person in charge, management or control of dust suppressants to comply with all applicable legislation and to consult with Nunavut's Department of Environment, other regulatory authorities and qualified persons with expertise in the control of dust from unpaved roads.

Copies of this Guideline are available upon request from:

Department of Environment
Government of Nunavut
P.O. Box 1000, Station 1360, Iqaluit, NU, X0A 0H0
Electronic version of the Guideline is available at http://env.gov.nu.ca/programareas/environmentprotection

Cover Photos: Top – Cypher Environmental Ltd.
Bottom – Midwest Industrial Supply Inc.

Table of Contents

Appendices

Introduction

All unpaved roads and other surfaces will give off dust when driven on. This dust can be a significant source of particulate matter in the atmosphere and have environmental, health and safety impacts. These may include reducing visibility along the road, increasing the risk of vehicle accidents, aggravating symptoms in individuals who suffer from respiratory diseases and impacts to aesthetics. Dust from unpaved roads can also slow the growth of plants up to 150 meters from the road edge by settling on leaves (the shading effect) and reducing photosynthesis.

Loss of fine particles can also lead to road surface damage and exposure the of larger gravel. This gravel can then be scattered by vehicles or washed away, making the road surface rough and unstable. Potholes and areas of washboard may develop which contribute to further road deterioration and travel safety issues, increased road maintenance needs and increased vehicle repair costs.

When used in accordance with manufacturers' instructions, dust suppressants can lower the environmental, health and safety impacts associated with road dust. Numerous products and techniques are available to reduce dust conditions and preserve road surfaces. In a report prepared for the federal Road Salts Working Group[1], Environment Canada describes seven broad categories of chemical dust suppression products: chloride salts and brines (i.e. calcium chloride and magnesium chloride); organic non-bituminous chemicals (i.e. lignosulfonates, sulphite pulp mill liquors, tall oil pitch, pine tar, vegetable oils, and molasses); petroleum-based binders and waste oils; electro-chemical stabilizers; various polymers; enzyme slurries; and cementitious binders. Each category of suppressant is unique with its own characteristics, benefits and limitations (i.e. toxicity, visual appearance, application rate and methods, costs).

This *Environmental Guideline for Dust Suppression on Unpaved Roads* (the Guideline) examines the most commonly used dust suppressants and the conditions under which they are most effective. It is intended to increase awareness and understanding of characteristics, benefits and hazards associated with commonly used dust suppressants and introduce best management practices to reduce dust levels from unpaved roads. It is not an official statement of the law. For further information and guidance, the owner or person in charge, management or control of dust suppressants is encouraged to review all applicable legislation and consult the Department of Environment, other regulatory agencies or qualified persons with expertise in the control of dust from unpaved roads.

The *Environmental Protection Act* enables the Government of Nunavut to implement measures to preserve, protect and enhance the quality of the natural environment. Section 2.2 of the *Act* provides the Minister of Environment with authority to develop, coordinate, and administer the Guideline.

1.1 Definitions

Approved Product	A product listed in section 3.2 *Approved Dust Suppressants* or approved by the Environmental Protection Division under section 3.5 *Approval of New Dust Suppressants*.

[1] Profile of Chloride-Based Dust Suppressants Used in Canada.

Commissioner's Land	Lands that have been transferred by Order-in-Council to the Government of Nunavut. This includes roadways and land subject to block land transfers. Most Commissioner's Land is located within communities.
Contaminant	Any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment, (a) endangers the health, safety or welfare of persons, (b) interferes or is likely to interfere with normal enjoyment of life or property, (c) endangers the health of animal life, or (d) causes or is likely to cause damage to plant life or to property.
Dust Suppressant	Any treatment material for reducing dust emissions.
Environment	The components of the Earth and includes (a) air, land and water, (b) all layers of the atmosphere, (c) all organic and inorganic matter and living organisms, and (d) the interacting natural systems that include components referred to in paragraphs (a) to (c) above.
Inspector	A person appointed under subsection 3(2) of the *Environmental Protection Act* and includes the Chief Environmental Protection Officer.
Roadway	The travelled surface of a road from shoulder to shoulder, but does not include the side slopes or ditches of the road.
Used Oil	Engine, turbine and gear lubricating oil, hydraulic and transmission fluid and insulating coolant (i.e. transformer fluid) that is unsuitable for its intended purpose due to the presence of impurities or the loss of original properties, but does not include waste derived from animal or vegetable fat or a petroleum product spilled on land or water.
Waste Fuel	A flammable or combustible petroleum hydrocarbon that is unsuitable for its intended purpose due to the presence of impurities or the loss of original properties, and includes gasoline, diesel and fuel oil, aviation fuel, kerosene and naphtha, but does not include paint, solvent or propane.

