



Izok Corridor Project Proposal

SECTION 7

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7 POTENTIAL PROJECT ENVIRONMENTAL EFFECTS

The Izok Corridor Project has the potential to affect the biophysical and human environments through activities and infrastructure development associated with all phases of the Project (construction, operation, closure and decommissioning, and post closure). The following provides a preliminary identification of potential biophysical effects that could occur as a result of routine Project activities and facilities. These are summarized in Appendix B, as contained within NIRB's Project Specific Information Requirements (Part 2 Form). Possible mitigation measures and monitoring for these potential effects are also described below.

A detailed assessment of the environmental effects of the Project and development of appropriate mitigation will be conducted as part of the feasibility study and environmental assessment (EA) phase of the Project and will be presented in the Draft Environmental Impact Statement (DEIS). The DEIS will focus on Project effects that have the potential to result in substantive changes to the selected Valued Components (VCs), and will include determinations of significance for changes in environmental receptors as a result of these changes.

The DEIS will include a description of possible accidents and malfunctions that could occur during the life of the Project, and a detailed evaluation of potential risks and consequences of these incidents on the environment and human health and safety (refer to section 11).

7.1 Identification of Potential Project Environmental Effects

Preliminary identification of potential environmental effects is based on an initial scoping exercise that considered the full scope of the Project based on pre-feasibility design.

The current base case route for the Izok Road has been used as the basis for identifying key environmental issues related to ground transportation. The alternative route alignment currently being studied would involve some additional footprint, and different topography, terrestrial habitats and stream crossing locations, which could influence the extent to which construction and operational activities affect the biophysical environment. However, the nature of the interactions is not expected to differ substantively. Final selection of the road alignment will be made as part of the ongoing feasibility study and assessed in detail in the DEIS.

7.1.1 Issues Scoping

Key elements of the scoping process included:

- Consideration of all Project-related issues identified to date through engagement with regulatory agencies and communities
- Identification of potential interactions between the Project and selected Valued Ecosystem Components (VECs)
- Ranking of Project-environment interactions as a means of identifying those interactions that have the potential to result in an adverse effect on a VEC despite planned mitigation (e.g., Best Management Practices, mitigation by Project design) and require a detailed assessment in the DEIS



Rankings of potential interactions between the Project and the environment are based on the predicted nature of the resulting effect, prior to the implementation of any mitigation. It is not intended to describe the predicted magnitude or extent of possible residual effects of the Project. Interactions have been prioritized based on the following definitions.

- Rank = 0 If there is no interaction or no potential for substantive interaction between a Project activity and the VC to cause a potential environmental effect, an assessment of that environmental effect is not required. These interactions are categorized as 0, and are not considered further in the EA.
- Rank = 1 If there is likely to be a potential interaction between a Project activity and a VEC but not likely to be substantive in light of planned mitigation, the interaction is categorized as 1. Such interactions are well understood, and can be mitigated with a high degree of certainty with proven technology and practices. These interactions are subject to a less detailed assessment and are rated as not significant.
- Rank = 2 If a potential interaction between a Project activity and a VEC could result in more substantive environmental effects despite the planned mitigation, if there is less certainty regarding the effectiveness of mitigation, or if there is high degree of concern from regulatory agencies, Inuit or stakeholders, the interaction is categorized as 2. These potential interactions are subject to a more detailed analysis in the environmental assessment.

In assigning rankings to each potential Project-environment interaction, consideration was given to the following criteria as a means of ensuring that a precautionary approach was taken early in the issues scoping.

- Relevant policies stated in legislation, regulations and policy statements that need to be considered
- The extent to which an environment component or system is likely to change as a result of Project actions
- The societal values placed on certain environmental features and qualities
- Whether there is or is likely to be controversy surrounding an issue
- Whether there is a meaningful degree of uncertainty with respect to the environmental effect or the effectiveness of planned mitigation

The issue scoping was based on available information regarding the VC (field baseline studies, and published and unpublished information sources), the effects literature, experience with similar northern mining projects, and best professional judgment to identify where potential interactions could occur based on likely spatial and temporal overlap with each Project activity.

7.2 Atmospheric Environment

7.2.1 Potential Changes to Air Quality

The Project will result in emissions to the atmosphere from fossil fuel combustion sources, and fugitive dust emissions from processing equipment, material handling and vehicle traffic. At sufficiently high



concentrations, these air emissions could have direct and indirect effects on human health, water and soil quality, vegetation quality and wildlife habitat.

7.2.1.1 Potential Effects

Key Project activities that may cause a change in air quality include those that involve emissions of chemicals of potential concern (COPCs). Potential changes in air quality include:

- Increases in ambient air concentrations of COPCs
- Emissions that contribute to the anthropogenic component of climate change

7.2.1.2 Effects Mechanisms and Linkages

During each phase of the Project, various activities have the potential to increase ambient air concentrations of COPCs within the local and regional study areas, including dust (TSP, PM₁₀, PM_{2.5}), metals, gaseous compounds (SO₂, NO_x, CO), and volatile organic compounds (VOCs). Sources of these emissions will include:

- Construction: Land clearing, blasting, grading, hauling, excavating, material handling, quarrying and aggregate crushing, fuel combustion, incineration of waste
- Operations: Drilling and blasting, ore and mine waste rock handling, stockpile and road maintenance, wind erosion of stockpiles, vehicle traffic, fuel combustion, milling operations and incineration of waste
- Closure: Decommissioning and removal of site pads, airstrips and roads, backfilling, contouring

Project activities that are likely to have the greatest effect on air quality include mining activities (i.e., blasting, loading and hauling), stockpiling and milling activities (ore handling, crushing and grinding and transport). Although emissions from ventilation of the underground mines are expected to be a source of fugitive dust, this is expected to be much lower than that associated with open pit mining activities.

Most waste management activities are expected to have little effect on air quality; however, incineration of wastes and odours from discharge of effluents and sewage sludge from VOCs or reduced sulphur could affect air quality.

Power generation and vehicle emissions associated with operation of service vehicle fleets will be a source of emissions. These will be accounted for as part of the overall fleet fuel consumption, and will be explicitly modelled as part of the detailed assessment.

In general, transportation-related activities will represent a key source of emissions from combustion of diesel. This will include emissions from general surface transportation, haul trucks, marine ship emissions, and ship loading/unloading. Emissions from air transportation are expected to be intermittent, and effects at the surface will likely be short lived and therefore negligible relative to other transportation-related emissions.

Project activities will have the potential to generate greenhouse gas (GHG) emissions that could affect climate change. These include fuel combustion from power generation, operation of heavy equipment and vehicles, and marine shipping.



7.2.1.3 Potential Mitigation

The Izok Project is fossil fuel intensive, as alternative energy sources do not exist in the area. The combustion of diesel will produce greenhouse gases (GHG) such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Features that have been incorporated into Project design to minimize air quality effects due to combustion of fossil fuels include:

- Low sulphur diesel will be used to reduce emissions of SO₂ and the formation of secondary sulphate particles in the PM_{2.5} size range
- Vehicles and power generation facilities will be regularly maintained to promote efficient operation
- Equipment and vehicle travel patterns will be optimized to minimize fuel consumption and GHG emissions

Several design and operational features have been incorporated into the current Project plans to manage fugitive dust emissions at the mine sites, port and along Izok Road, including:

- Rock coverings (non-acid generating; NAG) will be applied on top of tailings
- Vehicle speed limits will be established and enforced on Project roads
- Hard covers will be installed on concentrate trucks to avoid concentrate loss during transport
- Concentrate will be stored in enclosed facilities at the Izok Mine and the Grays Bay Port
- A covered conveyor with an elephant hose loading chute will be used for loading ships

In addition to these specific design and management features, a Road Management Program (including dust mitigation measures) and an Air Quality Management Plan will be developed for the Project (refer to section 12).

