

SECTION 6 • ENVIRONMENTAL IMPACTS, MITIGATION & MONITORING

6.1 ENVIRONMENTAL IMPACTS

Tables 6.1 to 6.6 (included at the end of this section) show the potential project impacts, mitigation measures, and monitoring efforts that have been developed from information available to date on mine development and the receiving environment. Each impact was evaluated for: the degree of uncertainty, assumptions used, project design characteristics that could eliminate or alter the impact, and confidence in the information available to assess the impact. In all cases, the interaction was rated in terms of the probability of the impact occurring under the worst-case scenario; frequency; magnitude; timing (the seasonal nature of the impact); spatial extent; duration; the effect on ecosystem functioning and integrity; and the capacity of the resource to meet present and future needs.

The major environmental pathways include air, water, and terrestrial resources. The effects are defined in relation to recognized VECs. It is not possible at this time to quantify the impact of each of these effects until the TEK workshops have concluded. The information contained in these tables will provide a starting point for discussions with the community.

6.2 CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative effects can arise from multiple activities that happen concurrently or sequentially and can have a greater combined impact on a VEC or VSEC than those of individual project components. The key ecosystem pathways are through groundwater, surface water, terrestrial, and atmospheric courses. Cumulative effects most commonly arise if individual impacts on a VEC or VSEC are left unmitigated or if a residual effect remains after mitigation is applied. To assess the potential for cumulative impacts, further baseline environmental data will be collected, the proposed mitigation measures will be assessed, and discussions with the community and regulators will be held.

6.3 ENVIRONMENTAL MANAGEMENT SYSTEM

A project EMS (Environmental Management System) will be implemented to provide a systematic method for managing the expected and potential interactions of the project with the biophysical environment. It will consist of three key elements: an integrated environmental management plan, a formal environmental awareness program, and an ongoing environmental monitoring program. These elements are described below.

1. An integrated *Environmental Management Plan* (EMP) will outline how the project will be operated to manage the interaction between the project components, activities, and the biophysical environment to prevent or mitigate adverse impacts. The EMP will be prepared by Cumberland prior to project construction and will include some or all of the following plans:



- | | |
|--|--|
| • Environmental Protection Plans | • Quarry Management Plan |
| • Aquatic Management Plans | • Processed Ore Containment Management Plan |
| • Wildlife Management Plans | • Mine rock & Till Storage Management Plan |
| • Emergency Response & Contingency Plans | • Dredged Lakebed Sediment Management Plan |
| • Occupational Health & Safety Plan | • Closure & Reclamation Plan |
| • Human Resources Plan | • Exploration Environmental Management Plan |
| • Reclamation Plan | • Traffic Management Plan |
| • Community/Inuit Involvement Plan | • No-Net-Loss Plan |
| • Waste Management Plan | • Construction Area & Activity Management Plan |
| • Water Management Plan | • Operations Area & Activity Management Plan. |
| • Hazardous Materials Management Plan | • Blasting/Explosives Management Plan |

Mitigation procedures for construction, operation, temporary closure, and closure will be integrated into the EMP to ensure that development is proceeding as predicted and can be maintained in an acceptable state. The mine will be monitored on a "first alert" basis to allow any problems to be quickly detected and clearly understood so changes in mitigation measures or design can be made accordingly. The EMP will also ensure mitigation measures are implemented correctly; project effects on biophysical or socioeconomic VECs/VSECs are documented; natural changes in the environment (distinguishing them from project-related impacts) are measured; the effectiveness of reclamation efforts is measured; and permit requirements are being met.

2. A *formal environmental awareness program* will inform employees, contractors, and visitors on environmental commitments made by Cumberland, as well as the expected code of conduct and environmental stewardship of all people on site. The objective is to inform and raise awareness of the EMS in the workforce and with visitors to ensure that environmental protection is a constant priority with everyone on site.
3. An ongoing *environmental monitoring program* will be integrated into the EMS as a tool to provide feedback on how well impacts have been predicted and to allow appropriate corrective actions to be taken, should unexpected impacts occur. A comprehensive monitoring program will be developed for the project as required by the terms and conditions of the project's permits and licenses (see Section 1.4 for a list).

