

CUMBERLAND
RESOURCES LTD.

MEADOWBANK GOLD PROJECT

AIR QUALITY & NOISE MANAGEMENT

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DESCRIPTION OF SUPPORTING DOCUMENTATION

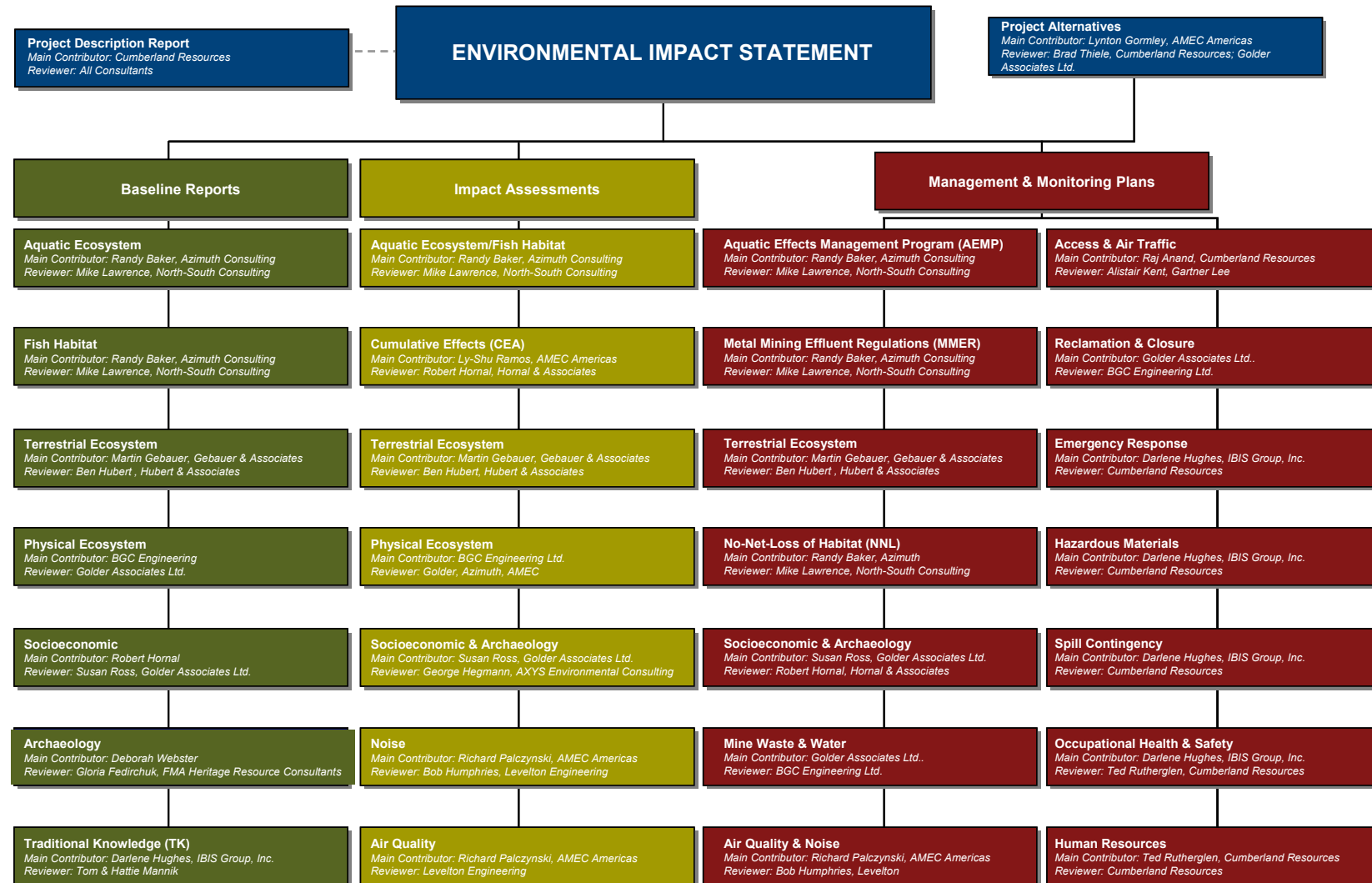
Cumberland Resources Ltd. (Cumberland) is proposing to develop a mine on the Meadowbank property. The property is located in the Kivalliq region approximately 70 km north of the Hamlet of Baker Lake on Inuit-owned surface lands. Cumberland has been actively exploring the Meadowbank area since 1995. Engineering, environmental baseline studies, and community consultations have paralleled these exploration programs and have been integrated to form the basis of current project design.