7.2.1.4 Potential Monitoring

The Air Quality Management Plan will detail measures to minimize GHG emissions from Project activities and infrastructure and will outline the air quality monitoring program, including:

- A source monitoring program
- An ambient air quality monitoring program
- Climate monitoring programs at the port and the mine sites, including wind speed and direction

7.2.2 Potential Changes to Noise and Vibration

7.2.2.1 Potential Effects

Project activities during the construction, operations and decommissioning phases have the potential to increase noise and vibration levels in nearby areas. Increased noise and vibration could potentially result in human health effects (i.e., annoyance, sleep disturbance) and/or wildlife effects (disturbance and displacement). Given that the closest permanent community (Kugluktuk) is located approximately 176 km from the Project Development area, any potential noise and vibration effects on humans are expected to be limited to seasonal use of the area.



Underwater noise effects are discussed in relation to marine wildlife (section 7.6).

7.2.2.2 Effects Mechanisms and Linkages

Increases in ambient noise levels and ground vibrations could result in disturbance to both humans and wildlife. The main source of noise and vibrations will likely include:

- Construction: Operation of heavy equipment during site preparation, quarry operations, blasting, construction of Project infrastructure, air traffic and ground transportation
- Operations: Operation of heavy equipment associated with open pit and underground mining, mill operations, loading/offloading of ore, truck traffic related to ore, overburden and waste rock, air traffic, marine vessel use
- Closure: Operation of heavy equipment during removal of infrastructure and reclamation activities

Airborne and ground-based noise and vibration levels will be modelled in relation to any sensitive receptors within the Local Study Area and Regional Study Area, and compared to International and provincial noise and vibration guidelines. The modelling results will also be used to assess potential effects on terrestrial wildlife within the study area.

Construction Phase

Ambient noise levels within the LSA will increase as a result of construction of infrastructure at the Izok and High Lake Mine sites and Grays Bay Port site, as well as road construction and movement of materials between sites. Activities will include, intermittent blasting associated with port, road and mine site preparation, and heavy equipment operation. These are expected to be intermittent and transient sources of noise.

Construction at the port site will involve in-water activities including drilling, blasting, excavation, setting sheet pile and placing of rock fill. These activities will generate short-term increases in noise levels.

Operations Phase

Noise associated with Project operations are expected to be greatest at the Izok and High Lake mines during the early stages of open pit mining. The mill will be fully operational, and all ore processing will be in progress. All major surface mining, milling and ancillary equipment will be housed within buildings. This includes the crushers, rod and ball mills, power generators and ore processing equipment. Attenuation of sound levels will be achieved through prudent equipment selection and building design. The noise characteristics of these sources will be reviewed during the detailed design stage and appropriate noise abatement measures will be implemented, where required.

Operation of service vehicle fleets will be a source of intermittent noise during the operations phases. Transportation of ore and concentrate will introduce a linear noise source along transportation routes between the mine sites and the dock facility.

Marine vessel generated noise will occur along the shipping routes, but this will be infrequent and restricted to two to three months per year during the open-water shipping season.



7.2.2.3 Potential Mitigation

A Noise Abatement Management Plan will be developed for the Project to reduce noise emissions generated by Project facilities and activities (refer to section 12). Mitigation measures that have been incorporated into Project design to reduce construction and operation-related noise include:

- Housing major stationary equipment (e.g., crushers, power generators) in insulated buildings
- Outfitting mobile equipment with appropriate muffler systems
- Following standard operating procedures and regular maintenance schedules for equipment and machinery

7.2.2.4 Potential Monitoring

The Noise Abatement Management Plan will outline a monitoring program that will be implemented throughout the life of the Project to monitor and manage effects of noise emissions (refer to section 12). These programs could include:

- Environmental noise monitoring at the Project sites
- Ambient noise surveys conducted at a distance from sources to determine the need for further noise mitigation

7.3 Hydrogeology

7.3.1 Potential Changes to Hydrogeology

The Izok Corridor Project is located within a continuous permafrost region, where permafrost extends to a depth of more than 300 m at the Izok Mine and to 440 m at the High Lake Mine. Groundwater flow occurs in the seasonal shallow active layer above the permafrost, within taliks and beneath the permafrost. Shallow groundwater flow only occurs in the summer months within the thawed active layer, which typically varies in thickness between 1 and 8 m. Bedrock geology, permafrost and lake taliks play a critical role in defining the deep groundwater flow system.

Project activities at the Izok Mine and High Lake Mine have the potential to result in changes to groundwater flow and groundwater quality.

7.3.1.1 Potential Effects

Key issues related to groundwater include:

- Changes in groundwater levels and groundwater flow patterns from dewatering and subsequent flooding of Izok Lake, open pits and underground mines
- Changes in shallow and deep groundwater quality from discharge of waters from the open pit and underground mines during post closure
- Changes in shallow and deep groundwater quality from discharge of waters affected by acid rock drainage (ARD) and metal leaching (ML) from waste rock and tailings to the shallow and deep groundwater system



- Changes in shallow groundwater and surface water quality from discharge of treated groundwater to surface waterbodies

Potential effects of spills of fuels, waste oil, reagents, concentrate, lime/cement and blasting reagents/residues on shallow groundwater quality can be mitigated through the use of best management practices or engineering designs that have been well developed and tested at similar sites.

Landfills and landfarms have been designed, constructed and monitored in northern environments for many years. The potential for these to affect groundwater is primarily through effects on shallow groundwater quality as a result of leachate migration. Any landfills constructed to manage solid waste or landfarms to manage contaminated soils will utilize proven designs and management plans to minimize the potential for Project-related effects on soil and groundwater.

7.3.1.2 Effects Mechanisms and Linkages

Mine Dewatering

Because groundwater levels and surface water levels are linked through lake taliks, dewatering of the open pits and underground mine workings and dewatering of Izok Lake has the potential to reduce groundwater and surface water levels and affect groundwater flow patterns during the construction, operation and post-closure phases of the Project.

As mining at the Izok Mine will not be in permafrost due to the deposits lying within the talik beneath the existing lake, groundwater inflows into the open pit and underground mine are expected to occur. At High Lake, the AB and D open pit mines will be largely developed in permafrost, and only negligible groundwater inflows are anticipated. Although no substantive inflow of groundwater is expected to occur in the upper part of the West Zone underground mine, inflows are expected to occur below 400 m.

Following closure, it is anticipated that groundwater and surface water levels will return to pre-mining levels and pre-mining groundwater flow patterns will largely be restored. This will be confirmed using a three-dimensional digital groundwater flow model for both the Izok and High Lake mines.

Mine inflow water quality may be affected by ARD reactions on the mine walls, blasting residuals, sediment and possibly minor hydrocarbons from mining equipment. These groundwater inflows will be captured in the open pit and underground mine sumps, and will be pumped to the water treatment facility (along with any surface water inflows) for treatment prior to discharge or reuse.

Discharge of Waters from Flooded Mine Workings

During the post-closure period, the Izok Lake basin including the open pits and Inukshuk underground mining operation will be flooded by groundwater and surface water inflows. Over time, pit lakes are expected to develop in the AB and D pits, but they will not be connected to the deep groundwater system because a through talik is not expected to develop. After groundwater and surface water levels have returned to pre-mining levels, groundwater flow directions will reverse from inward to outward and there is a potential for contaminant movement in the groundwater flow system to receiving water bodies (where there is sufficient permeability/hydraulic connection and no permafrost).



It is possible that water quality will be adversely affected as a result of the interaction between groundwater/surface water and the walls of both the open pit and underground mine workings. During the post-closure and closure phases of the Project, discharge of untreated waters from the open pit and underground mines has the potential to affect shallow and deep groundwater quality.

Future field work and groundwater modelling will attempt to define any potential groundwater pathways for contaminant migration, and provide estimates of potential contaminant loadings and travel times from the tailings facility to surface water resources. The overall effect on the environment as a result of Project activities will be quantified through the development of a site-wide water balance and water quality model.