Cumberland is committed to working with the regulatory agencies and landowner to develop an appropriate EMP for the Meadowbank project. It is expected that the requirements for monitoring the biophysical, socioeconomic, cultural, and heritage resources throughout the life of mine will be part of the terms and conditions of the project's licenses, permits, and IIBA. It is expected the integrated EMP will include some or all of the elements shown in Table 6.7 below.

The EMP will be modified throughout the life of mine to address policy and regulation changes and to benefit from technological advances where improvements can be clearly demonstrated. The primary objective will be to maintain compliance with the regulations and requirements governing the project. ISO 14001 protocols will be used as a guide to audit project performance and demonstrate continuous improvement during the operating period.

Table 6.7: Potential Key Elements of the Environmental Monitoring Plan

	Function/Key Elements
Integrated EMP	A program of compliance monitoring to ensure that the project is meeting the environmental criteria established under legislation, regulation and in the license, permits and land leases that apply to the project;
	An aquatic environmental effects monitoring program to determine impacts on the aquatic receiving environment
	A program of workplace air quality monitoring to measure specific contaminants within the workplace to protect employee health and prevent release of unacceptable air quality to the surrounding environment (monitoring for hydrogen cyanide in the processing plant, airborne dust levels underground and in the plant, engine emission gas monitoring in the underground mine, etc.);
	A quality assurance/quality control program to ensure that the environmental monitoring programs are meeting acceptable standards;
Aquatic Monitoring	A program of terrestrial effects monitoring to assess effects on wildlife and wildlife habitat generally; and
	A cooperative monitoring program with the Government of Nunavut that describes the nature and seasonal use of the caribou herds of the region.
	A monitoring program to verify compliance with water license terms and conditions and to evaluate the effectiveness of the mitigation measures
	Cumberland will implement an aquatic monitoring program at the start of project construction
Terrestrial Monitoring	The aquatic monitoring program will include compliance and biophysical monitoring to measure project effects on water quality and aquatic biota
	Subject to the development of a Surveillance Network Program (SNP) by the NWB, Cumberland proposes an SNP be established
	Streams would be monitored during periods of flow (typically June through September)
	Parameters to be monitored will be pH, total arsenic, copper, cyanide, lead, nickel, zinc, suspended solids, alkalinity, hardness, and nutrients
Air Quality Monitoring	Prior to the annual release, tail Lake water will be analyzed for acute toxicity.
	The following wildlife monitoring program components will be continued through the mine life:
	-Maintenance of a wildlife sighting and activity log for the project site and continued annual monitoring of raptor nesting patterns and numbers in relation to the proximity of mining activities.
	Caribou is a resource of high value to the lifestyle of Nunavut residents. Due to the large geographic range of the caribou herds, effective monitoring of caribou herd health and well being is best conducted on a scale that matches the range of these animals. Cumberland would prefer to assist, where practical, caribou monitoring programs sponsored by the government of Nunavut and other governments and industry
QA/QC Program	A program of workplace air quality monitoring will be developed and implemented
	The primary objective will be to measure for specific contaminants within the workplace to protect employee health and to prevent the release of air quality harmful to the surrounding environment
	Monitoring will include:
	Monitoring of airborne hydrogen cyanide in the process plant
	Measurement of airborne dust levels and respirable quartz both underground and in the plant
	Measurement of diesel engine emission gases from the underground mining equipment and
	Monitoring of air quality in the underground mine
	A quality assurance/quality control (QA/QC) program will be developed and implemented as part of each of the environmental monitoring programs described above
	The objective of the QA/QC program is to ensure that the environmental monitoring programs are meeting acceptable accuracy standards
	The QA/QC will include use of duplicate samples, field blanks and analytical control standards
	The QA/QC program will include protocols for sampling, handling and shipping of samples and for data management and reporting.

