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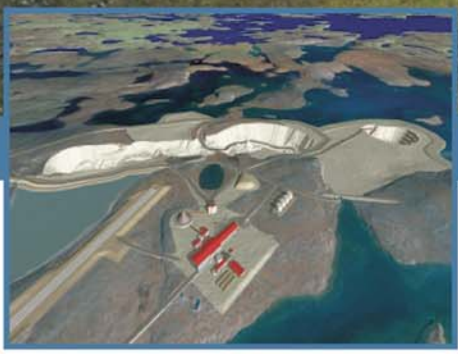

MEADOWBANK GOLD PROJECT

Draft Environmental Impact Statement

PART 1: REPORT

December 2004

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PART 2: APPENDICES

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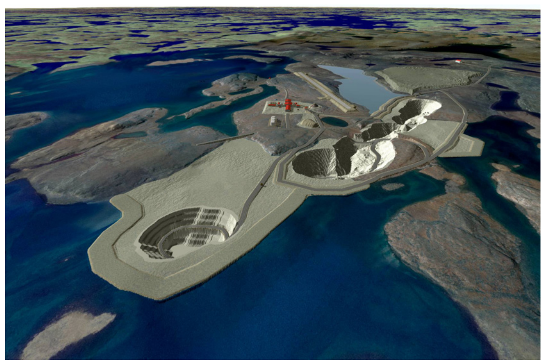
EXECUTIVE SUMMARY

Cumberland Resources Ltd. (Cumberland) is proposing to develop an open pit gold mine on the Meadowbank property. The property is located in the Kivalliq Region of Nunavut approximately 70 km north of the Hamlet of Baker Lake on Inuit-owned surface lands. Cumberland has been actively exploring the Meadowbank area since 1995. Engineering, environmental baseline studies, and community consultations have paralleled these exploration programs and have been integrated to form the basis of current project design. Cumberland has complied with all governmental policies and regulations pertaining to environmental and socioeconomic issues in developing the Meadowbank project and has an exemplary local employment and safety record over nine years of exploration in Canada's Arctic.



This Draft Environmental Impact Statement (DEIS) is submitted in accordance with the Nunavut Impact Review Board's (NIRB) requirements for proposed mine developments established by Part 5 of the Nunavut Land Claims Agreement. Cumberland has written this Draft Environmental Impact Statement based on guidelines issued by the Nunavut Impact Review Board. The objective of the EIS and its supporting documents is to provide a detailed description of the proposed project, current physical, biological and socioeconomic conditions, potential impacts, mitigation and management strategies, and long-term monitoring plans. The lead authorizing agency, NIRB, will facilitate a comprehensive review of the documents and determine whether additional information is required for the Final Environmental Impact Statement.

As of November 2004, the Meadowbank Gold project hosts estimated combined measured and indicated resources of approximately 3,203,000 oz of gold and additional inferred resources of approximately 581,000 oz. The economics of the project are sensitive to fuel prices and construction capital costs, common factors of northern mine development and operations. A feasibility study of the Meadowbank Gold project is nearing completion.

Many alternatives were considered in developing the Meadowbank project including the "no go alternative". Environmental and economic impacts were important in evaluating the alternatives and deciding the preferred options.

Meadowbank is planned to have a 12- to 14-year project life. The project will have a 2-year construction period followed by 8 to 10 years of mine operation and a 2-year post-closure period. During the construction period, approximately 350 direct jobs will be created and approximately 250 jobs will be created through

the operating mine. Similar to the gold and diamond mines currently operating in the Arctic, Meadowbank is planned as a "fly-in/fly-out" operation with personnel rotated every several weeks by air transportation. It is reasonable to expect that the operations could be extended as a result of continued exploration. Depending on local workforce capacity, skill levels and training programs during the early operational life of the mine direct project wages paid to workers from Baker Lake and the rest of the Kivalliq Region could exceed $3 M annually with 60 to 90 jobs.

Based on an estimate of operating expenditures of $92 M per year, total expenditures on local wages, goods, and services could be in the order of approximately $310 M during the 8- to 10-year mine life and 2-year post-closure period.