Discharge of Waters from Tailings and Waste Rock

Waste rock and tailings will be generated during construction and operation of the mines. Waste rock and tailings geochemistry suggests that there is the potential for acid rock drainage and metal leaching (ARD/ML) to affect groundwater and surface water quality in the vicinity of the Izok Mine (tailings and waste rock) and High Lake Mine (waste rock only). Infiltration of precipitation through the waste rock piles and tailings dry stack will produce leachate that will report to both the shallow groundwater system underlying the waste rock piles and the lake talik beneath Izok Lake.

Environmental effects of the discharge of ARD/ML affected waters could begin during construction and extend to the closure phase of the Project if left unmitigated. During construction and operations, the majority of seepage from waste rock piles and the tailings dry stack will report to the open pits at the Izok Mine, or will be collected at the base of waste rock piles at the High Lake Mine. All seepage will be collected and treated to meet discharge standards prior to release to the downgradient receiving environment (Itchen Lake, High Lake or the Kennarctic River). During the post-closure phase of the Project, water levels within the Izok Lake basin are anticipated to recover to pre-mining levels. Lake levels in Izok Lake are anticipated to fluctuate within the NAG waste rock underlying the tailings dry stack. All water within the Izok Lake catchment will be treated until discharge standards are met prior to release to Itchen Lake.

A site-wide water balance and water quality model will be used to assess the potential for any effects on surface and groundwater quality as a result of the Project.

Discharge of Treated Water to Surface Water Bodies

Discharge of treated groundwater to surface water bodies has the potential to affect shallow groundwater and surface water quality. There is the potential that highly saline groundwater will be encountered during development of the Inukshuk underground mine at the Izok Mine. Depending on the lowermost economic mining horizon, groundwater may also be encountered at the West Zone underground mine at High Lake.

Existing literature describing the quality of deep groundwater quality beneath permafrost suggests that the quality of water could be quite variable and highly saline, with substantial concentrations of trace metals. Because deep groundwater from both the Inukshuk and West Zone underground mine is anticipated to be brackish to saline, treatment of these waters will be required prior to discharge to the environment. Treatment of saline groundwater is technically challenging, and will likely produce a large



volume of residual, highly concentrated brine that will also need to be managed. The treatability of large volumes of highly saline groundwater from underground mine workings is poorly understood and will be further investigated as part of the environmental assessment.

7.3.1.3 Potential Mitigation

A Groundwater Management Plan will be developed for the Izok Mine and the High Lake Mine, which will outline adaptive strategies for controlling, collecting and treating groundwater inflows (refer to section 12). Possible mitigation to address potential effects to groundwater is discussed below.

Mine Dewatering

- Where the shallow and deep groundwater systems are connected (lake taliks), the potential for effects on nearby surface water bodies can be minimized through grouting or ground freezing to control any large persistent inflows to the mines. This will be particularly important in areas where any high permeability structures intersect both open pits and adjacent lakes. Ongoing monitoring of permafrost, groundwater levels, lake levels and mine inflows will assist in determining the most effective method of mitigating any large inflows.

Discharge of Waters from Flooded Mine Workings

- By minimizing the volume of waste rock and ore left in the mine workings and implementing measures to minimize the potential for ARD and ML processes, effects on groundwater quality can be mitigated. Groundwater flowing through the bedrock system is anticipated to flow at a very slow rate, and there may be the potential for attenuation of metals and other mine-related compounds along groundwater flow pathways. Travel times from the mine workings along the groundwater flow path to any downgradient receptors are anticipated to be long. Discharge through the surface water pathway will be treated to meet discharge criteria until such time as it is no longer required. Travel times, the potential for attenuation and the potential for effects on environmental receptors will be assessed using geochemical models, groundwater models, a site-wide water balance and water quality model.

Discharge of Waters from Tailings and Waste Rock Facilities

- A progressive closure plan will be implemented for the tailings dry stack and waste rock piles (refer to section 12). This will involve installation of temporary and/or permanent covers to minimize the volume of water that interacts with waste rock or tailings. Permafrost aggradation into the waste rock piles and tailings will also help to minimize infiltration over time. It is anticipated that the final cover will be designed as a thermal cover to minimize infiltration through the tailings mass. By minimizing infiltration, the volume of leachate reporting to the underlying groundwater flow system will also be minimized. Unsaturated groundwater flow will dominate within the tailings dry stack, and infiltrations rates through the tailings are anticipated to be lower than if the tailings mass was maintained at saturation in a flooded state. The tailings dry stack will be constructed on top of a waste rock base at an elevation well above measured levels in Izok Lake to avoid contact between tailings and surface water upon flooding of Izok Lake at closure. Additional mitigation may involve treatment of runoff and seepage from the tailings and waste rock piles, or installation of an



engineered liner or groundwater extraction wells. The need for mitigation measures will be evaluated based on the results of predictive geochemical and groundwater modelling and ongoing monitoring during operations, closure and post closure. The results of monitoring will be incorporated into the adaptive management plan.

Discharge of Treated Water to Surface Water Bodies

- If large volumes of water require treatment to meet discharge limits, a large volume of sludge will be generated, which will require management. Additional investigation is required to confirm the feasibility of treating highly saline groundwater and managing sludge. Prior to developing any mine workings below the base of permafrost, groundwater quality samples will be collected using boreholes drilled from the underground mine workings to verify the quality of any groundwater that may be encountered. Additional permeability testing will also be conducted to help estimate the volume of groundwater that may report to the mine.

7.3.1.4 Potential Monitoring

Monitoring of groundwater levels will be required to determine the potential for effects on nearby lakes and rivers with underlying through taliks, and determine the effectiveness of mine dewatering.

Groundwater quality will be monitored throughout the life of the mine and during the post-closure period to determine effects on the surrounding environment and guide adaptive management. Groundwater quality samples will be collected from the sub-permafrost aquifers prior to mine development to permit characterization of groundwater quality and design of mine water treatment plants as required. Water quality in the pit lakes and underground mines will also be monitored during operations and while flooding during the post-closure period. This information will be used to update the site-wide water balance and water quality model as mine development continues.

Based on the results of the monitoring program, adaptive management strategies will be developed to address any groundwater flow or groundwater quality concerns.

7.4 Freshwater Aquatic Environment

7.4.1 Potential Changes to Surface Hydrology

7.4.1.1 Potential Effects

The Izok Corridor Project has the potential to interact with surface hydrology and affect its spatial and/or temporal distribution. The main Project components or activities that may affect surface water quantity and distribution include:

- Izok Lake dewatering and diversion
- Runoff from waste rock piles or ore stockpiles
- Interception and containment of surface runoff
- Project infrastructure development



- Stream crossings along Izok Road
- Freshwater requirements

7.4.1.2 Effects Mechanisms and Linkages

Izok Lake Dewatering and Diversion

Draining of Izok Lake is necessary to mine the ore beneath the lakebed. This water will be pumped to the water management pond for treatment before being released to Itchen Lake. This represents a one-time change in the fate of Izok Lake water and flow pattern within the Izok Lake outflow channel.

Construction of the Izok diversion channel and diversion dam will affect the spatial distribution of surface water by directing outflow from Iznogoudh Lake into Itchen Lake at a different location, and possibly changing the integrity of the channel as a result of potential exposure of permafrost. Other possible effects include the need to temporarily block inflow to the channel during the operations phase if repair work becomes necessary to maintain/adjust fish passage structures or repair/install erosion protection works, and blockage of inflow due to snow and ice accumulations at the channel entrance.

Surface runoff not contained by the diversion channel will continue to flow into the lake area and will be diverted to facilitate open pit mining within the lake footprint. Non-contact water will be segregated and, when found to satisfy water quality standards, will be conveyed directly to Itchen Lake. Contact water will be diverted to holding ponds, where it will be treated and then released into Itchen Lake. Removal of Izok Lake from the system will likely cause the rates of inflow to Itchen Lake to change. A water balance model will confirm the extent to which changes in surface water flows will occur.