6.4 INUIT IMPACT & BENEFIT AGREEMENT

Some of the issues that will be addressed in the Inuit Impact and Benefit Agreement (IIBA) are listed below. Negotiations for the IIBA will begin this year (2003).

- job opportunities
- training
- preferential hiring programs
- project financing
- participation
- new business and contract arrangements
- participation in monitoring activities and dispute resolution.

Table 6.1: Summary of Potential Environmental Effects - Air

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor/Maintain
Air quality	Physical mine site	Relatively small release of carbon monoxide & dioxide, sulphur dioxide, nitrogen oxides from diesel power.	Air scrubbers	Air quality (ongoing)
		Potential for thermal inversions & poor air quality over mine pits from diesel.	Use equipment with minimal emissions in open pits. Cover conveyors.	Air quality (ongoing)
	On-land disposal	Generation of dust from conveyors.	Use dust suppressants. Cover stockpiles.	Air quality (ongoing)
	Mine pits	Generation of dust from stockpiles.	Maximize combustion efficiency.	Air quality (ongoing)
	Traffic (ground & air)	Generation of dust and gases from blasting.	Use control measures such as watering, dust suppressants, roadway preparation.	Air quality (ongoing)

Table 6.2: Summary of Potential Environmental Effects - Hydrology

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitoring
Surface water quantity & distribution	Mine pits	Increase in outflows from Third Portage to Second Portage during open pit construction & dewatering.	Reduce footprint of mine pits. Modify remaining channels to balance rates of runoff (may be unnecessary given combined impacts)	Hydrologic (ongoing)
		Small increase in water levels in Third Portage from the loss of natural outflow channel(s) to Second Portage. Increased lake volume & depth, surface area & evaporation in Third Portage (see opposite effect below).		Hydrologic (ongoing)
		Reduced lake surface area & evaporation from introduction of open pits.		Hydrologic (ongoing)
		Increased runoff volumes to Second Portage. More dramatic fluctuations in lake water levels, storage volume, & depth (increased rate of change) in Third Portage (see opposite effect above).		
	Submerged disposal	Displaced water as tailings are disposed into Third & Second Portage (minimal effect for water quantity because of slow rate of displacement)	Some water will be re-used in mine process. Remaining water will be treated & discharged	Hydrologic (ongoing)
		Small changes in lake volume & surface area from footprint of disposal area (as above).	Minimize footprint of disposal areas. Modify remaining channels to balance runoff.	Hydrologic (ongoing)
	On-land disposal	Changes in drainage patterns & runoff to Third & Second Portage.	Minimize footprint of disposal areas. Use retention ponds in site drainage.	Hydrologic (ongoing)
	Physical mine site	Lower lake levels in Third Portage from water consumption. Decreased runoff to Second Portage.	Diversion of water from other sources during low flow periods (Pipedream Lake, Second Portage). Modify remaining channels to balance runoff.	Hydrologic (ongoing)
		Localized change in drainage area & land uses. Small changes in runoff patterns from Third to Second Portage.	Minimize mine footprint. Reduce impervious surface area. Use retention ponds in site drainage.	Hydrologic (ongoing)
		Localized change in snow accumulation. Small changes in runoff patterns from Third to Second Portage.		Hydrologic (ongoing)