The Meadowbank project is subject to the environmental review and related licensing and permitting processes established by Part 5 of the Nunavut Land Claims Agreement. To complete an environmental impact assessment (EIA) for the Meadowbank Gold project, Cumberland followed the steps listed below:

1. Determined the VECs (air quality, noise, water quality, surface water quantity and distribution, permafrost, fish populations, fish habitat, ungulates, predatory mammals, small mammals, raptors, waterbirds, and other breeding birds) and VSECs (employment, training and business opportunities; traditional ways of life; individual and community wellness; infrastructure and social services; and sites of heritage significance) based on discussions with stakeholders, public meetings, traditional knowledge, and the experience of other mines in the north.
2. Conducted baseline studies for each VEC and compared / contrasted the results with the information gained through traditional knowledge studies (see Column 1 on the following page for a list of baseline reports).
3. Used the baseline and traditional knowledge studies to determine the key potential project interactions and impacts for each VEC (see Column 2 for a list of EIA reports).
4. Developed preliminary mitigation strategies for key potential interactions and proposed contingency plans to mitigate unforeseen impacts by applying the precautionary principle (see Column 3 for a list of management plans).
5. Developed long-term monitoring programs to identify residual effects and areas in which mitigation measures are non-compliant and require further refinement. These mitigation and monitoring procedures will be integrated into all stages of project development and will assist in identifying how natural changes in the environment can be distinguished from project-related impacts (monitoring plans are also included in Column 3).
6. Produce and submit an EIS report to NIRB.

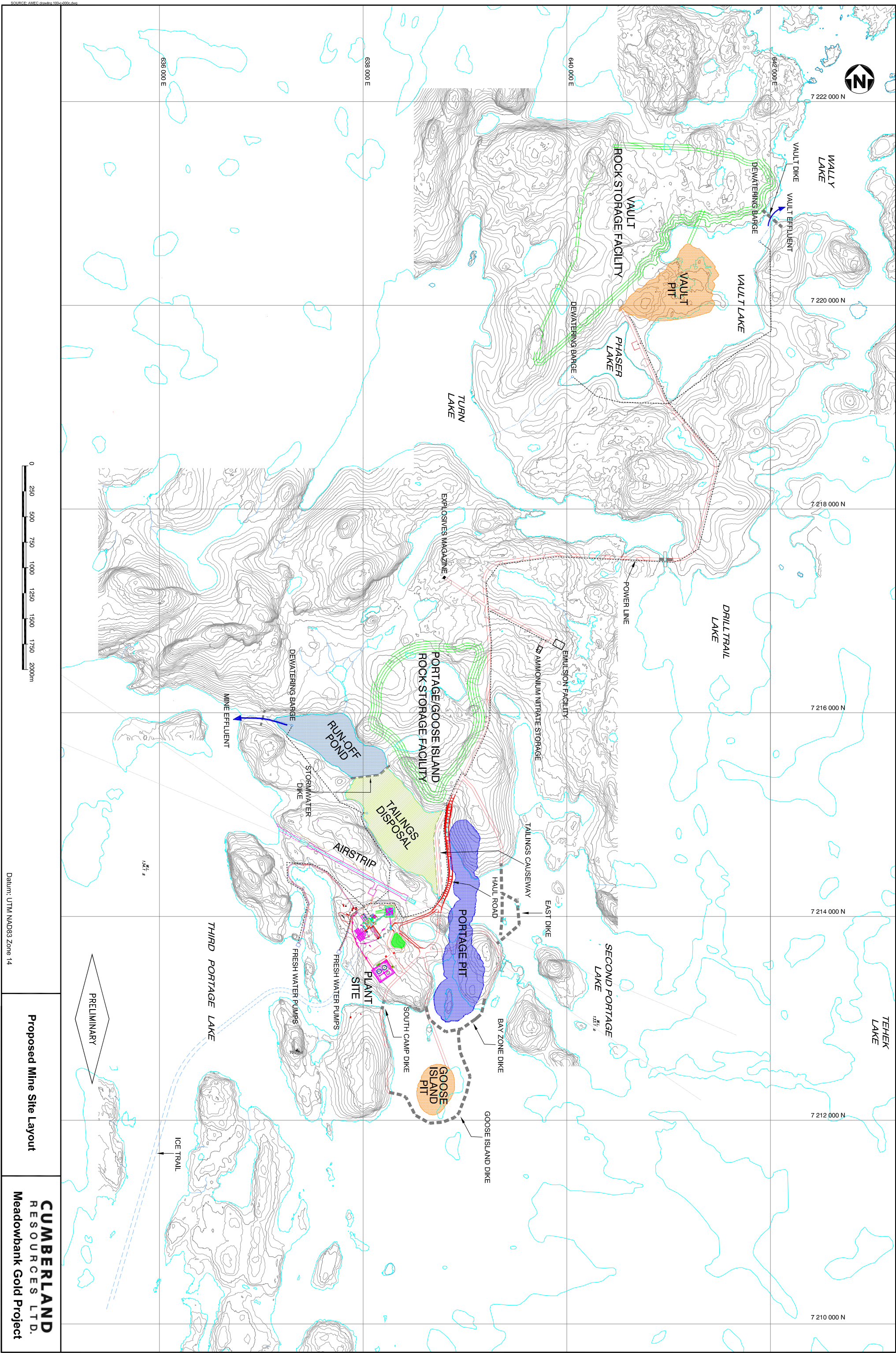
As shown on the following page, this report is part of the documentation series that has been produced during this six-stage EIA process.