Runoff from Waste Rock Piles and Ore Stockpiles

Runoff from waste rock piles at the High Lake Mine site and waste rock and ore stockpiles at the Izok Mine site will be collected and directed to temporary holding ponds for treatment before release to the receiving environment (High Lake or Kennarctic River, Itchen Lake). A portion of this water will be lost from the system due to wetting of the material surface and freezing within the piles. A model that estimates runoff rates has been developed for High Lake and will also be used for estimating runoff from the Izok Lake storage piles.

Surface Water Management

Interception, collection and conveyance of surface water along road ditches and around mine infrastructure will be required to minimize effects on water quality. As water is held and treated in the sedimentation ponds, there is the potential for the temporal distribution of surface water to be altered, thus affecting water levels, volumes and flow rates. Water management is also likely to change surface flow patterns from the natural surface drainage system. The key risk associated with this is possible erosion of ditches and sediment loading in response to high flows, snow accumulation in ditches or undersized culverts.



Project Infrastructure Development

Site clearing and construction activities at the Izok Mine and High Lake Mine sites will require the dewatering of small ponds and standing water, which can affect surface hydrology. The amount of ponded water that will require dewatering will be estimated to assess potential effects on water volumes and flow rates both locally on site and downstream.

Stream Crossings along Izok Road

Bridge and culvert crossings along Izok Road have the potential to interfere with the conveyance of water through the crossing section. This could have implications for fish passage, particularly at culvert crossings.

Freshwater Requirements

Fresh water will be required for potable water, fire-fighting water, dust suppression and general water needs at the Project sites. Water will be sourced from local waterbodies, which may reduce water levels, volumes and flow rates in the lakes and downstream environment. The maximum rate of diversion and total volume of diversion will be determined for each site to assess potential effects on surface hydrology of the source lakes.

Water withdrawal will also be required for flooding of the winter roads and airstrips. Although use of lake water to flood ice for enhanced thickening will not likely result in substantial changes to lake levels, water diverted to construct ice roads could have an effect on the source streams and lakes.

7.4.1.3 Potential Mitigation

Izok Lake Diversion

Effects of the Izok diversion channel on surface hydrology will be primarily mitigated through engineering design for the Probable Maximum Flood (PMF) event and to minimize potential issues with ice and snow accumulation or permafrost. Adaptive management measures will be implemented as required to maintain diversion channel performance during and after operations.

Surface Water Management

Drainage facilities will be designed (sized) for the 100-year flood event to minimize potential effects on surface hydrology. This will help to minimize risks associated with potential erosion of ditches and sediment loading from high flows or snow accumulation in ditches.

Stream Crossings along Izok Road

Potential effects of bridges and culverts on surface hydrology will be mitigated by adopting the 100-year flood peak for sizing of the openings and designing crossings based on natural flow conditions at each of the road crossings.



Freshwater Requirements

The following features have been incorporated into the design of the Project to reduce the amount of fresh water that will be withdrawn from the source lakes for use at the Izok Mine site (Itchen or Iznogoudh lakes) and High Lake Mine site (lakes 4, 5 and 15; refer to Figure 2.5-3).

- The process plant at Izok will recycle water and makeup water will be predominantly from other parts of the mine site (e.g., open pit water, mine groundwater inflows and settled surface runoff).
- Contact water will be recycled for use in the crushing and screening plant and other operations at the Izok and High Lake mines.
- Contact water will be treated in an effluent treatment plant at the High Lake Mine site and re-used at the site.
- Winter road construction will conform to DFO's protocol for winter water withdrawal such that no more than 10% of the under-ice volume will be withdrawn from a source lake during one ice-covered season.

7.4.1.4 Potential Monitoring

Potential monitoring of surface hydrology at the Project sites could include the following.

- Continued operation of selected baseline hydrometric stations
- Installation of water level recorders at prescribed locations within the water management system at the Izok Mine site
- Maintenance of the climate stations at the High Lake and Izok mines

7.4.2 Potential Changes to Water Quality and Sediment Quality

7.4.2.1 Potential Effects

The Project has the potential to affect water quality and sediment quality through release of contaminated water, transport and deposition of dust, alteration of the natural hydrologic cycle, and alteration of watersheds through land use disturbance. Changes in water quality and sediment quality may affect the ability of the receiving environment to protect aquatic life and to provide a source of safe and secure drinking water.

7.4.2.2 Effects Mechanisms and Linkages

Linkages through which Project activities could affect water quality and sediment quality include:

- Site clearing, snow clearing, contouring for site drainage, and erosion and sedimentation control
- Installation and commissioning of hazardous materials areas including fuel tanks and explosives
- Installation and commissioning of power generation facilities, water intakes and outfalls
- Generation of air emissions including particulate matter, metals and potential acid inputs (PAI)



- Construction and operation of Izok Road including watercourse crossings, borrow sources and site drainage
- Open pit mining operations including dewatering of Izok Lake and mine pits, blasting, stockpiling of waste rock, ore and tailings and alteration of groundwater flows
- Construction of the Izok diversion channel including quality of material within the channel (i.e., potential acid generation and metal leaching), erosion and sedimentation, and rerouting of flows into another basin
- Collection, treatment and release of process and mine water
- Treatment and release of non-mineral waste (domestic wastewater)
- Decommissioning of in-water structures

Mechanisms linking Project activities to water quality and sediment quality are transport of Contaminants of Potential Concern (COPC) through runoff of surface water, seepage to surface water, direct discharge to surface water, and atmospheric deposition.

- **Runoff of Surface Water** – ground disturbance, dewatering activities, site alteration and spills can result in the mobilization or deposition of trace metals, hydrocarbons and suspended solids to the surface of the ground or to snow. Subsequent rainfall or snowmelt may carry these materials to surface waters.
- **Seepage to Surface Water** – precipitation falling on waste rock piles or ore stockpiles may mobilize solids, metals or acids, and carry them to surface water through seeps.
- **Direct Discharge to Surface Water** – Water that comes into contact with Project activities, including domestic sewage and mine site water, at the Izok and High Lake Mine sites will be collected, treated and discharged to surface water. This water may contain trace metals, blasting residues, nutrients, solids, highly saline groundwater and compounds, which consume high amounts of oxygen. These contaminants will be treated to reduce concentrations to levels considered safe to discharge under the terms of the Project Water Licence.
- **Atmospheric Deposition** – Traffic, blasting and site disturbance will generate dust that may be deposited to fresh water, or to areas that run off to fresh water and carry suspended solids and trace metals into the aquatic environment. Combustion of diesel fuel for power generation and incineration of waste will generate particulate matter, and acid emissions to the atmosphere that could subsequently be deposited to land or surface water.

7.4.2.3 Potential Mitigation

A number of mitigation measures have been incorporated into design of the Project to reduce potential effects on water quality and sediment quality.

- Development of an Izok Lake Dewatering Plan (refer to section 12) that will minimize total suspended solids in surface waters
- Recycling of process and mine water to minimize freshwater requirements and the volume of treated effluent discharged to receiving environments



- Use of holding ponds to collect contact runoff water and allow for suspended sediments to settle before release to the receiving environment
- Dust suppression measures in the Roads Management Program and the Air Quality Management Plan (refer to section 12)
- Enclosed conveyance systems and processing facilities to reduce emission of particulate matter, metals and PAI
- Secondary containment and minimum set-back of tanks, hazardous materials, chemicals, and explosive storage areas from surface water
- Management of potential acid generating (PAG) and non-acid generating (NAG) rock and collection of drainage from waste rock areas
- Use of NAG material at all road watercourse crossings
- Management, placement and collection of runoff from tailings

7.4.2.4 Potential Monitoring

Various monitoring and adaptive management programs may be developed to inform management decisions around mine operations, implement changes in operations as required, and ensure compliance with operational permits (refer to section 12). Possible monitoring programs for surface water and sediment quality could include:

- Monitoring of turbidity in Itchen Lake during release of water from Izok Lake
- Monitoring of the quality of source and treated drinking water supplies for the mine operations
- Regular sampling and analysis of treated effluent prior to release to the receiving environment
- Monitoring of disposition of NAG and PAG rock, stability and thermal status of waste rock piles and runoff and seepage to reduce and manage the potential for ML/ARD
- Development and implementation of an Aquatic Effects Monitoring Program for water, sediments, aquatic life and fish

7.4.3 Potential Changes to Aquatic Organisms and Habitat

The Izok Corridor Project has the potential to cause changes to fish habitat, fish abundance and distribution, and fish health. The assessment will focus on species of interest, including lake trout, Arctic grayling, and Arctic char, as well as changes to fish habitat.