Table 6.3: Summary of Potential Environmental Effects - Wildlife

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor/Maintain
Ungulates	Ground traffic	Caribou & muskox avoid areas with activity. Activity may cause the abandonment or alienation of critical habitat components. Mortality.	Minimize use of obstructive berms along Valut haul road. Route roads to avoid areas used by caribou. Establish low speed limits on haul roads. Convey shipments when possible. Give wildlife right-of-way. Define travel corridors.	Wildlife logs & long-term population indicators.
	Physical mine site (ground activity)	As above. Habitat loss & habitat avoidance	Avoid activity in areas used by caribou. Minimize mine footprint. Muffle noise. Use fencing & diversions to direct caribou away from high activity areas. Reclaim habitat at closure.	Wildlife logs & long-term population indicators.
	Air traffic	Habitat loss & habitat avoidance. Ungulates may have energy losses associated with harassment.	Avoid activity in areas used by caribou. Use clearly defined travel corridors. Establish minimum altitude for mine aircraft. Establish a no harassment policy.	Wildlife logs & long-term population trend indicators.
	On-land disposal	Loss of habitat & disruption. Contamination by toxic waste products.	Guide & divert caribou away from waste dumps. Reclaim habitat at closure. Immobilize toxic wastes.	Wildlife logs & long-term population trend indicators.
	Hunting pressure	Mortality, disruption, & avoidance. Disruption of relations with predators.	No hunting & no trapping policy for employees. No hunting corridor around mine site & haul route.	Hunting activity & kill rates near mine & roads. Wildlife logs & long-term population indicators.
	Quarrying	Loss of habitat & disruption.	Minimize requirement for quarried materials. Store overburden for habitat reclamation.	Wildlife presence & use. Long-term population indicators.
	Barge traffic Ice-breaking	Disruption of caribou crossings. Disruption of caribou crossings.	Avoid sensitive windows Avoid sensitive windows	Caribou use Caribou use
Predatory Mammals	Ground traffic	Mortality & disruption.	Route access roads to avoid wildlife areas. Establish low speed limits on haul roads. Convey shipments whenever possible. Give wildlife right-of-way. Limit random traffic.	Wildlife logs & population trend indicators
	Air traffic	Habitat loss & avoidance. Wildlife harassment & energy loss.	Use defined flight corridors. Establish minimum altitude & no harassment policies.	Wildlife logs & population trend indicators
	Physical mine site (ground activity)	Loss of habitat & disruption.	Avoid denning areas. Minimize mine footprint. Muffle noise. Guide & divert wildlife away from mine site. Reclaim habitat at closure.	Wildlife logs & population level indicators.
	On-land disposal	Loss of habitat & disruption. Contamination by toxic wastes.	Avoid denning areas. Immobilize toxic wastes. Guide & divert wildlife away from disposal sites. Reclaim habitat at closure.	Wildlife logs & population level indicators.
	Hunting pressure	Mortality, disruption & habitat avoidance. Disruption of predator prey relations.	No hunting & no trapping policy for employees. No hunting corridor around mine site & haul route.	Hunting activity & wildlife logs. Population level indicators.
	Quarrying	Loss of habitat & disruption.	Avoid denning areas. Avoid sensitive windows (spring). Minimize need for quarried materials. Store overburden for reclamation.	Wildlife logs & population level indicators.
	Garbage & food handling	Attract bears	Implement camp bear safety procedures & train staff.	Wildlife logs & population level indicators.