EIA Documentation Organization Chart



PROJECT LOCATION MAP





SECTION 1 • INTRODUCTION

This Air Quality and Noise Management plan has been prepared by Cumberland Resources Ltd. (Cumberland) for the Meadowbank Gold project to ensure compliance with relevant environmental regulations during construction and operation of the project. This plan has been prepared in concert with Cumberland's "Air Quality Impact Assessment" and "Noise Impact Assessment," which are included in this Environmental Assessment documentation series under separate cover. The air quality and noise at site management plan will:

- identify emission sources at site
- describe the air emission limits for the overall project (including plant) and for major sources and stacks (including pertinent operational parameters)
- identify permissible sound levels
- describe air basin and baseline noise
- provide emission inventory and emission forecasts
- conduct dispersion modelling
- commit to reporting greenhouse gas (GHG) emissions in support of Canada's Voluntary Challenge and Registry
- develop a baseline and monitoring system for GHG emissions to evaluate and report on progress in improving efficiency and reductions in GHG emissions
- report particulate matter emissions to the National Pollutant Release Inventory (NPRI)
- promote cleaner technology to improve performance
- take into consideration fuel economy as an important criterion when purchasing, upgrading, or maintaining the haul truck fleet
- search for a market-based solution to ensure cost-effective emission reductions
- implement air quality and noise mitigation measures as presented in this document
- develop and implement air quality and noise monitoring plan to verify compliance with relevant regulations
- conduct employee training awareness
- establish a continuous improvement program
- search for certification to international standards such as ISO 14001 to help demonstrate Cumberland's environmental commitment to regulators and other stakeholders.

Air quality and noise monitoring will be an essential component of the management plan. The monitoring program will:

- provide clear, directions on how to minimize air pollution and noise
- describe clearly the regulatory requirements and corporate standards for environmental performance pertaining to air quality and noise control
- form the link between operations, safety, and environmental programs
- provide the monitoring results programs required to ensure the air pollution management systems are operating as designed
- identify the reporting requirements for documenting and communicating the monitoring results
- ensure that all environmental, health, and safety (EHS) risks are addressed.

SECTION 2 • NOISE MANAGEMENT

Workplace noise levels are regulated by occupational safety and health standards. Ambient noise standards for the Meadowbank project developed with reference to the Alberta Energy and Utilities Board's Guide 38 are discussed in Section 2.4.