PROJECT DESCRIPTION

Meadowbank Deposits

Five significant gold deposits—North Portage, Third Portage, Bay Zone, Goose Island, and the Vault—have been identified on the property. These deposits have been defined by 111,576 m of drilling in 801 diamond drill holes. As of November 2004, the project hosts estimated combined measured and indicated resources of 22.9 Mt grading 4.4 g/t of gold and additional estimated inferred resources of 4.2 Mt grading 4.3 g/t. The project is now estimated to contain approximately 3,203,000 oz in the measured and indicated category and 581,000 oz in the inferred category.

The Meadowbank gold deposits have relatively simple mineralogy consisting of pyrite and pyrrhotite hosted in oxide (magnetite-rich) facies iron formation and intermediate volcanic rocks. The gold deposits do not contain arsenopyrite, sphalerite, or chalcopyrite.

Mining & Waste Rock Management

Open pit mining is planned in three separate areas. The Portage open pit (comprising the North portage, Third Portage, and Bay Zone deposits) is expected to be the largest, measuring 2,000 m long, 200 to 400 m wide, and 175 m deep. The Goose Island open pit is less than 500 m in diameter and 150 m deep. The Vault open pit, located 5 km north of Portage and Goose Island, is designed to be approximately 900 m long, 600 m wide, and 185 m deep.

Dewatering dikes will be constructed at the Portage, Goose Island and Vault areas to allow mining of the ore where it occurs beneath shallow lakes. The dikes will be constructed in water approximately 2 to 6 m in depth, using appropriate rock selected from surface mining activities. Fish will be removed before dewatering. On closure, the pits will be flooded and fish allowed to return.

Dike construction will utilize floating sediment curtains as needed to minimize the release of suspended solids into surrounding lake waters.

Mine waste rock will be placed in one of two land based storage areas. As mine scheduling permits, some mine rock may be stored in mined-out pit areas or used as cover for tailings. It is expected that superchilling in the cold northern climate will minimize surface runoff during operations. To the extent practical, any potentially acid-generating (PAG) waste rock will be covered with suitable material during progressive reclamation and closure activities. Permafrost will aggrade through the cover and waste rock thus encapsulating all potential contaminants.

Waste rock and overburden material that is geotechnically and environmentally suitable will be used in constructing the airstrip, roads and site facilities. Some overburden material may also be used as a low permeability central core material in constructing the dewatering dikes. During mining, water collected from the base of open pits will be collected and treated as required prior to discharge.

Ore Processing & Tailings Management

Exhaustive metallurgical studies have been completed to support a conventional milling process flowsheet for the Meadowbank project. The preferred option leaches a total mill throughput of greater than 5,500 tpd, and includes standard crushing and grinding, gravity concentration, carbon-in-pulp (CIP) cyanide leach technology with cyanide destruction, and refining to doré bars.

In the proposed flowsheet, ore is delivered from the mine to a blending and surge pad at the crusher. Run-of-mine ore is crushed in a gyratory crusher and conveyed to an open coarse ore storage pile. The ore is reclaimed and ground in two stages incorporating semi-autogenous grinding (SAG) and ball mill grinding.

The SAG and ball mills discharge the ground product to cyclones for size classification. Gravity separation of liberated gold particles is applied within the grinding circuit. A high-grade gravity concentrate suitable for treatment by intensive cyanidation in an Acacia reactor is then produced. The milled ore is pre-aerated prior to treatment in a CIP cyanidation circuit. The CIP circuit concurrently dissolves the gold and adsorbs it onto activated granular carbon. The loaded carbon from the CIP circuit is stripped in a pressure Zadra-type elution circuit. The stripped carbon is reintroduced to the CIP circuit. Gold is recovered from the strip solution in the Acacia reactor by electrowinning. The gold-laden cathodes are treated in an on-site refinery to produce gold doré bars.

Tailings from the CIP circuit will be treated with sodium metabisulphite, an effective and commonly used cyanide destruction process. To minimize any potential for ARD, the treated tailings will be disposed of using a permanent freezing concept in the Second Portage Arm impoundment area. To the extent practical, PAG tailings will be covered with suitable material during progressive reclamation continuing on through closure. According to the thermal model, permafrost will develop and remain intact under the worst climate change predictions. The closed tailings facility will be re-contoured to blend into the landscape having comparable relief with the adjacent natural topography.