Table 6.3 - Continued

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor
Small mammals	Traffic (ground, air)	Mortality & disruption	Confine traffic to corridors & maintain speed limits.	Population level indicators.
	Physical mine site (ground activity)	Loss of habitat & disruption.	Reclaim habitat at closure.	Population level indicators.
Raptors	On-land disposal	Loss of habitat, mortality & disruption. Toxic contamination of the food chain.	Immobilize toxic wastes. Reclaim habitat at closure.	Population level indicators & toxic chemical in body tissues.
	Traffic	Mortality & disruption.	Avoid nest areas. Limit random traffic. Enhance nest areas outside mine site.	Nest site use & fledging success.
Waterfowl	Physical mine site (ground activity)	Loss of habitat, mortality & disruption	Avoid nest areas. Muffle noise. Enhance nest areas outside mine site. Reclaim habitat at closure.	Nest site use & fledging success.
	On-land disposal	Loss of habitat (e.g., wetland & nearshore). Toxic contamination in the food chain.	Avoid nest areas. Immobilize toxic wastes. Enhance nest areas outside site. Reclaim habitat at closure.	Nest use, fledging success. Toxic chemicals in tissues.
	Submerged disposal	Loss of aquatic habitat. Toxic contamination in the food chain.	Avoid nest areas. Immobilize toxic wastes. Enhance nest areas outside site. Reclaim habitat at closure.	Nest use, fledging success. Toxic chemicals in tissues.
	Traffic (ground, air)	Mortality & disruption	Avoid nest areas. Limit random traffic. Enhance nest areas outside site.	Nest site use & fledging success.
Other birds	Physical mine site (ground activity)	Loss of habitat, mortality & disruption.	Avoid nest areas. Muffle noise. Enhance nest areas outside site. Reclaim habitat at closure.	Nest site use & fledging success.
	On-land disposal	Loss of habitat, mortality & disruption. Toxic chemical contamination of the food chain.	Avoid nest areas. Enhance nest areas outside site. Reclaim habitat at closure.	Nesting success. Toxic chemicals in body tissues.
	Barge traffic	Disruption & potential for spills.	Confine traffic to corridors & concentrate shipping season.	Population level indicators. Toxic chemicals in body tissues.
Marine mammals	Barge noise	Disruption.	Avoid sensitive time windows.	Use in open water created by ice breakers.
	Ice-breaking	Mortality (increased predation, trapping in Inlet) & disruption.	Confine ice breaking traffic to corridors & concentrate season.	Use in open water created by ice breakers.

Table 6.4: Summary of Potential Environmental Effects - Aquatic Resources

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor
Water quality	Submerged disposal	Release of sediment porewater to Third & Second Portage from containment dikes.	Contain porewater. Use non-acid generating rock.	Water quality during construction
		Disturbance of lake bottom in Third Portage & increased suspended sediments from dike construction.	Use silt curtains to contain plumes of suspended sediments.	Water quality during construction
		Leaching of metals & nutrients to Third Portage from rock in containment dikes.	Use non-acid generating rock.	Receiving environment (ongoing)
	On-land disposal	Changes to water quality in tailings disposal areas in Third & Second Portage arm. Changes through all trophic levels.	Use engineered solutions to contain disposal areas. Minimize footprint of tailings disposal areas.	effluent quality (ongoing)
		Changes to water quality in adjacent receiving environments (Third & Second Portage) from seepage.	Use engineered solutions to contain disposal areas.	Receiving environment (ongoing)
		Changes to water quality in adjacent receiving environments from discharges.	Reuse water in mine process. Treat displaced water & meet discharge limits for receiving environment.	Receiving environment (ongoing)
		Changes to water quality in adjacent receiving environments (Third & Second Portage) from leaching, seeps, discharges (upland tailings).	Use non-acid-generating rock in containment dikes. Use engineered solutions to contain disposal areas. Reuse tailings water. Treat effluent.	Effluent & receiving water quality (ongoing)
	Mine pits	Changes to water quality in receiving environments from stockpile runoff.	Ensure stockpiles & country rock are non-acid generating. Use retention areas to treat discharge.	Effluent & receiving water quality (ongoing)
		Changes to receiving environment water quality from dust off stockpiles.	Contain disposal areas.	Receiving environment (ongoing)
		Changes to groundwater quality from on-l&d disposal.	Contain disposal areas. Ensure stockpiles & country rock are non-acid generating.	Effluent & receiving water quality (ongoing)
		Disturbance of lake bottom in Third & Second Portage & increased suspended sediments from dike construction.	Use silt curtains to contain plumes of suspended sediments.	Water quality during construction
		Release of sediment porewater to Third & Second Portage from containment dikes.	Contain porewater. Use non-acid generating rock.	Water quality during construction
		Changes to water quality from open pit water & blasting residue. Increased suspended sediment from dust & air emissions.	Treat open pit water prior to discharge. Use dust suppressants. Cover conveyors & stockpiles.	Effluent quality (ongoing) Receiving environment (ongoing)
	Physical mine site	Release of metals & suspended sediment from open pit after closure.		Post-closure water quality
		Water quality impacts from process-related effluents.	Discharge effluents into tailings disposal areas.	Mine (ongoing)
		Changes to water quality from camp effluents (e.g., sewage, grey water, etc.).	Install effective & contained effluent systems.	Receiving environment (ongoing)
	Traffic (marine, ground, air)	Runoff of particulates from disturbed surfaces into Third & Second Portage.	Maintain buffer areas around shoreline. Install detention ponds for runoff.	Receiving environment (ongoing)
		Potential contamination in Third & Second Portage from spills.	Follow spill mitigation systems. Implement emergency response.	Receiving environment (ongoing)
		Potential contamination from spills in Third, Second Portage & Baker Lake.	Follow spill mitigation systems. Implement emergency response.	Ongoing monitoring in receiving environment.
		Potential contamination in lakes & streams along winter road from spills.	Follow spill mitigation systems. Implement emergency response. Avoid use at beginning & end of winter.	Road conditions.