Noise levels are expected to be highest during blasting at deposit sites and in the vicinity of the diesel generator(s), the mine haulage trucks, the primary crusher, and the grinding circuit. Employees will be required to wear hearing protection in areas where noise exceeds a minimum safe level. The project's industrial hygiene department (or comparable) will be responsible for monitoring sound levels and assigning appropriate hearing protection to workers. As discussed in the following sections, many noise sources such as equipment will have built in mitigation features, as provided by manufacturers.

2.1 CONSTRUCTION PHASE

When dealing with construction noise, a higher level of noise is usually tolerated if its duration is relatively short. Construction stage works are also frequently associated with noise mitigation measures such as natural topographical obstructions (different ground elevation), which provide a barrier to construction noise.

Controlling construction noise involves noise level and time restrictions. The shorter the work phase, the more likely that a higher level of construction noise will be acceptable by noise-sensitive receptors. As the length of the construction period increases, the tolerable exceedance of the background level is reduced.

Table 2.1 lists the project-related noise sources that have been identified, as well as proposed mitigation/management measures, and any action required during the construction phase.

The mitigation measures that will be applied to all noise sources during construction are summarized as follows:

- schedule noisy construction activities at normal working hours to the extent possible
- perform regular inspection and maintenance of construction vehicles and equipment to ensure that quality mufflers are installed and worn parts are promptly replaced
- limit on-site equipment
- reduce power operation by using only the size and power required
- consider noise barriers, baffles, or enclosures for particularly noisy equipment such as crushers, grinders, compressors, pumps, gearboxes, etc.
- develop a noise monitoring program for the construction phase.

Table 2.1: Noise Sources & Proposed Mitigation Measures during Construction

Noise Source	Noise Management & Mitigation Measures	Action Required
Road traffic	<ul style="list-style-type: none"> - Avoid trucking operation during night time, where possible - During maintenance, check that noise abatement devices are in good order (e.g., brakes, exhaust mufflers, engine hoods). - Select vehicles with minimum noise output including tire noise, exhaust, and compressor/fan noise 	Cumberland will assure that construction contractors follow mitigation measures
Air traffic	<ul style="list-style-type: none"> - Avoid low altitude flights - Restrict air traffic to daytime hours 	Cumberland advises air traffic operator on noise restrictions
Impact equipment (pile drivers, jack hammers, drills, pneumatic tools)	<ul style="list-style-type: none"> - Use of a noise-attenuating jacket around the jackhammer - Avoid operating numerous pneumatic tools at the same time and spread operation throughout working periods 	Noise attenuation is incorporated into design by the manufacturer
Stationary equipment (compressors, generators, pumps)	<ul style="list-style-type: none"> - Position equipment in sheltered locations, e.g., behind the earth berm if possible - Keep equipment in good condition 	Cumberland advises operators on noise regulations
Blasting	<ul style="list-style-type: none"> - Use delays, both surface and down hole - Follow approved blasting practices - Select time when the environment is least sensitive to noise impact (e.g., daytime hours) 	Cumberland to retain an experienced blaster and develops an appropriate blasting schedule
Materials handling equipment (crushers, concrete mixers, cranes)	<ul style="list-style-type: none"> - Place crushers in sheltered/enclosed locations if possible - Maintain equipment in good working condition - Turn equipment off when not in use 	Cumberland advises operators on noise regulations and performs regular inspections
Earth moving equipment (trucks, loaders, dozers, scrapers)	<ul style="list-style-type: none"> - Restrict equipment age so only newer, more efficient machinery will operate - Operate equipment within specification and capacity (e.g., don't overload machines) - Use noise abatement accessories such as sound hood and mufflers 	Cumberland implements proper operating practices according to best practices
Other internal combustion engine powered equipment	<ul style="list-style-type: none"> - Equipment restrictions: use equipment conforming with noise standards - Intake and exhaust silencers: ensure equipment has quality mufflers installed - Reduced power option: use only necessary size and power - Equipment maintenance: maintain equipment on a regular basis, replace worn parts, lubricate as required 	Noise attenuation is incorporated into design by the manufacturer Cumberland implements an equipment maintenance program

2.2 OPERATIONAL PHASE

Table 2.2 describes the project-related noise sources that have been identified as well as proposed mitigation/management measures and actions required during operation of the facility.