1.2 Roles and Responsibilities

1.2.1 Owners and Applicators of Dust Suppressants

Owners or persons in charge, management or control of a chemical dust suppressant, also referred to as the Responsible Party, and applicators must ensure the chemical is properly and safely managed from the time it is purchased to its final use or disposal. This includes community, territorial and federal government, commercial, industrial and institutional operators and any person who may own or possess chemical dust suppressants.

Contractors may manage and apply dust suppressants on behalf of the Responsible Party. However, the Responsible Party remains liable for ensuring the contractor complies with all applicable statutes, regulations, standards, guidelines and community by-laws. If the contractor does not comply with the requirements of the *Environmental Protection Act* and is charged with a violation while managing or applying the dust suppressant, the Responsible Party may also be charged.

If a dust suppressant becomes contaminated, expires or otherwise becomes unsuitable for its intended purpose, it may be categorized and managed as a hazardous waste. Information on the management of hazardous waste and the registration of generators, carriers, receivers and hazardous waste management facilities can be obtained by referring to the *Environmental Guideline for the General Management of Hazardous Waste*.

1.2.2 Government of Nunavut

Department of Environment

The Department of Environment's Environmental Protection Division is the key territorial agency with responsibility for ensuring Nunavut's natural environment is protected. Authority is derived from the *Environmental Protection Act*, which prohibits the discharge of contaminants to the environment and enables the Minister to undertake actions to ensure appropriate management measures are in place. Although programs and services are applied primarily to activities taking place on Commissioner's and community lands and to Government of Nunavut undertakings, the *Environmental Protection Act* may be applied to the whole of the territory where other controlling legislation, standards and guidelines do not exist. A complete listing of relevant legislation and guidelines can be obtained by contacting the Department or by visiting the web site at http://env.gov.nu.ca/programareas/environmentprotection.

The *Environmental Guideline for Ambient Air Quality* sets standards for maximum levels of dust in ambient air. The standard for fine particulate matter[2] measured over a 24 hour period is 30 micrograms per cubic meter ($\mu g/m^3$) while the standard for total suspended particulate[3] measured over a 24 hour period is 120 $\mu g/m^3$. These standards apply to the whole of Nunavut. They are used to assess the impact dust levels may have on the environment, facilitate regional air quality management planning and establish benchmarks for reporting on the state of air quality. A copy of the *Environmental Guideline for Ambient Air Quality* can be downloaded from the Department's web site at http://env.gov.nu.ca/node/82#Guideline Documents.

Workers' Safety and Compensation Commission

The Workers' Safety and Compensation Commission is responsible for promoting and regulating worker and workplace health and safety in Nunavut. The Commission obtains its authority from the *Workers' Compensation Act* and *Safety Act* which require an employer to maintain a safe workplace and ensure the safety and well being of workers. The Workplace Hazardous Materials Information System, or WHMIS, requires information be provided to workers on the safe use of any hazardous material used in the workplace.

[2] Fine particulate matter consists of extremely fine particles and droplets with a diameter of less than 2.5 microns (one micron equals one millionth of a meter).
[3] Commonly referred to as airborne dust or dirt, total suspended particulate consists of airborne particles or droplets that have a diameter of up to 100 microns.

Department of Health and Social Services

Activities related to the handling, storage, transportation, application and disposal of dust suppressants may have an impact on public health. The Office of the Chief Medical Officer of Health and Regional Environmental Health Officers should be consulted regarding legislated requirements under the *Public Health Act.*

Department of Community and Government Services

The Department of Community and Government Services is responsible under the *Commissioner's Lands Act* for issuing land leases, reserves, licenses and permits on Commissioner's Lands. The Department, in cooperation with community governments, is also responsible for planning and funding solid waste and sewage disposal facilities in most Nunavut communities. The Department's emergency planning responsibilities under the *Emergency Measures Act* include developing territorial emergency response plans, coordinating emergency operations at the territorial and regional levels and supporting community emergency response operations.