7.4.3.1 Key Effects

Key potential effects of the Project on freshwater fish include:

- Physical habitat loss or alteration from mine footprints, dewatering, road crossing footprint, and sedimentation
- Fish passage alteration or disruption from mine footprints, stream crossing structures, dewatering, and diversion channels



- Reduced habitat quality due to increased sedimentation from mine and road construction, operation and closure, effluent discharge and site runoff
- Reduction in fish health from changes in water quality and sediment quality

7.4.3.2 Effects Mechanisms and Linkages

The primary sources of potential disturbance or effects on freshwater fish and fish habitat are the winter roads, Izok Road and the Izok and High Lake Mine sites. The following highlights potential mechanisms by which construction, operational or closure activities associated with these Project components could result in effects on the selected Key Indicators (KIs).

- Winter Road
 - Winter habitat alteration from water withdrawal from small lakes for road construction
 - Riparian habitat alteration at access points for lakes and river from both road construction and operation
 - Flow and passage alteration in small streams during spring freshet due to ice build-up
- Izok Road
 - Habitat loss from watercourse crossing footprint
 - Fish passage alteration or disruption from watercourse crossing design
 - Change in habitat quality from sedimentation during stream crossing construction, operation and removal
- Izok and High Lake Mine sites
 - Loss of fish habitat from dewatering of Izok Lake and mine-related infrastructure footprint
 - Habitat fragmentation from watercourse diversions and alterations of fish passage at Izok
 - Sedimentation and changes to habitat quality from mine construction, footprint, reclamation and removal
 - Habitat loss from the water intake and effluent diffuser footprints
 - Habitat loss and alteration from water withdrawals and use at the mine sites
 - Changes in habitat quality and fish health from camp and mine effluent discharge, mine site runoff and dust deposition (e.g., sedimentation, increased metal concentrations, increased nutrient concentrations)

7.4.3.3 Potential Mitigation

The following includes some of the possible mitigation measures that could be employed to reduce or eliminate Project-related effects on freshwater fish and fish habitat.

- Winter Road
 - Follow DFO guidelines regarding water withdrawal from small lakes for winter road construction
 - Notch the ice crossing on small streams to encourage faster melting of ice build-up during early spring



- Izok Road
 - Minimize the number of stream crossings
 - Design crossings to allow for fish passage
 - Implement sediment and erosion control measures during construction
- High Lake Mine
 - Manage, capture and treat mine site runoff and mine-related effluent as required to achieve regulatory standards before release to the receiving environment
 - Implement the dust control measures in the Roads Management Plan and the Air Quality Management Plan (refer to section 12)
- Izok Mine
 - Design the Izok channel diversion such that fish passage is maintained and spawning habitat and rearing habitat is provided
 - In accordance with DFO's Fresh Water Intake End-of-Pipe Fish Screen Guideline (DFO 1995), design freshwater intakes and fit with appropriately sized fish screens to prevent potential losses of fish due to entrainment and impingement
 - Develop fish habitat compensation in consultation with local Inuit communities, DFO, and other regulatory agencies for loss of fish habitat in Izok Lake
 - Plan and implement pre-development fish salvage from Izok Lake in consultation with DFO and local Inuit communities

7.4.3.4 Potential Monitoring

An Aquatic Effects Monitoring Program will be developed to guide construction, operation and closure of the Project, and will outline study design, monitoring schedules, methods and reporting procedures (see section 12).

7.5 Terrestrial Environment

7.5.1 Potential Changes to Terrain

7.5.1.1 Potential Effects

The Izok Corridor Project has the potential to affect terrain through changes in permafrost conditions and terrain stability due to vegetation clearing, changes in slope and changes in surface and subsurface flow.

Construction of Project components and infrastructure could also cause a change in terrain and landforms due to disturbance of permafrost sensitive landforms and uncommon landforms (e.g., eskers), which may support valuable terrestrial ecosystems and contribute to biodiversity.



7.5.1.2 Effects Mechanisms and Linkages

Change in Permafrost and Terrain Stability

Site preparation, excavation, contouring and construction of both on-land structures (i.e., buildings, airstrips and roads) and in-water and shoreline structures (i.e., freshwater diversions, dykes, berms, collection ponds, water crossings, effluent pipelines and dock site) could induce changes in the permafrost regime and affect terrain stability. These effects could in turn cause slope instability, shoreline erosion, slides, rock falls and slumping in surficial deposits and bedrock.

During closure of the Project, removal of site pads and infrastructure, freshwater diversions and surface drainage containment could affect terrain and the permafrost regime, as a new shallow permafrost regime and terrain slope may be re-established at these locations. Shallow permafrost condition and the stability of terrain could also be affected due to disturbances during closure of the Project.

Change in Landforms

Construction of infrastructure, including roads, airstrips and foundations, as well as borrow source quarrying will result in ground surface disturbance, which could lead to the loss of landforms.

Construction and operational activities will also cause changes in surface and subsurface water systems and the shallow thermal regime, which could result in changes in permafrost conditions and loss of permafrost sensitive landforms.

7.5.1.3 Potential Mitigations

The following mitigation measures could be implemented to reduce potential effects of the Project on the permafrost regime and terrain stability.

- Use coarser materials for road construction to minimize frost effects
- Manage drainage around infrastructure to reduce deep pools of water at the surface
- Insulate infrastructure, where feasible
- Minimize surface disturbance in high ground-ice areas to reduce potential for deepening the thaw depth and associated thaw settlement
- Place culverts or other drainage structures where the road crosses surface drainages
- Undertake construction activities in sensitive areas during winter whenever feasible
- Monitor the Izok Road to ensure that signs of permafrost degradation, erosion or mass movement are quickly identified and mitigated by appropriate surface cover, drainage and erosion control measures

Potential Project effects on permafrost sensitive and uncommon landforms may be mitigated through Project design as well as specialized measures, including:

- Consider local and regional climatic conditions, and the presence and expected changes to permafrost terrain in Project design



- Avoid uncommon landforms (eskers, wetlands and shoreline areas) and steep terrain where possible
- Minimize cut width or disturbance through eskers, wetlands and shoreline areas
- Reduce the use of glaciofluvial landforms during mine infrastructure construction

7.5.1.4 Potential Monitoring

Monitoring of terrain stability and landforms could include establishment of a Thaw-Depth Monitoring System including routine field inspection to monitor landform changes.

7.5.2 Potential Changes to Soils

Soil quality, measured in terms of nutrient and elemental composition, could be altered by deposition of dust or runoff. Soil quantity (i.e., extent and depth of soils) could be altered by removal, disturbance, replacement or burial of soils.

7.5.2.1 Potential Effects

Soil quality could be adversely affected by potential acid inputs (PAI) from air emissions, stockpile runoff and fugitive dust deposition (e.g., metals) during all phases of the Project. Potential changes in soil quality could also occur due to compaction, admixing and erosion during construction and operational activities.

Potential changes in soil quantity could occur due to topsoil stripping, surface soil erosion, soil movement and burial during construction activities.

Reduced soil quality and quantity could affect reclamation activities associated with soil placement and vegetation occurrence at closure.

7.5.2.2 Effects Mechanisms and Linkages

Soil Quality

Air emissions from the combustion of fossil fuels could introduce acidifying compounds (i.e., sulphur dioxide [SO₂] and nitrogen dioxide [NO₂]) to soils, which could lead to soil acidification or contamination. The largest sources of PAI would be power generation from diesel generators, use of industrial machinery and equipment and the milling process. Soil acidification resulting from long-term deposition of acidifying substances could result in lower soil pH, a decrease in base saturation and increase in aluminum bioavailability. Such changes in soil chemical properties have been shown to adversely affect nutrient cycling and decomposition processes by changing microbial community populations and soil function.