Table 2.2: Noise Sources & Proposed Mitigation Measures during Operations

Noise Source	Noise Management & Mitigation Measures	Action Required
Road traffic	<ul style="list-style-type: none"> - Avoid trucking operation during night time, when possible - Select vehicles with minimum noise output including tire noise, exhaust, and compressor/fan noise - During maintenance, check that noise abatement devices are in good order (e.g., brakes, exhaust mufflers, engine hoods) - Place speed limit for the plant area and on the Vault haul road - Use shallow slopes for haul road - Educate truck drivers about the characteristics of diesel engines (i.e., that the flat torque characteristic allows ascending an incline in a higher gear, which is a less noisy operation) 	Cumberland to follow haul road slopes incorporated into design specifications
Air traffic	<ul style="list-style-type: none"> - Avoid low altitude flights - Restrict air traffic to daytime hours 	Cumberland advises air traffic operator on noise restrictions
Impact equipment (pile drivers, jack hammers, drills, pneumatic tools)	<ul style="list-style-type: none"> - Use a noise-attenuating jacket around the jackhammer - Avoid operating numerous pneumatic tools at the same time, and spread operation throughout working periods 	<ul style="list-style-type: none"> - The manufacturer to incorporate noise attenuation into design - Cumberland to enforce mitigation measures
Stationary equipment (compressors, generators, pumps)	<ul style="list-style-type: none"> - Position equipment in sheltered locations, e.g., behind the earth berm if possible - Keep equipment in good condition 	Cumberland advises operators on noise regulations
Blasting	<ul style="list-style-type: none"> - Use delays, both surface and down hole - Select time when the environment is least sensitive to noise impact (e.g., daytime hours) - Blasting in depressed pits (normal production practice) 	Cumberland to retain an experienced blaster
Outdoor materials Handling equipment (crushers, concrete mixers, cranes)	<ul style="list-style-type: none"> - Place crushers in sheltered/enclosed locations if possible - Maintain equipment in good working condition - Turn equipment off when not in use if practicable 	Cumberland to follow Periodic noise measurement
Earth moving equipment (trucks, loaders, dozers, scrapers)	<ul style="list-style-type: none"> - Restrict equipment age so only newer, more efficient machinery will operate - Operate equipment within specification and capacity (e.g., don't overload machines) - Use noise abatement accessories such as sound hood and mufflers 	Cumberland to implement by developing proper operating practices

Table 2.2 – Continued

Noise Source	Noise Management & Mitigation Measures	Action Required
Primary plant facilities (gyratory primary crusher, SAG mill, ball mill, power plant)	<ul style="list-style-type: none"> - Equipment restrictions: use equipment conforming with noise standards - Provide building with walls absorbing noise - Maintain equipment on a regular basis, replace worn parts, lubricate as required - Provide diesel plant units with efficient intakes and exhaust silencers - Restrict use of sirens and reversing alarms to the minimum; use "smart" reverse alarms - Use conveyor system with low noise output, paying particular attention to rollers - Enclose conveyors where necessary 	<ul style="list-style-type: none"> - Include recommendations in the building design - The manufacturer to incorporate noise attenuation into design
Utilities and services	<ul style="list-style-type: none"> - Ensure that a rotating biological contactor treatment system operates quietly - Dump solid waste behind barriers 	Cumberland to implement

The noise mitigation measures applicable to the operations phase of the project can be summarized as follows:

- perform regular inspection and maintenance of material handling vehicles and equipment (i.e., ensure that quality mufflers are installed, worn parts are replaced, and lubricants are applied) so that they continue to meet the designers' noise output specifications
- comply with established noise limits: consider a 100 m wide buffer along the property perimeter
- limit working on-site equipment to only have necessary on-site equipment
- examine the noise mitigation strategy chosen by similar plants with similar requirements for noise reduction
- provide an air inlet silencer and exhaust silencers for combustion engines and other units
- consider noise barriers, baffles, or enclosures for particularly noisy equipment such as crushers, grinders, compressor, pumps, gearboxes, etc.
- conduct noise survey at the property line and at the location of critical receptors when the project attains full production capacity and annually thereafter during daytime and night time hours to confirm compliance.