The Office of the Fire Marshal is responsible for ensuring the safe storage, handling and use of flammable and combustible liquids and materials and obtains its authority from the *Fire Prevention Act*, *National Fire Code* and *National Building Code*.

Department of Economic Development and Transportation

The Airports Division of the Department of Economic Development and Transportation is responsible for the safe, efficient and effective management and operation of airports in Nunavut including the maintenance of runways and airport terminal aprons. The Motor Vehicles Division is responsible for the safe transport of dangerous goods and hazardous waste by road through administration of the *Transportation of Dangerous Goods Act*.

1.2.3 Government of Canada

Environment Canada

Environment Canada is responsible for administering the *Canadian Environmental Protection Act* (CEPA). In 1995, chloride-based dust suppressants were placed on the Government of Canada's Priority Substances List 2 for assessment to determine their toxicity under the CEPA. The resulting scientific assessment concluded road salts pose a serious threat to the aquatic environment, plants and animals due to high releases around storage and snow disposal sites and run-off from roadways into soils, streams and rivers.

Environment Canada also regulates the interprovincial and international movement of hazardous waste under the *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations.* It is also responsible for administering the pollution prevention provisions of the federal *Fisheries Act*.

Aboriginal Affairs and Northern Development Canada

Aboriginal Affairs and Northern Development Canada is responsible under the *Territorial Lands Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act* for the management of federal lands and waters, including the impact dust suppressants may have on the quality of these lands and waters.

1.2.4 Community Governments and Co-management Boards

Local Community Governments

Community governments perform an important role in the proper management of dust suppressants. In addition to being major users of dust suppressants, community governments are entitled under the Nunavut Land Claims Agreement to control their own community landfill site and sewage lagoon. Unwanted dust suppressants may be deposited into landfills and sewage lagoons only with the consent of the local community government. The local fire department may also be called upon if a fire or other public safety issue involving chemical dust suppressants is identified.

Co-management Boards and Agencies

Co-management boards and agencies established under the Nunavut Land Claims Agreement have broad authority for land use planning, impact assessment and the administration of land and water. Activities involving the management and use of dust suppressants may be controlled through setting terms and conditions in plans, permits and licenses issued by the Nunavut Water Board, Designated Inuit Organizations responsible for land administration and other co-management boards and agencies.

Overview of Dust Suppressants

2.1 Dust Suppression Products and Alternatives

There are many different methods which can be used to control dust from unpaved roads. It is best to choose a method that will be most effective and economical. When planning a dust suppression program, the dust suppressant material or technique should be:

- Environmentally safe
- Easily applied using locally available road maintenance equipment
- Workable and responsive to maintenance activities
- Reasonably effective at controlling dust
- Not degrading to ride quality or use of the road
- Relatively harmless to vehicles using the road
- Posing little hazard or inconvenience to users of the road and adjacent residents
- Cost effective

The most commonly used dust suppressants are water, chloride salts, asphalt products and lignins. The general characteristics of these and other treatments used to control dust on unpaved roads are described in this section.

Water

Water is the most commonly used dust control agent. Water wets the road surface and binds fine particles together by the surface tension of the water. While water is readily available, low cost and easy to apply, it evaporates quickly and generally controls dust for less than 12 hours. Seawater is more effective for controlling dust than freshwater but repeated applications and long-term use may harm nearby vegetation and freshwater aquatic life.

Chloride Salts

Calcium chloride and *magnesium chloride* are the two most commonly used chemical dust suppressants. They are hygroscopic, or water attracting, agents that increase the moisture content of the road surface by attracting moisture from the air. This helps form a crusty layer which holds the fine particles on the road surface. Usually one to two treatments is required each year to maintain effective dust control.

Lignins and Petroleum Products

Lignosulfonate, a residue of paper production, and *petroleum products* is the other major group of chemical dust suppressants. Unlike chloride salts, these materials are adhesives and binders that physically glue soil particles together. These form a hard crust and are waterproof which helps to protect and stabilize the road surface. Lignin derivatives usually require one or two treatments each year and can create low dissolved oxygen conditions that are harmful to aquatic life if a spill or runoff from the road surface is allowed to enter adjacent rivers or lakes. A wide range of petroleum products (i.e. bitumens, tar and resins) are commercially available in Canada for dust suppression. Their effectiveness, safe use and environmental risks vary widely.