Exposure of waste rock and tailings to air and precipitation runoff could also result in the generation of ARD and/or increased release of metals into the surrounding environment, which could lead to deterioration of soil quality.



On-land construction, mining, milling, transportation and on-land decommissioning will generate dust, which could potentially change the pH and nutrient regime of soils. Fugitive dust from storing, handling or transporting the concentrate could introduce metals in the form of particulates into the air, which could be deposited on soils and vegetation away from their source.

Soil admixing and erosion could occur during excavation and construction, stockpiling and decommissioning of Project infrastructure. Admixing of the soil layers could affect soil quality by causing changes in soil texture and structure, as well as diluting organic matter and organic carbon, which could adversely influence microbiological activities. Soils stored in overburden piles will be susceptible to erosion due to exposure to climatic events. Erosion of soils could also occur along roadways, stream crossings and facility footprints if areas are denuded of vegetation. A loss of soil from erosion events could affect revegetation efforts following replacement of soils from the stockpile over disturbed areas.

Soil compaction could also occur due to movement of heavy equipment or repeated movement of lighter equipment, as well as placement of heavy materials on top of the soils. Soil compaction influences structure, drainage, porosity, and susceptibility to erosion, which could reduce the ability of vegetation to become established.

Soil Quantity

Loss of soil could occur as a result of site preparation for on-land, in-water and shoreline structures (i.e., freshwater diversions, dykes, berms, collection ponds, water crossings, effluent pipelines and dock site), which requires soil salvage and storage. Soils disturbed during construction of Project infrastructure and quarry sites, as well as waste and overburden stockpiles will be susceptible to erosion due to their exposure to climatic events such as wind, precipitation, or water flow over a surface.

7.5.2.3 Potential Mitigations

A number of mitigation measures have been incorporated into design of the Project that will reduce Project-related effects on soil quality and quantity.

- Industrial machinery and equipment and diesel-powered generators will meet federal air emission standards
- NAG waste rock will be used for construction
- Low sulphur diesel will be used to reduce SO₂ fumigation
- Dust suppressants will be used to control of dust dispersion at the mine sites and along Project roadways
- Speed limits will be imposed on Project roads to reduce airborne dust from vehicles and equipment
- Rock covers will be installed on mineral waste piles as early as possible to minimize dust generation
- Conveyance systems and processing facilities will be enclosed to reduce emission of particulate matter, metals and PAI
- Disruption and compaction of soil will be minimized by limiting the area of land disturbance
- Use of frozen lake surfaces along the winter road route will be maximized



- Soil erosion will be prevented by constructing freshwater diversions to divert surface drainage around the mine site
- Soil transport will be minimized by selecting location for stockpiles that will reduce haul distances

7.5.2.4 Potential Monitoring

Monitoring for potential changes in soil quality and soil quantity could include conducting regular checks of overburden piles for signs of soil erosion.

7.5.3 Potential Changes to Vegetation

7.5.3.1 Potential Effects

The Izok Corridor Project has the potential to cause changes in the cover, composition, distribution and diversity of vegetation on the landscape, and the health of vegetation.

7.5.3.2 Effects Mechanisms and Linkages

Key Project activities and mechanisms by which effects on vegetation could occur include:

- Vegetation clearing, surface disturbance, flooding, burial and compaction, which could cause a direct loss of vegetation
- Changes in substrate composition, moisture and temperature, which could indirectly affect vegetation
- Alteration of local hydrology, which could result in changes to upstream and downstream plant communities
- Air emissions and dust deposition, which could affect plant health and the composition of vegetation communities
- Introduction of invasive plants through vehicles and materials being brought into the Project area

The potential for changes in vegetation would be greatest during the construction phase of the Project when plant cover will be removed and disturbed due to building of infrastructure.

7.5.3.3 Potential Mitigation

In addition to the Project design features outlined for soil (refer to section 7.5.2.3), the following measures could also be implemented to minimize direct effects on vegetation.

- Restricting winter road use to frozen ground conditions
- Ensuring all equipment is cleaned and weed free prior to transportation to the Project to reduce potential for introducing exotic invasive plants to the region

7.5.3.4 Potential Monitoring

Possible vegetation monitoring includes monitoring of Project reclamation and revegetation progress and implementing adaptive management to address problem areas.



7.5.4 Potential Changes to Wildlife and Wildlife Habitat

7.5.4.1 Key Effects

Key potential Project effects on wildlife and wildlife habitat include change in habitat availability, change in injury or mortality risk, and disruption of movement patterns and distribution.

7.5.4.2 Effects Mechanisms and Linkages

Animals may interact with the mine during normal movements within their home ranges, or through attractants such as food, waste and shelter. Human-wildlife interactions may lead to a wildlife incident resulting in injury or death (an incident is defined as any wildlife interaction that requires a response by mine personnel, such as deterrent or avoidance action). Injury or death may occur as a result of vehicle wildlife collisions, destruction of dens, nests and/or burrows, interactions with development infrastructure, lethal control of problem wildlife, and from contaminants.

Development can affect habitat directly where the habitat is no longer available or accessible to wildlife or indirectly where the habitat is still accessible but altered such that its use by wildlife is affected. Direct habitat loss is most effectively evaluated as potential Project effects on vegetation (wildlife forage) and landforms (e.g., eskers as den site habitat). Potential Project-related sources of habitat loss are the same as described for terrain (section 7.5.1.2) and vegetation (section 7.5.3.2). A reduction in functional habitat may result from Project-related activities that displace wildlife from an area, thus reducing its overall effectiveness as suitable habitat. This may include activities such as blasting, vehicle and aircraft noise, and human presence near key habitat areas (e.g., calving areas).

Corridor placement (e.g., haul routes and airstrips), mine and facility placement, and noise emissions may disrupt movement patterns and result in changes in wildlife distribution. Project-specific sources that may affect wildlife movement include vehicle and air traffic, Project infrastructure (roads, port site, camps, airstrips, equipment storage and stockpiling areas), and Project surface disturbance (open pit mine). Both daily and seasonal movements may be affected. Indicators for examining the permeability of the proposed roads will include the distribution and crossing rate of caribou tracks encountering the roads.

7.5.4.3 Potential Mitigation

A Wildlife Mitigation and Monitoring Plan will be developed for the Project based on lessons learned from other Arctic projects, and will incorporate traditional knowledge and input from other stakeholders (refer to section 12.2.2.11). The plan will present mitigation and management policies, and effects monitoring study designs and procedures to reduce potential Project-related effects on wildlife and wildlife habitat.

Since Project-related effects mechanisms and linkages are similar for most wildlife species and habitat within the RSA, the following mitigation measures are generally applicable to addressing effects to a number of species. Some possible species-specific mitigation measures are outlined below.