Table 6.4 - Continued

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor
Fish habitat	Submerged disposal	Permanent loss of fish habitat in Third & Second Portage arm by removing lake areas from production. Changes in all trophic levels. Permanent loss of habitat on lake bottom of Third & Second Portage arm under tailings & dikes. Changes to fish habitat in Third & Second Portage from increased sedimentation during construction of containment dikes. Changes in habitat quality in Third & Second Portage from changes in lake circulation patterns. Loss of shoreline & wetland habitat along parts of Third & Second Portage. Changes in stream habitat quality from construction of disposal areas.	Creation/enhancement of fish habitat. Minimize footprint of tailings disposal areas.	Habitat measurements. Habitat measurements.
	On-land disposal	Changes to fish habitat in Third & Second Portage from increased sedimentation during construction of containment dikes. Changes in habitat quality in Third & Second Portage from changes in lake circulation patterns. Loss of shoreline & wetland habitat along parts of Third & Second Portage. Changes in stream habitat quality from construction of disposal areas.	Use silt curtains to contain suspended sediments & minimize disturbance area. Habitat enhancement. Minimize footprint of tailings disposal areas. Habitat enhancement. Maintain a buffer around shoreline. Habitat compensation. Minimize footprint of disposal. Avoid small streams. Habitat compensation.	Receiving environment (ongoing). Receiving environment (ongoing) Habitat measurements (ongoing) Habitat measurements (ongoing)
	Mine pits	Direct loss of fish habitat in Third & Second Portage from construction of open pits, removing lake areas from production. Changes to habitat in Third & Second Portage from increased sedimentation during dike construction. Loss of fish habitat from changes in hydrology, circulation patterns, & fluctuations in lake levels in Third & Second Portage.	Minimize footprint of mine pits. Reclaim pits at mine closure. Create/enhance fish habitat elsewhere. Use silt curtains to contain suspended sediments & minimize disturbance area. Habitat enhancement. Minimize footprint of pits. Enhance remaining outflow channels to balance flows. Minimize water consumption.	Habitat measurements Receiving environment (ongoing) Receiving environment (ongoing)
	Physical mine site	Change in habitat of outflow channels between Third & Second Portage. Loss of shoreline & wetland habitat along parts of Third & Second Portage. Changes in stream or lake habitat quality from infrastructure or drainage patterns.	Modify/enhance remaining outflow channels to restore fish habitat. Maintain a buffer strip between infrastructure & lake shoreline. Minimize mine site footprint. Avoid small streams in & around the area.	Habitat measurements. Habitat measurements (ongoing) Habitat measurements (ongoing)
	Traffic (marine, ground, air)	Loss of marine fish habitat from dock facility in Baker Lake. Increased sedimentation in Third & Second Portage from dust/air emissions. Potential damage to stream habitat quality from winter road crossings.	Minimize dock footprint. Avoid high quality habitat. Habitat compensation. Use dust suppressants, watering, road preparations to minimize dust. Avoid use of winter road at the beginning & end of the season. Install protective devices.	Habitat measurements (ongoing) Receiving environment (ongoing) Road, habitat, water quality.