Other Dust Suppressants

Electro-chemical stabilizers attract positively charged dust particles and bind ionically to them. They also expel absorbed water and aid in compaction of the road surface. While a large variety of these materials are commercially available, their performance can be variable and pilot tests should be performed

before large-scale applications take place. *Polymers* are composed of long-chained molecular structures and bind road particles together to form a semi-rigid film on the road surface. These suppressants are usually more expensive than competitive road surface treatments and are most effective on lightly trafficked surfaces. *Enzyme slurries* promote compaction and have been effective in reducing dust under highly specific trafficked surfaces and gravel conditions. *Cementitious binders* work to chemically and permanently bind soil particles together.

Refer to Appendix 2 *Comparison of Dust Suppressant Characteristics* for more details on these and other dust suppressants.

2.2 Potential Effects of Chemical Dust Suppressants on the Environment and Human Health

There are no environmental hazards associated with the use of freshwater as a dust suppressant if it is not applied excessively. Repeated applications and long-term use of seawater may however, impact nearby vegetation and aquatic life as it contains small quantities of chloride salts.

Chloride salts are not toxic to humans at low concentrations. Domestic pets (i.e. dogs) can however, develop drooling, vomiting and diarrhea from ingesting road salts either by eating them directly or licking salty paws. Exposure of a dog's paws to road salt can also produce painful irritations, inflammation and cracking of the feet pads. The most visible impact of road salt on the environment is on plants along treated roadways. Stress and dehydration caused by salt can result in foliage damage and reductions in seed germination and flowering. Elevated levels of chloride salt in soil can also cause a colonization of salt tolerant plant species such as cattails, thereby reducing plant diversity. In addition, elevated chloride levels can be toxic to many forms of freshwater fish and aquatic insects.

Lignosulfonates are low in toxicity based on results of tests in laboratory animals including rats, rabbits and guinea pigs. The primary environmental concern from lignosulfonate use comes from its high solubility in water and high biological oxygen demand. Dissolved oxygen will be removed from waterways during lignosulfonate decomposition to levels that may be harmful to fish and other aquatic organisms. Allowing these products to enter waterways can also result in foaming and discoloration.

The potential effects of petroleum products and petroleum-derived dust suppressants on the environment and human health is directly related to their physical properties and the types and levels of contaminants present. While petroleum-derived dust suppressants generally have a low volatility, inhaling the more volatile components can cause irritation and inflammation of the throat and lungs. Prolonged or repeated skin contact may cause irritation and dermatitis, and should be avoided.

Used oil was once commonly used as a dust suppressant in Nunavut but now its use is strictly prohibited. During its use in engines, lubricating oil can become contaminated with by-products of combustion from engine wear. These contaminants include cancer-causing polycyclic aromatic hydrocarbons (PAHs) and metals (i.e. aluminum, cadmium, chromium, lead and copper). When used oil is applied to a road surface, these contaminants can bind to dust particles and then be washed off the road by rainfall or get blown into the air by traffic and wind. People and animals may swallow these harmful chemicals and metals through drinking water, breathing in contaminated air or dust, or eating contaminated berries or vegetation.

Best Management Practices

3.1 Pollution Prevention

Pollution prevention involves methods and practices that minimize or eliminate the generation of waste. Employing these methods only makes good sense as they help to reduce the hazards and costs associated with handling, storing, transporting, recycling, treating and disposing of any resulting waste. Implementing pollution prevention methods and practices also helps to reduce impacts on the environment, human and worker health and safety and minimize the use of raw materials.

Owners of dust suppressants can help prevent pollution and reduce costs by implementing a range of waste reduction, reuse and recycling initiatives. These include changes to operational procedures, maintenance practices and raw material use. Several of these initiatives are identified below.

Reduce

- Purchase the right type of dust suppressant and only the amount needed
- Use what you purchase
- Develop effective inventory controls and ensure the stored dust suppressants are completely used before purchasing additional supplies
- Establish and maintain storage methods and schedules that are consistent with those suggested by the manufacturer or supplier

Reuse and Recycling

- Donate unused dust suppressant to reputable local companies or individuals
- Make an agreement with your supplier to return un-opened and undamaged containers or packages of dust suppressants

There are also several practical alternatives to dust suppressants that will help reduce the level of dust from unpaved roads. Table 1 describes several of these alternatives.