2.3 TRANSPORTATION-RELATED NOISE

The following measures should be implemented to minimize the effects of transportation-related noise associated with the project during both construction and operation:

- enforce speed limits along roads, especially near the campsite and in important wildlife habitat
- keep road surfaces in good repair to reduce tire noise

- ensure continuous traffic flow to avoid prolonged idling
- schedule transportation for daytime hours whenever possible.

2.4 NOISE MONITORING

The ambient noise monitoring program during both the construction and operation stages will include one full day (day and night) of measurements during the first year of development and every second year thereafter. This will determine noise parameters such as the equivalent continuous noise level (L_{eq}) in decibels (dBA), the A-weighted sound pressure level that is exceeded for 50% and 90% of the time over which a given sound is measured (L_{A50} and L_{A90}), and frequency noise analysis. Measurements will be taken at noise-sensitive locations where noise levels are likely to be the highest (see Photo 2.1). Noise measurements should follow a recognized guideline such as Alberta Energy and Utilities Board's Guide 38 Noise Control Directive ID-99-8.

The following items will be included in a noise monitoring report:

- type of monitoring test conducted (i.e., the construction stage or operation)
- noise limits (daytime and night time) for the facility
- description of the nearest affected receivers
- monitoring locations
- noise instrumentation used
- weather conditions during noise survey
- time and duration of monitoring, including dates
- results of noise monitoring at each monitoring location
- statement outlining the compliance or non-compliance with the limit
- statement of the reason for non-compliance when noise exceedances are found
- strategies to manage the noise exceedance.

The noise monitoring results will be used for the evaluation and review of the noise management plan.

Photo 2.1: Noise Monitoring



SECTION 3 • AIR QUALITY MANAGEMENT

The air quality management plan will include measures to minimize air emissions from major sources such as haul trucks operating in open pits and other diesel-powered equipment associated with ore extraction and processing. The air quality plan will include particulate matter (PM) emission control units at the primary crusher, SAG and ball mills, power plant, and tailings and waste rock piles. As well, Cumberland is committed to developing a Tailings Air Quality Management Plan addressing the PM fugitive emissions for the waste rock and tailing areas.

The main concern for workplace air quality will be cyanide and acid mists associated with the process plant and chemical mixing areas. Careful maintenance of pump seals and piping will minimize the generation of hazardous dust and mists in the plant areas. In addition, ventilation systems and minimizing of confined areas will keep the concentration of chemicals in mists below the maximum permissible concentration. Therefore, chemical mixing is not considered a risk to the health and safety of workers in mixing areas.

Air quality impacts during construction and operation are summarized in this section, and a number of mitigation measures are proposed to manage ambient air quality below the maximum permissible levels.

3.1 CONSTRUCTION PHASE

During the early site preparation and construction phase of the project, fugitive emissions resulting from earthwork, burning of organic waste during site clearing, and vehicle movement on temporary dirt roads will increase particulate concentrations. In addition, fugitive dust (dust picked up by wind from the ground) will be created by construction activities, exposed topsoil, moved overburden (the muskeg and layers of soil over top of the gold ore deposit to prepare the area for surface mining), and stored dusty construction material. The fugitive dust emissions will increase when the initially wet material dries after being subjected to dry and windy weather.

Heavy-duty diesel vehicles and stationary construction equipment will generate diesel exhausts. Chemical analysis of exhaust has shown that it contains hydrocarbons, carbon monoxide, nitrogen oxides, and particulates. These pollutants disperse into the surrounding air along the travelled route while the vehicle is in motion.

Burning of organic wastes, which generates other pollutants in addition to particulates, will add to the problem. Nonetheless, these emissions generally do not result in high concentrations that would have long-term health effects or would affect the ecology within the construction site and beyond. In addition, trees and vegetation are scarce at the far north areas where the plant will be located.