Site Facilities & Services

The implications of the cold climate have been taken into account in the design of the process buildings, which will be supported on concrete foundations extending to bedrock. The foundations will be built at a suitable elevation to prevent frost damage. Recovered heat from the power plant will be used to heat the entire plant and camp building complex.

On-site infrastructure for the proposed mine will include a process plant, power plant, maintenance facilities, tank farm, accommodation facilities for approximately 250 personnel, sewage treatment facility, on-site access roads, airstrip, and potable water treatment plant. Barge unloading facilities, a laydown area, and tank farm will also be required in Baker Lake for storing and staging materials to be transported on the haulage road.

The mine and camp fresh water supply will be pumped from Third Portage Lake. Sewage will be collected and pumped to a sewage treatment plant that meets Nunavut guidelines for

wastewater discharge. The treated sewage effluent will be discharged to the tailings pond. Mine process water will be primarily reclaimed from the tailings pond.

All construction and operating supplies for the project will be transported on ocean freight systems to marshalling and storage facilities constructed at Baker Lake. An overland haulage route will provide access and re-supply to the proposed mine from Baker Lake. The mine will produce gold doré (bars), which will be flown to southern sales destinations.

ENVIRONMENTAL BASELINE STUDIES

Cumberland began conducting extensive studies in the project area in 1996 in preparation for the environmental assessment process. These studies examined geology, ARD, climate, terrain and soils, fisheries, hydrology, vegetation, and wildlife, and traditional knowledge and land use. The information gathered during these baseline studies has been integrated into current project design.

Valued ecosystem components (VECs) were identified in consultation with regulatory and governmental authorities, and members of the local community. Each VEC is of ecological importance, and is intimately connected with one or more of the other components. The VECs include Permafrost, Water Quantity, Surface

Water Quality, Air Quality, Noise, Vegetation Cover (i.e., wildlife habitat), Ungulates (caribou and muskoxen), Predatory Mammals (grizzly bear, wolverine, and wolf), Small Mammals, Raptors, Waterfowl, Other Breeding Birds, Fish Populations, and Fish Habitat.

Valued Socioeconomic Components (VSECs) in the project area, as identified by consultation with regulatory and governmental authorities, and members of the local community, consist of: employment, training and business opportunities; traditional ways of life; individual and community wellness; infrastructure and social services; and sites of heritage significance.

Surficial Geology

Laterally extensive deposits of glacial till, a product of the Laurentide ice sheet, cover the central project area. Trenching, diamond drilling, and overburden drill data suggest an average thickness of 2.75 m, with local deposits in excess of 10 m.

Permafrost

Locally, the land surface is underlain by continuous permafrost, except under large bodies of water that are too deep to freeze entirely (i.e., taliks). The depth of the permafrost is estimated to be in the order of 400 to 500 m, based on data collected from thermistors. The depth of the active zone is estimated to be generally between 2 and 4 m, depending on proximity to lakes, overburden thickness, vegetation, snow cover, climate conditions, and slope direction.

Taliks occur beneath lakes in the region at an estimated depth equal to one-quarter to one-half the width of the lake. Because of low ambient air and ground temperatures, this ratio may be close to one-quarter.

Water Quantity

Hydrometric data have been recorded from the on-site meteorological weather station (operational since 1997) as well as through monitoring of lake levels and lake outlet discharges and snow surveys. Most streams in the Meadowbank project area are fed from lake outflows and are relatively short, small to medium width channels feeding into downstream lakes in a cascading network. Snowmelt runoff in the region begins in the period from late May to mid-June. Third Portage Lake drains into Second Portage Lake via three small stream channels that flow across a narrow isthmus of land. The majority of the flow occurs beneath the surface, or between the large rock and boulder substrate that separates the lakes. Second Portage Lake drains into the larger Tehek Lake. Vault Lake eventually drains via a number of lakes such as Wally and Drilltrail lakes to Second Portage Lake.