Wildlife Habitat

- Restrict the mine surface footprint to the smallest area necessary, and limit habitat change with a compact design
- Restrict the road to the shortest possible route, and maximize the use of frozen lake surfaces along the winter road route
- Assign designated areas for storing materials that avoid sites such as vegetated areas or water bodies
- Limit disturbance near riparian areas and lakeshores, and avoid sensitive and unique wildlife habitat, where practicable
- Remove infrastructure and reclaim roads and airstrips upon closure to minimize duration of potential wildlife effects

Wildlife Incidents and Mortality

- Provide wildlife awareness and sensitivity training (especially bear awareness training) for all on-site personnel to familiarize them with an ecologically responsible code of ethics regarding wildlife and wildlife habitat
- Report all wildlife incidents immediately
- Where appropriate, use an electric or non-electric fence in selected areas to exclude wildlife
- Inspect the airstrip for wildlife prior to take-off and landing of all aircrafts
- Design buildings to discourage their use by animals for shelter
- Use signs and radios to warn drivers when wildlife, especially caribou, is present in an area
- Enforce speed limits on Izok Road and winter roads
- Vehicle operators to yield to wildlife crossing on roads, be vigilant in watching for wildlife near roads, and take all reasonable measures to avoid vehicle-wildlife incidences
- Install wildlife crossing signs at high frequency wildlife crossing areas or in areas where animals are found to reside near roads
- Implement and enforce a Waste Management Plan to minimize the presence of attractants such as garbage and waste food (refer to section 12)
- Immediately report problem wildlife, any dens or nests, or substantial mine-related wildlife incidents immediately to the appropriate authorities

Wildlife Movements and Distribution

- Reduce noise by use of muffled exhaust systems and meet emission guidelines
- Adhere to prescribed airflight corridors and altitudes near known concentrations of wildlife
- Restrict vehicles to designated roads and prepared work areas only



Caribou

The following mitigation measures are specific to reducing potential collisions and subsequent caribou mortalities along transportation infrastructure and within Project facilities, and minimizing sensory disturbance and restrictions to movement of caribou and other ungulates within the RSA. Many of the general mitigation measures outlined above pertain to caribou and other ungulates.

- Establish a caribou (ungulate) alert system to immediately warn personnel of the number and location of ungulates
- If a group of caribou is observed in the vicinity of construction or operation activity, implement and monitor traffic activity controls
- Deter caribou from hazardous areas

Grizzly Bear and Wolverine

Wildlife mitigation, waste management, and mine personnel education will be proposed to minimize effects of the Project on grizzly bears and wolverine, and to reduce the possibility of bear-human interactions.

7.5.4.4 Potential Monitoring

Wildlife Habitat

A discussion of possible programs for monitoring direct and indirect habitat loss is provided in the following sections for selected species.

Caribou

The broad objectives of caribou monitoring would be to determine whether the Project is adversely affecting the abundance, distribution and behaviour of caribou, and harvest of caribou within the RSA. To address these objectives, monitoring could include:

- Regular aerial surveys to document caribou numbers, distribution, and group composition in the RSA
- Ground-based surveys of caribou snow tracks along Izok Road and winter roads
- Scanning observations of caribou from the ground to document caribou behaviour and group composition in the RSA
- Documentation of caribou sightings and interactions by Project personnel in a wildlife log for the Project
- Conduct interviews and surveys in Kugluktuk, Umingmaktok and Bathurst Inlet or with GN DOE wildlife staff to document hunter activity in the RSA



Grizzly Bear and Wolverine

Monitoring will be undertaken to determine whether the Project is affecting the abundance and distribution of grizzly bears and wolverine within the RSA. This could include the following.

- Continued hair-snagging, DNA monitoring Conduct aerial transect surveys to document grizzly bear and wolverine sightings incidental to ungulate monitoring in the RSA
- Conduct observations of grizzly bear and wolverine interactions with development infrastructure within the LSA

7.5.5 Potential Changes to Birds and Bird Habitat

7.5.5.1 Potential Effects

Project activities during construction, operation and closure have the potential to adversely affect the distribution, abundance and health of bird populations in the RSA. Potential effects include:

- Sensory and auditory disturbance from mining activities and road traffic to nesting and breeding birds, potentially leading to nest abandonment
- Increased risk of injury or mortality of birds as a result of attraction with lighting on mine facilities and collisions with infrastructure
- Direct habitat loss from site clearing for Project roads and infrastructure

7.5.5.2 Effects Mechanisms and Linkages

Raptors

Raptors are susceptible to disturbance during the breeding season, especially early in the season prior to the initiation of nesting and early in the brooding period (typically May and June, depending upon the species). Construction and operational activities (including road traffic) could cause sensory disturbance of incubating or brooding adults at nest sites close to these activities, which could result in reduced nest productivity.

Waterfowl

The Project has the potential to cause both direct and indirect effects on waterfowl. Construction activities could result in the direct habitat loss, while disturbance from construction and operational activities could cause disturbance to waterfowl in the vicinity of the mine sites and affect waterfowl breeding success and energetics.

Upland breeding birds

Although the zone of influence of Project disturbances will likely be limited to less than 300 m to 400 m (Smith et al. 2005), some disturbance (primarily from direct loss of habitat) could occur on and near the Project disturbance footprint.



7.5.5.3 Potential Mitigation

Raptors

In addition to the general mitigation measures outlined in section 7.5.4.3, the following measures could be implemented to minimize disturbance to peregrine falcons and other cliff-nesting raptors.

- Develop a nest-specific management plan for active raptor nests identified within 1.6 km of the footprint
- Avoid disturbance to nests during the early part of the nesting cycle (late May through to early July, depending on the species) to minimize the risk of nest site abandonment
- Discourage nesting of raptors on artificial structures, pit walls, or other facilities

Waterfowl

Although waterfowl are not common on inland lakes and rivers in the Izok Corridor Project area, they are susceptible to displacement from high levels of human disturbance. Specific measures for waterfowl could include the following.

- Avoid known habitats of waterfowl in development areas, wherever and whenever possible
- Conduct land clearing in potential waterfowl habitat outside of the waterfowl breeding season unless a systematic nest survey by a qualified wildlife biologist has determined that no waterfowl nests are present
- Avoid activities and disturbances within occupied waterfowl nesting areas
- Prevent waterfowl and loons from landing or nesting on mine infrastructure and man-made ponds (e.g., tailings and reclamation), and use aversion tactics if necessary
- Develop a nest-specific management plan for all active waterfowl nests found within 200 m of development activities or in areas slated for clearing during the breeding season

Upland breeding birds

In addition to the above general measures and those outlined in section 7.5.4.3, the following mitigation measures also apply to upland breeding birds.

- If windows, transmission lines, or other structures or components of buildings result in bird collisions and death, implement deterrent measures such as placement of streamers on wires
- Make efforts to prevent upland birds from nesting on mine infrastructure

7.5.5.4 Potential Monitoring

Raptors

Raptor monitoring could be used to determine whether the Project is affecting the distribution, occupancy rate, or productivity of raptors. Although the territories of all raptors would be monitored



during such surveys, the peregrine falcon would be the focal species because it is most numerous and is a listed species.

Waterfowl

Waterfowl monitoring may be implemented to determine if the Project is adversely affecting the abundance and distribution of waterfowl and nesting habitat through early summer nesting surveys around wetlands and waterbodies.

Upland breeding birds

Breeding bird monitoring may be implemented to determine if the Project is adversely affecting the density, diversity and species richness of upland breeding birds through stratified breeding bird surveys using an area-search, plot-based (PRISM) protocol.

7.6 Marine Environment

7.6.1 Potential Changes to Marine Water and Sediment Quality

The Izok Corridor Project has the potential to affect marine water quality and sediment quality at the proposed Grays Bay Port and, in turn, the health of marine organisms.

7.6.1.1 Potential Effects

Key Project activities or mechanisms through which effects on marine water and sediment quality could occur include:

- Fugitive dust from blasting, dredging and land clearing during construction
- Fugitive dust from handling and loading of the concentrate into ships during operations
- Discharge of contact water from the port site
- Discharge of brine from the desalination plant
- Accidental spills of concentrate, petroleum or other hazardous materials

7.6.1.2 Effects Mechanisms and Linkages

Construction Activities

Construction of the Grays Bay Port will entail periods of blasting and dredging of rock, which could result in an increase in turbidity and sedimentation of marine habitat. In addition, clearing of land during construction of the port has the potential to increase suspended sediment concentrations in the marine environment through site runoff.

Although the marine environment of Grays Bay often experiences elevated levels of suspended sediments from silt-laden plumes from large river systems, increases attributable to construction activities could at times exceed natural levels.



Increased suspended sediment levels from construction activities could also result in elevated total metal levels within the water column for a period of time before the sediments settle out.

Atmospheric Deposition

Traffic, blasting, site disturbance and handling of concentrate at the port will generate fugitive dust that may be deposited in the marine environment and could potentially cause elevated metal levels in water and sediment within Grays Bay.