Several mitigation measures will be implemented to minimize air quality impacts during several early site preparation and construction. These are as follows:

- implement fleet maintenance program ensuring that all diesel-powered equipment will operate efficiently, thereby reducing air emissions

- impose vehicle speed limits to mitigate fugitive dust
- apply water (recycled if available) as dust suppressant to construction roadways during dry weather in summer months (June to September) and calcium chloride or other liquids during cooler weather when ground is not covered with snow
- reduce vehicle emissions by not allowing motors to idle, except when necessary
- limit blasting to calm days or use delay blasting technique
- reduce smoke generation, avoid incomplete combustion, and minimize the duration of burning by burning organic waste in fewer larger piles instead of numerous smaller loads
- review the option of salvaging the largest woody debris to provide ground cover for small mammals while considering the possibility of an increased fire risk
- avoid spills during vehicle and stationary power equipment refuelling to avoid releases of hydrocarbons into the atmosphere
- use water spray instead of pneumatic flushing when removing dust whenever possible.

3.2 OPERATION PHASE

Mining, ore processing, waste rock and tailings disposal and storage, heap leaching, and associated operations and support activities at the mining site will be sources of air pollutants. The principal pollutants will be particulate matter less than 10 micrometers in diameter (PM₁₀), oxides of nitrogen (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂), and volatile organic compounds (VOCs). The mine also has the potential to emit small quantities of hydrogen cyanide (HCN), sodium hydroxide (NaOH), and hydrochloric acid (HCl).

Emissions of gases and dust from the industrial processes will be minimized and, if possible, eliminated. A diesel-fired 16 MW plant with multiple generator sets will be used to generate electricity. There will be five main diesel engines (5.5 MW each) with three normally operated and one standby providing sufficient operating capacity to handle the peak demand during the winter season. Carbon dioxide and carbon monoxide emissions will also be produced from an electric kiln used for carbon regeneration in the process plant. These stationary sources of air emissions generally have a greater impact on the ambient air quality than mobile sources because they operate 24 h/d and lack horizontal motion, which assists in the dispersion of air contaminants.

3.3 POTENTIAL ATMOSPHERIC IMPACTS DURING CONSTRUCTION

To mitigate potential atmospheric impacts of the proposed project during operation, the following measures will be considered:

Plant Production Facilities

- select the diesel power plant engines with low NO_x emissions to prevent ozone formation and with low hydrocarbon emissions to lower greenhouse gas (GHG) emissions
- use low sulphur content diesel fuel to mitigate SO₂ emissions

- collect and vent any process emissions (flotation, CIP circuit, carbon treatment, gold refining, and cyanide detoxification) into the atmosphere
- design all stacks using good engineering practice (including accessible sampling ports and adequate height) to ensure the required dispersion to meet ambient air quality objectives
- implement fleet maintenance program to ensure that all diesel-powered equipment will operate efficiently, thereby reducing air emissions
- install dust filters at the primary crusher building and at fine grinding facilities (SAG mill and ball mill) and provide dust suppression equipment (dust covers, sonic sprays, etc.)
- install enclosure of feed conveyor to avoid fugitive emissions during windy weather
- provide crushed ore stockpile enclosure to limit any dust to indoor environment.

Transportation

- impose vehicle speed limit on Vault haul road to mitigate fugitive dust and reduce engine emissions
- apply dust suppressants (water, calcium chloride) to haul and service roads during dry weather to mitigate fugitive dust
- to reduce vehicle emissions, do not let motors idle, except when necessary.
- no mitigation measures required for aircrafts as emissions will be low in magnitude given a small number of flights and the small size of aircraft
- upgrade road-surfacing materials using local coarse rocky aggregates.

Blasting & Waste Disposal

- limit blasting to calm days or use delay blasting technique; natural mitigation to take place when mining pits are from 85 to 175 m below the ground level; ore and waste to be coarse run-of-mine muck not prone to generating excessive dust
- cover dewatered tailings with non-potentially acid-generating (non-PAG) aggregates to control wind erosion.

Miscellaneous Items

- provide pressure valves to control fuel vapour fugitive emissions from the storage tanks
- use water spray instead of pneumatic flushing while cleaning equipment and working areas when temperature is above the freezing point
- use site-generated mineral material (dirt, aggregate, etc.) to cover disposed solid waste at the waste dump
- select waste incinerator with build-in emission control system (secondary combustion chamber, catalytic converter, etc.) and install a stack to disperse emissions to concentrations below ambient air quality objectives
- apply vegetation cover on stripped areas and long-term stockpiles.