In areas of continuous permafrost there are two groundwater flow regimes: a shallow groundwater regime located in the active layer near the ground surface, and a deep groundwater regime beneath the permafrost. Groundwater in the active layer flows to local depressions and ponds that drain to Second and Third Portage lakes or flows directly to Second and Third Portage lakes. The deep groundwater regime is connected by taliks located beneath large lakes. At Meadowbank, analyses have predicted that open taliks exist beneath Third and Second Portage lakes, including Second Portage Arm. These analyses also suggest that the closed talik beneath Vault Lake does not extend to the deep groundwater flow regime because this lake is relatively shallow and much of the lake freezes to the bottom in winter.

Surface Water Quality

All of the conventional water quality parameters (e.g., pH, anions, nutrients), metals concentrations, and limnological data indicate that water quality of the study and reference lakes is very good. Because the study lakes are situated in the uppermost reaches of the Quoich River system, they do not receive input from upstream lakes that might carry suspended and dissolved solids and/or nutrients. This helps explain why the lakes are so oligotrophic, nutrient–poor, and relatively unproductive.

Groundwater

Groundwater baseline data were collected from four monitoring wells located within the three main rock types in the area of the Goose Island and Portage deposits (namely the Iron Formation (IF), Intermediate Volcanic (IV) and Ultramafic (UM) lithologies), and from the talik underlying the proposed tailings storage facility area at Second Portage Lake. No wells were installed in the Vault area, as it lies within continuous permafrost. The chemistry of groundwater demonstrates distinct signatures for each lithology.

Geochemistry

The relative potentials of the rock types to generate ARD or leach metals under neutral drainage conditions, and the implications on potential use as construction rock, are presented in the table below.

Summary of Geochemistry Considerations

Open Pit	Material Type	Quantities (Mt)	ARD Potential	Potential for ML	Restrictions for Storage/Use
All Pits	Overburden		None	Low	None
	Tailings	20	High	High	Requires measures to control ARD
Portage & Goose	Ultramafic & Mafic Volcanic Waste Rock	35	Very low (95% low; 5% uncertain to high)	Low	May require collection and treatment of drainage
	Intermediate Volcanic Waste Rock	27	Variable(65% low; 35% uncertain to high)	Moderate	Requires measures to control ARD
	Iron Formation Waste Rock	33	High	High	Requires measures to control ARD
	Quartzite Waste Rock	2	High	Low	Co-disposal with ultramafic/mafic volcanic or cap/water cover
Vault	Intermediate Volcanic Waste Rock	54	75% low; 25% uncertain to high	Variable (low to moderate)	May require collection and treatment of drainage

Water quality was calculated for each mine component by combining predicted water flow volumes with laboratory-derived chemical loading rates, the later obtained by leaching representative samples of mine site materials. The laboratory-derived chemical loading (leaching) rates were factored to account for the differences expected between site and laboratory conditions. Of particular importance are the lower ambient temperatures, larger size of rock fragments (tailings excepted), and expected water flow through the mine components.

Vegetation Cover

The Meadowbank study area lies at the lower end of the Northern Arctic Ecozone and is characterized by a continuous vegetation cover interspersed with bedrock outcroppings and continuously aggrading surfaces.

Vegetative cover is composed of lichens, mosses, ericaceous shrubs and heaths, herbs, grasses, and sedges.

In the summers of 1999 and 2002, baseline vegetation studies were carried out to inventory the flora and plant communities in the project area. Vegetation plots showed that vegetation at the mine site is typical of upland tundra. No sensitive, rare, or endangered species or communities were identified.

Wildlife

Based on traditional knowledge, the Meadowbank site is considered to be a low usage area for caribou hunting due to low abundance and distance from Baker Lake.

Aerial and ground surveys for wildlife were conducted in 1999 and from 2002 to 2004. These surveys were used to establish baseline conditions and determine diversity, relative abundance, and distribution of wildlife species within the local and regional study areas. Additional information was obtained from on-site wildlife logs, from the Baker Lake Hunter's and Trapper's Organization (HTO), and various Elders.