Discharge of Brine from Desalination Plant

Potable water at the Grays Bay port will be produced in a water desalination treatment plant using sea water as feed. Salts removed during the desalination process will be discharged back to the marine environment as a high salinity brine.

Discharge of Contact Water

Water that comes into contact with Project facilities and activities may contain trace metals, blasting residues and other contaminants.

7.6.1.3 Potential Mitigation

The following mitigation has been incorporated into Project design to reduce potential effects on water quality and sediment quality in Grays Bay.

- Sediment and erosion control measures will be implemented during construction and operation, including diversion ditches, silt traps, silt fences and settling ponds
- water collected in the settling pond, will be tested for contaminants prior to treatment and/or release to the marine environment
- Use of an enclosed concentrate storage shed with dust filters
- Use of enclosed conveyors for movement of concentrate from the storage shed to ship loaders
- Development of a spill contingency and emergency response plan for potential spills at the port (refer to section 12)

Other possible measures to mitigate Project effects on the marine environment in Grays Bay might include:

- Use of silt curtains or other means during blasting and dredging
- Use of a diffuser for discharge of desalination brine

7.6.1.4 Potential Monitoring

Water and sediment quality monitoring programs might include:

- Turbidity monitoring in Grays Bay during construction
- Water and sediment quality monitoring in the immediate vicinity of the port



- Effluent monitoring during construction and operations to assess discharge water quality

7.6.2 Potential Changes to Marine Aquatic Organisms and Habitat

7.6.2.1 Potential Effects

Key potential effects of the Project on marine fish include:

- harmful alteration, disruption or destruction (HADD) of fish habitat
- change in health, distribution or size of arctic char populations
- increased risk of fish mortality

The primary sources of disturbance to marine fish and fish habitat will be underwater blasting and dredging during construction, possible infilling of part of the shallow bay between the dock and the concentrate storage shed, presence of the dock, and accidental spills of concentrate, petroleum or other hazardous materials. Arctic char has been selected for assessing these potential effects due to the importance of this species for subsistence harvesting.

7.6.2.2 Effect Mechanisms and Linkages

Direct loss of fish habitat will occur within the dock footprint and any filled portion of the shallow bay. Alteration or disruption of fish habitat (including substrate and sessile organisms) could occur around the dock site as a result of turbidity and sedimentation from blasting and dredging, and potential accidental spills of concentrate, petroleum or other hazardous materials. These disturbances could also result in changes in the health, distribution or size of arctic char populations in the Grays Bay area. Construction noise caused by underwater blasting could also result in direct mortality of fish.

7.6.2.3 Potential Mitigation

All blasting operations will be carried out in accordance with applicable guidelines and regulations, and the details will be agreed with DFO at the *Fisheries Act* authorization application stage. Authorization for harmful alteration, disruption, or destruction (HADD) of fish habitat will be obtained from the Minister of Fisheries, and a No Net Loss Plan will be prepared and implemented. Habitat enhancement will be applied to achieve no net loss (refer to section 12).

Other possible mitigation measures include:

- Use of rock fill for the dock that is free of fine materials to minimize increases in turbidity and sedimentation
- Use of a bubble curtain system around the blasting area to minimize injury or mortality to fish
- Use of lined fuel tank farms to minimize the risk of an accidental diesel release

7.6.2.4 Potential Monitoring

An environmental effects monitoring (EEM) program will be developed to monitor the marine receiving environment and determine whether project discharges have any effects on infaunal benthos.



7.6.3 Potential Changes to Marine Mammals

7.6.3.1 Potential Effects

Key potential effects of the Project on marine mammals include:

- Change in behaviour and distribution
- Increase in hearing impairment
- Increased risk of injury or mortality

The primary sources of disturbance will likely be underwater noise created by construction activities (underwater blasting, dredging, and pile driving) in Grays Bay, and underwater noise generated by Project vessels along the shipping routes. The presence of the large vessels travelling at speed is also expected to be a source of disturbance to some marine mammals.

Key indicator species selected for assessing potential Project effects in Grays Bay include ringed seals and beluga whales. Beluga whale, narwhal, bowhead whale, polar bear and possibly other species will be the focus of the effects assessment for the marine shipping component of the Project.

7.6.3.2 Effect Mechanisms and Linkages

In-water construction activities at Grays Bay (blasting, dredging) will generate underwater noise that could result in avoidance of the area by ringed seals in spring and/or summer and by belugas in summer. Avoidance would likely be temporary, during and shortly after the construction activities. If ringed seals or belugas were sufficiently close to the sound sources, hearing impairment could potentially occur. Noise or other disturbances during ringed seal pupping in early spring could startle pups to the extent that they enter the water and suffer hypothermia. Underwater blasting could also cause injury or mortality of ringed seals (in spring or summer) or belugas (in summer) if they are in close proximity to the dock site when blasting is taking place.

Underwater sound generated by marine vessels along the shipping routes could result in changes in distribution of marine mammals due to avoidance behaviour. Also, a collision between a bulk carrier moving at speed and a marine mammal could result in serious injury or direct mortality. Large, slow-moving whales such as the bowhead whale are particularly susceptible to collisions, especially while socializing.

7.6.3.3 Potential Mitigation

All blasting operations will be carried out in accordance with applicable guidelines and regulations (e.g., DFO's "*Guidelines for the Use of Explosives in or near Canadian Fisheries Waters*"), and subject to discussion with DFO.

An Environmental Monitor will be on site during all construction activities. Before commencing with underwater blasting or dredging, the Environmental Monitor will assess the area for marine mammal presence. If a marine mammal enters the area during underwater blasting, dredging or pile driving, the activity will be suspended until the animal has left the area.

Other possible mitigation measures include:



- Use of either a long-stick backhoe or a clamshell dredge, which produce less noise than suction or cutter suction dredges
- Use of a bubble curtain system around the blasting area to minimize sounds produced during underwater blasting

Mitigation measures will be employed to reduce the risk of Project-related vessel-mammal strikes. Possible measures include speed restrictions in sensitive areas, maintenance of a constant course, and use of onboard marine mammal observers (MMOs). In general, all Project vessels would steer a straight course, maintain constant speed, and avoid sudden changes in speed or direction whenever possible.

7.6.3.4 Potential Monitoring

Onboard monitors would record marine mammal and other wildlife sightings, ice conditions and wildlife behaviour, including near-misses and incidents of vessel strikes with marine mammals.

7.6.4 Potential Changes to Marine Birds

7.6.4.1 Potential Effects

Key issues related to potential effects of the Project on marine birds and marine bird habitat include changes in distribution, abundance, and health. Responses to disturbance vary from behaviours of alertness and vocalizations, temporary cessation of incubating or brooding, to nest site abandonment (K. Poole, AWR, personal observations).

7.6.4.2 Effects Mechanisms and Linkages

The Project could cause both direct and indirect effects on marine birds. Construction of the dock facilities could result in direct habitat loss. Disturbance from shipping traffic could result in changes in distribution and use of foraging and nesting habitat. Wake activity from passing ships could also change shoreline nesting and foraging habitat.

Indirect effects of the Project on seabirds could result from human activity during both the construction and operational phases, which could have an adverse effect on breeding success and energetics.

7.6.4.3 Potential Mitigation

Marine birds occur in moderate numbers along the coast near Grays Bay and the proposed dock site. Marine birds are susceptible to displacement from high levels of human disturbance. Specific measures to mitigate Project-related effects could include the following.

- Avoid known habitats of seabirds in development areas, wherever and whenever possible
- Develop a nest-specific management plan for all active seabird nests found within 200 m of development activities or in areas slated for clearing during the breeding season
- Establish flight corridors and minimum aircraft cruising altitudes to avoid known concentrations of seabirds



7.6.4.4 Potential Monitoring

Seabird monitoring may be undertaken to determine whether the Project is adversely affecting the abundance and/or distribution of seabirds in important habitat areas along the coastal portion of the RSA.