Additional mitigation measures will be implemented on an ongoing basis when an opportunity for emission reduction is identified and technology development offers new tools for emission reduction.

3.4 AIR QUALITY MONITORING

The objective of the air quality monitoring plan is to collect sufficient data to determine the environmental effect of project activities on air quality. The air quality monitoring plan will address one of the most prominent issues for mining projects: the concentration of suspended particulate matter in the air surrounding the major areas of activity (dynamic monitoring) and the deposition rate of particles (static monitoring).

Dynamic monitoring will be based on high volume (HV) air sampling for particulate matter of diameter equal or less than $10\text{ }\mu\text{m}$ (PM_{10}). The U.S. EPA has described standard methods for collection of PM_{10} air samples in Section 40 CFR Part 53 and 58 of the *U.S. Code of Federal Regulations* (U.S. CFR, 1997a, 1997b, 1997c).

Of the several PM_{10} samplers available on the market, the one most commonly used in the mining industry is the Rupprecht and Patashnick (R&P) Partisol™ Model 2000 Air Sampler. This sampler will be deployed at the Meadowbank plant boundary in the direction of prevailing winds away from any taller structures or hills (see Photo 3.1). The Partisol™ sampler will operate automatically and results will be extracted on a monthly basis and compared with ambient air quality standards for PM_{10} to determine facility compliance status.

Photo 3.1: Air Quality Monitoring Stations



Static monitoring of dust deposition at Meadowbank will follow the D1739-98 standard test method for collection and measurement of dustfall (settleable particulate matter). A dust canister will be installed to measure the amount of dust that settles out of the atmosphere by gravity and is deposited on a unit area over a certain length of time (see Photo 3.2). It is proposed to deploy three static sampling stations: one near the dynamic sampler, the others near two open pit areas at the ground level to monitor the rate of PM deposition near the mining sites. The samplers will be replaced every month and gravitational analyses will be performed at the plant's laboratory. The ambient air "trigger levels" for dust fallout is a mining standard: $4\text{ g}/(\text{m}^2\text{ month})$ averaged over one month.

No continuous monitoring is proposed for gaseous pollutants because of the relatively low concentrations in the ambient air as predicted by the AERMOD dispersion model.

3.4.1 Purpose of Ambient Air Quality Monitoring

The purpose of ambient air quality monitoring is not only to verify compliance with applicable standards and regulations, but also to:

- commit to reporting emissions in support of Canada's Voluntary Challenge and Registry
- refine environmental management systems, reporting, and stewardship
- support research and data-gathering efforts to encourage a better understanding of the issue and its integration into the public policy debate
- promote cleaner technology to improve performance
- report PM emissions to the National Pollutant Release Inventory (NPRI).

The PM monitoring program will be implemented for the operational phase only because emissions during the construction phase will continuously change, both spatially and temporally. After the first year of monitoring during the operation phase, the results will be reviewed and, if necessary, the sampling program will be maintained, expanded, or discontinued.

3.4.2 Items Included in Dust Monitoring Report

The following items are included in a typical dust monitoring report:

- fallout guidelines and dust concentration standards for the facility
- type of monitoring test conducted (i.e., the concentration or fallout measurements)
- monitoring locations
- instrumentation used
- weather conditions during ambient quality survey (monthly weather report)
- time and duration of monitoring, including dates
- results of monitoring at each monitoring location (daily for concentrations in $\mu\text{g m}^{-3}$; monthly for fallout in $\text{g m}^{-2} \text{ month}^{-1}$)
- measurement error analysis (statistical and systematic errors)
- Partisol sampler audit report
- quality assurance/quality control (QA/QC) data

Photo 3.2: Static Monitoring Station



- statement outlining compliance or non-compliance with the limit
- discussion of the reason for non-compliance when concentrations or dustfall exceedances are found
- strategies to be used to manage air quality exceedance
- annual report summarizing the monthly report and giving the annual arithmetic mean, statistical analysis, and graphs (to add to the transparency of the results).

Establishing an equipment maintenance program and good operating practices will further control undesirable air emissions.