Based on existing information, baseline surveys, and traditional knowledge, the Meadowbank area and vicinity is not used as a calving area for caribou. The largest numbers of caribou occur between mid-August and March, with wintering caribou apparently originating from several herds including the Beverly, Ahiak (Queen Maud), Lorillard, Wager Bay, and possibly Boothia Peninsula and Qamanirjuaq. Muskoxen also occur in the Meadowbank area, with herds numbering in the 30s having been observed.

Grizzly bear has only been observed on one occasion since 1996, when a sow and two cubs were spotted several kilometers to the north of the Meadowbank property (May 1999). Wolverines have been observed on a few occasions, and wolves are seen on a regular basis. Arctic fox, Arctic hare, ermine, sik sik, voles, and lemmings are other mammal species that are observed regularly.

Breeding landbirds include Lapland longspur, horned lark, rock ptarmigan, savannah sparrow, and several other less common species. Raptors, including peregrine falcon, rough-legged hawk, snowy owl, and gyrfalcon, have been seen occasionally; however, no active nests have been observed due in part to the relative absence of suitable cliff habitat in the vicinity of the project. Waterbirds occur at low densities with Canada goose, long-tailed duck, and loons being the most common. Waterfowl nesting has not been confirmed within the local study area, despite waterfowl nesting surveys.

Fish Populations & Habitat

Key fish species in the Meadowbank region are lake trout, Arctic char, and round whitefish. Arctic char in the system are landlocked since there is an impassable falls (St. Clair Falls) on the Quoich River near Chesterfield Inlet. Traditionally, fish has been the secondary food source for Baker Lake residents after caribou meat. Fishing or "jigging" is a year-round activity that is pursued more vigorously in spring and early winter. A study completed in 1978 found that lake trout accounted for approximately half of the domestic harvest, totalling 65,000 kg from the lakes around and north of Baker Lake. According to the Elders of Baker Lake, the area around the mine was not used for fishing, although some fishing did take place several kilometers to the south.

Since 1996, Second Portage, Third Portage, Tehek, and Turn lakes have been the subject of studies investigating seasonal and inter-annual trends in water and sediment quality, lower trophic level (i.e., phytoplankton, zooplankton, benthos, periphyton) community structure and abundance, and fisheries. In addition, regional studies were conducted to examine the physical, chemical, and biological features of several lakes on a broader geographic scale. All of the lower trophic level taxa identified from the project lakes are common, widespread species that are well known from this region of the Arctic.

Socioeconomic Conditions

The Kivalliq Region, one of three administrative regions in Nunavut, had an estimated population of over 7,500 people in 2001. The population is spread among seven communities, with Rankin Inlet being the largest (over 2,200 people) and Whale Cove the smallest (less than 350 people). Baker Lake, with an estimated population of over 1,500 in 2001, is the only inland Kivalliq Region community.

In an economy that is predominantly based on government services, there is little opportunity for a growing labour force with constrained educational achievement. Unemployment levels are very high compared to the rest of Canada. The challenges to community health and wellness are large. Poor employment prospects have translated into a recent decline in family incomes, which in Baker Lake are substantially lower than in the region and the territory.

Traditional Knowledge & Archaeology

Participation in traditional ways of life is high, at about 50% both in Nunavut as a whole and in Baker Lake. Traditional activities shape social relationships and are a source of individual identity and values, sustaining Inuit culture.

During archaeological surveys in 1999 and 2003, a total of 42 sites were recorded. Most of the sites identified were considered temporary campsites that had been occupied relatively recently. Tent rings, autumn houses (qarmait), hearths, shelters, inuksuit, markers, blinds, caches, storage features, kayak stands, fox traps, and other unidentified features are described in the Baseline Archaeology Report. No Pre-Dorset or Dorset sites were encountered in the study area, and only one Thule or early historic site was visited.

The area between Baker Lake and the mine site is considered primarily a transit route to Back River, a traditional winter hunting and fishing area. This is the likely origin of many campsites and other heritage features along the road, as supported by traditional knowledge. In the interviews conducted during Phase 1 and Phase 2 of the Baseline Traditional Knowledge study, only few people indicated the area around Tehek Lake was used for fishing, and this was usually an activity performed while enroute to somewhere else.