Table 6.4 - Continued

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor
Fish populations ¹	Submerged disposal	Fish mortality in Third & Second Portage from smothering, suspended solids in the water column, or contamination. Changes in all trophic levels. Fish mortality during salvage.	Conduct a fish salvage program prior to disposal.	Fish mortality.
	Mine pits	Changes in fish tissue quality from introduction of contaminants.	Implement a stocking program in other areas for compensation.	Fish mortality.
		Obstruction of fish moving between Third & Second Portage from loss of natural outflow channel.	Contain toxic wastes in disposal areas.	Fish tissue & water quality (ongoing)
		Fish mortality in Third & Second Portage from blasting. Changes in all trophic levels.	Modify/enhance remaining outflow channels to restore fish movements.	Fish use & movements.
		Fish mortality during salvage.	Conduct a salvage program prior to blasting.	Fish mortality
	Hunting pressure	Changes in fish tissue quality from introduction of contaminants.	Implement a stocking program in other areas for compensation.	Fish mortality
		Increased mortality with increased fishing by staff.	Collect & discharge open pit drainage into tailings areas. Contain toxic wastes in disposal areas.	Fish tissue & water quality (ongoing)
		Increased mortality with increased access to fishing lakes by winter road.	Implement a no-fishing policy at camp.	Fish mortality at camp
	Physical mine site	Fish mortality in water withdrawal systems.	Minimize seasonal lifespan of winter road. Control access.	Levels of fishing activity
			Include effective screens or other barriers in withdrawal systems.	Fish mortality

¹ Changes to fish populations may also occur indirectly through changes to water quality and fish habitat

Table 6.5: Summary of Potential Environmental Effects - Vegetation

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitor
All Vegetation VECs	Traffic (ground & air)	Dust fall on vegetation, affecting respiration & growth.	Use control measures such as watering, dust suppressants, roadway preparation.	Site conditions
		Loss & damage of vegetation, landforms, & wildlife habitat.	Minimize traffic corridors. Control off-site vehicular movements (e.g., ATVs). Habitat reclamation.	Site conditions & boundaries of footprint
		Loss or damage of vegetation from spills.	Follow spill mitigation systems. Implement an emergency response system.	Routine maintenance of equipment
		Potential damage to vegetation from winter road crossings at shorelines.	Avoid use of winter road at the beginning & end of the season. Install protective devices.	Road conditions
	On-land disposal	Replacement of native vegetation by introduction of non-native plants on vehicles.	Wash vehicles before arrival. Train staff on identification & removal.	Growth of non-native plant species
		Loss of vegetation, landforms, & wildlife habitat from construction.	Minimize footprint of disposal areas. Habitat reclamation.	Site conditions & boundaries of footprint
	Mine pits	Dust fall on vegetation, affecting respiration & growth.	Contain stockpiles.	Site conditions & chemical concentrations
		Loss or change of vegetation patterns from changes in drainage & snow accumulation patterns.	Minimize footprint of disposal areas. Use retention ponds & culverts. Habitat reclamation.	Site conditions & drainage
	Physical mine site	Dust fall on vegetation, affecting respiration & growth.	Use dust suppressants. Cover conveyors & stockpiles.	Site conditions & chemical concentrations
		Loss of surficial material, landforms, vegetation, & wildlife habitat from pit construction.	Minimize footprint of open pits on l&. Habitat reclamation.	Site conditions & boundaries of footprint
Dust fall on vegetation, affecting respiration & growth.		Use control measures such as watering, dust suppressants, roadway preparation.	Site conditions & chemical concentrations	
Loss of vegetation, landforms, & wildlife habitat from infrastructure construction.		Minimize site & construction footprint. Avoid sensitive areas. Train contractors. Habitat reclamation.	Site conditions & boundaries of footprint	
Quarrying	Loss or change of vegetation patterns from changes in drainage & snow accumulation patterns.	Maintain natural drainage patterns. Use retention ponds & culverts. Habitat & contour reclamation.	Site conditions & drainage.	
	Change of vegetation species around grey water/sewage systems from excess nutrients.	Treat camp effluents. Habitat reclamation.	Site conditions & drainage	
	Loss or damage of vegetation from spills.	Follow spill mitigation systems. Implement an emergency response system.	Routine maintenance of equipment	
	Damage to vegetation from human presence.	Restrict movements around camp to minimize footprint of activity.	Camp activities & movements	
Quarrying	Replacement of native vegetation by introduction of non-native plants on machinery, supplies, etc.	Wash equipment before delivery. Train staff on identification & removal.	Growth of non-native plant species	
	Loss of vegetation & landform (particularly eskers).	Use alternative materials. Avoid sensitive areas. Use engineered solutions for access roads & ramps. Restore approximate contours of land & sand/gravel surface.	Site conditions & boundaries of footprint	