Table 1.

	Description
Reducing Traffic	Reducing the number of vehicles on the road can reduce dust. Traffic can be reduced voluntarily by encouraging people to walk. Alternatively, limiting vehicle access to certain unpaved roads and paths will reduce dust levels.
Reducing Speed	Fast moving vehicles result in more dust than slow moving vehicles. Reducing speed from 60 kilometers per hour to 30 kilometers per hour can reduce dust by as much as 65%. Speed limit signs, enforcement and awareness can reduce vehicle speeds.
Improving Road Design	Good road design and drainage can reduce dust. When a road has poor drainage, water in puddles floats the fine particles up from the soil beneath the road. Traffic and wind can then spread the dry fine particles as dust.
Reducing Exposed Ground	Covered ground does not blow away and create dust. Covering the road surface with gravel can reduce the levels of dust from unpaved roads.
Slowing the Wind	Windbreaks are barriers designed to slow the speed and direction of wind. Methods may include leaving snow fences stand in place during the summer and maintaining vegetation along ATV paths.

3.2 Approved Dust Suppressants

Industrial suppliers offer many different products for controlling dust on unpaved roads. Each product has its own environmental, safety and operational benefits and limitations. The following dust suppressants are currently approved for use in Nunavut:

Freshwater and sea water
Calcium chloride
DL 10
EK-35
DUST-STOP

Refer to appendix #3 *Approved Dust Suppressants* for information on these approved products.

Dust suppressants may only be used on unpaved roads in Nunavut if they are listed as an 'approved dust suppressant' or have been approved for use by the Nunavut Department of Environment or through the setting of terms and conditions in plans, permits and licenses issued by the Nunavut Water Board or a Designated Inuit Organization responsible for land administration. Refer to section 3.5 *Approval of New Dust Suppressant Products* for information on the assessment and approvals process.

Used oil and waste fuel are strictly prohibited from use as dust suppressants on unpaved roads.

3.3 General Application Procedures for Approved Dust Suppressants

Regardless of the dust suppressant used, there are general application procedures which should be followed when planning or undertaking any dust suppression program in Nunavut. Table 2 describes these general procedures.

Table 2.

	General Application Procedures
Manufacturer's Directions	The manufacturer's specifications, directions and other procedures must be followed at all times. Where the dust suppressant is a manufactured product, these specifications and directions are available through the supplier.
Notification	The general public or other users of the road should be notified at least 24 hours before any application is scheduled to begin. This notification can be through the use of temporary road signs, public notices and local media announcements. The local office of the territorial Department of Environment should be provided with information on the dust suppressants to be used, location and schedule of work. If a dust suppressant is to be applied on private property, a written agreement should be entered into between the property owner and the applicator.

When to Apply	Dust suppressants generally work best when applied to damp road surfaces. If the road surface is dry, a water truck can be used to dampen the road before applying the suppressant. Caution should be undertaken when applying chloride salts and lignosulphonates because they are soluble and can be leached out of a road by excess water. Soluble suppressants should not be applied when it is raining or if rain is forecast in the next few days.
How to Apply	The road surface should be tested to ensure proper gradation. The dust suppressant should not pool on the surface due to depressions in the road surface or run off the traveled area because of excessive surface slope. If the road surface is tight and penetration of the liquid suppressant is poor, the top one to two inches of road surface should be loosened or scarified before applying the dust suppressant. Application equipment should be accurately calibrated and the suppressant applied evenly across the road surface. The amount of dust suppressant should not exceed the minimum amount required to effectively suppress dust. The dust suppressant should be bladed or incorporated into the road surface immediately following its application. This helps to ensure the product is incorporated into the surface materials and does not migrate off the roadway. It is ideal to keep traffic off the road for up to two hours after application has been completed. Avoid applying dust suppressant when heavy vehicle traffic is expected (i.e. immediately before or after regular office hours). If this is not possible, then only one side of the road should be treated at a time and traffic diverted. This will help to minimize the spreading of dust suppressant by vehicles and protect vehicles from metal corrosion.
Where to Apply	The application must be limited to the roadway or parking lot surface. Carefully monitor the application rate to ensure adequate coverage is achieved without any runoff of the product. Limit the application of dust suppressants near open bodies of water (i.e. lakes and streams) to prevent runoff or leachate from entering the water. Never apply a dust suppressant to areas of roads that are subject to flooding.
Cleaning of Equipment	The application equipment should be cleaned immediately following use when using chloride salts due to their corrosive nature.
Reworking the Road Surface	Many dust suppressants allow the road surface to be periodically reworked to remove potholes and ruts. Grading should never exceed the depth of the suppressant to avoid its dilution with untreated gravel and sand.
Test Sections	It is sometimes difficult to predict what level of performance will be achieved through the use of a dust suppressant. It is advisable to test the suppressant on a small portion of the road when the product is being applied for the first time.