Table 6.5 - Continued

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitoring
Permafrost	All activities	Potential for thawing, scarring, or subsidence of permafrost within the project area.	Minimize impacts through engineering design & infrastructure construction.	

¹ Potential vegetation VECs include sedge communities, heath tundra, ridge complexes (including eskers), riparian birch and willow groves, boulder fields, and rocky outcrops (including cliffs).

Table 6.6: Summary of Potential Environmental Effects - Cultural Resources

VEC	Potential Hazard	Potential Effect	Potential Mitigation	Monitoring
Archaeology sites (graves, tent rings, etc.)	Traffic (ground & air)	Loss or damage of archaeological sites & material from physical placement of infrastructure. Damage of archaeological sites & material from winter road.	Avoid archeological sites of significance. Minimize footprint. Excavate historical material. Avoid archeological sites of significance. Install protective devices.	Site boundaries
	Mine pits & disposal areas	Loss or damage of archaeological sites & material from increased human presence & movement in the area.	Implement a no-disturbance policy for any sites or materials discovered by staff. Restrict random traffic. Avoid these sites. Excavate material.	Report all new archaeological material & sites
	Physical mine site	Loss or damage of archaeological sites & material from physical placement of pits, disposal areas & infrastructure. Loss or damage of archaeological sites & material uncovered during construction.	Avoid archeological sites of significance. Minimize footprint. Excavate historical material. Implement a no-disturbance policy for any sites or materials discovered by staff. Avoid these sites. Excavate material if necessary.	Site boundaries Construction activities
		Loss or damage of archaeological sites & material from increased human presence & movement in the area.	Implement a no-disturbance policy for any sites or materials discovered by staff. Restrict random movement. Avoid these sites. Excavate material if necessary.	Report all new archaeological material & sites
		Loss or damage of archaeological sites & material from physical placement of infrastructure. Loss or damage of archaeological sites & material uncovered during construction.	Avoid archeological sites of significance. Minimize footprint. Excavate historical material. Implement a no-disturbance policy for any sites or materials discovered by staff. Avoid these sites. Excavate material if necessary.	Site boundaries Construction activities
Traditional & current use areas	Traffic (ground & air)	Increased access to traditional use areas from winter road. Increased human presence & disturbance.	Control road traffic. Avoid or mitigate impacts to fish & wildlife.	Community response & activity in affected use areas
	Mine pits & disposal areas	Increased human presence & disturbance in use areas near mine site traffic. Loss or damage of traditional use areas around Second & Third Portage from mine development. Increased noise & disturbance in use areas.	Restrict random traffic. Implement a no-disturbance policy around use areas. Avoid use areas. Avoid or mitigate impacts to fish & wildlife. Muffle noise during hunting & fishing windows.	Community response & activity in affected use areas Community response & activity in affected use areas Community response & activity in affected use areas
	Physical mine site	Increased human presence & disturbance in use areas. Loss or damage of traditional use areas around Second & Third Portage from mine development.	Implement a no-disturbance policy around use areas. Avoid use areas. Avoid or mitigate impacts to fish & wildlife.	Community response & activity in affected use areas Community response & activity in affected use areas