3.4 Spill Response and Cleanup

Spills of chemical dust suppressants can affect soil, groundwater and surface water quality if they are not cleaned up quickly and properly. Be prepared to respond to accidental spills. Spill contingency plans

should be developed by the person in charge, management or control of any chemical dust suppressant. All spills of hazardous materials must immediately be reported to the NWT/Nunavut 24-Hour Spill Report Line at (867) 920-8130 in accordance with the *Spill Contingency Planning and Reporting Regulations*.

3.5 Approval of New Dust Suppressants

Dust suppressants may only be used if they have either been listed as an 'approved dust suppressant' (refer to section 3.2 *Approved Dust Suppressants*) or been approved for use by the Nunavut Department of Environment or through the setting of terms and conditions in plans, permits and licenses issued by the Nunavut Water Board or a Designated Inuit Organization responsible for land administration.

To enable new dust suppressants to be assessed, specific information should be provided to the Environmental Protection Division of the Department of Environment no later than 30 calendar days before the dust suppression program is scheduled to begin. Table 3 describes the type of information needed to assess new dust suppressants. The submission of incomplete information may result in delays in obtaining the necessary approval.

Table 3.

	Information Requirements
Product Information	Manufacturer's product information (including toxicity and solubility) and Material Safety Data Sheet
Procedures	Manufacturer's Standard Operating Procedures (SOP) for the handling, storage and application of the dust suppressant
Laboratory Testing	Results of the Toxicity Characteristic Leaching Procedure[4] if the dust suppressant and road material forms a solid substance following application
Schedule and Location	Schedule for applying dust suppressant to road test sections and its full application. Include a map of the area to be treated including location of any sensitive environments (i.e. lakes, streams, rivers), homes and businesses
Other Information	Copies of regulatory approvals from other Canadian jurisdictions, Boards and agencies; and accounts of product effectiveness and subsequent durability of the treated road surface

[4] The recommended leachate testing procedure is the United States Environmental Protection Agency Toxicity Characteristic Leaching Procedure (TCLP) Test Method 1311. The procedure is designed to assess the mobility of organic and inorganic analytes by simulating material residing inside a landfill containing unsegregated waste. Any leachate collected from the test must then be analyzed using methods contained in the most recent edition of *Standard Methods for the Examination of Water and Wastewater.* Analysis must be conducted by a laboratory that has been formally recognized by the Canadian Association of Environmental Analytical Laboratories (CAEAL) as being competent to perform the specified tests.

Conclusion

Dust from unpaved roads can have environmental and public heath and safety impacts. Use of chemical and non-chemical dust suppressants can be effective in reducing the impacts of fugitive dust by minimizing the loss of fine particles to the air and stabilizing the road surface. Numerous products and techniques are available, each with its own characteristics (i.e. toxicity and solubility), benefits and limitations. This Guideline examines the most commonly used dust suppressants and the conditions under which they are most effective. It is intended to increase the awareness and understanding of the characteristics, benefits and hazards associated with dust suppressants and introduce the reader to best management practices which, when safely and properly applied, can reduce the impacts of dust suppressants and minimize fugitive dust levels from unpaved roads.

Familiarity with the Guideline does not replace the need for the owner or person in charge, management or control of dust suppressants to comply with all applicable federal and territorial legislation and community by-laws. The management of these products may also be controlled through permits and licenses issued by Nunavut's co-management boards, Aboriginal Affairs and Northern Development Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

For additional information on the management of dust suppressants in Nunavut, or to obtain a list of available guidelines, go to the Department of Environment web site or contact the Department at:

Environmental Protection Division
Department of Environment
Government of Nunavut
Inuksugait Plaza, P.O. Box 1000, Station 1360
Iqaluit, Nunavut X0A 0H0

Telephone: (867) 975-7729
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