A lack of human activity in Meadowbank prevails today. The area is not used by trappers, outfitters, tourist operators, or any other commercial organizations.

Community Consultation

Cumberland has made it a priority to keep the community informed of project advancements or setbacks and to create constructive dialogue between all parties. Consequently, numerous mine elements have been planned based on community input. This practice of information sharing will continue and will provide a framework for addressing future opportunities and concerns. Cumberland has opened an office in Baker Lake and has appointed a full-time community liaison representative.

Inuit Impact Benefits Agreement

Before construction of the proposed mine begins, an Inuit Impact Benefits Agreement (IIBA) must be negotiated with the Kivalliq Inuit Association (KIA) because the proposed mine project is on Inuit Owned Lands. Currently, Cumberland has a benefit agreement to accompany the exploration land lease. This agreement focuses on jobs, training, local hiring programs, contracting, and community liaison.

ENVIRONMENTAL IMPACTS

Overall, the proposed development is projected to have a negligible impact on the existing environment in a regional context, and a low to moderate impact on a local or site-specific context. The majority of the project impacts on the environment will be mitigated through project design or by following an effective Environmental Management System (EMS).

Permafrost

During the construction phase, dewatering activities resulting in lower water tables will cause the active layer area to increase, resulting in some combination of thaw subsistence, local thaw instability, and sediment production within the dewatered basin. These effects are expected to stabilize during operation. Ditches may also cause some localized degradation of permafrost, causing instability where ground ice is present. Mine facilities also have the potential to thaw permafrost if appropriate mitigation alternatives are not implemented.

Air Quality

Mining activities and ore processing facilities of the project will generate dust. The dust arises predominantly from inert soil, ore materials, and tailings. The main potential sources of dust will include processing plant, stockpiles, ore hauling trucks, tailings and waste rock disposal, stripping, and overburden storage. Rather than occurring at specific locations, dust sources are generally dispersed. Dispersion modelling of fugitive dust originating at coarse ore stockpile, tailings area, and waste rock disposal facility showed compliance with all applicable ambient air quality objectives.

Gaseous contaminants will be emitted by equipment and power plant diesel engines.

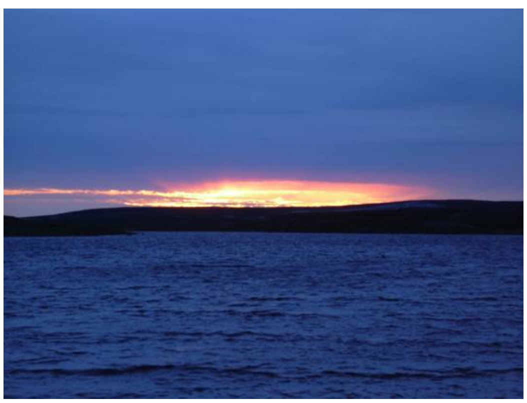
Noise

Anticipated noise levels for the Meadowbank project were modeled using industry standards and the best available prediction models. The model output showed elevated (over 70 dBA) sound levels. The 70 dBA noise level is significant when compared to the low-level baseline noise at the project area; however, it is comparable with noise levels generated by industrial facilities. This estimate is based on a worst-case scenario in which all noise sources simultaneously contribute to the overall noise level. This is an unlikely situation at Meadowbank because noise will be produced in subsequent stages of operation (i.e., blasting, rock braking, and loading at the pit; and crushing, screening, and processing at the process plant). Mitigation measures will protect individuals in these areas.

Surface Water Quantity

Construction of the East and Bay Zone dikes will isolate and eliminate the westernmost and primary connecting channel between Third Portage and Second Portage lakes. Without mitigation, the natural flow outlet may be constrained, causing higher water levels in Third Portage Lake and increased discharge velocity through the remaining two channels, possibly leading to erosion during spring freshet.

Dewatering to create the Portage, Goose, and Vault pits will impact Second Portage, Third



Portage, and Vault lakes, respectively. In particular, movement of 12 Mm^3 of water from Second Portage Lake into Third Portage Lake could increase the average water level of the latter by up to 30 cm, possibly leading to shoreline erosion if discharge occurs in a wet year. The loss in Second Portage Lake (North Portage pit), Third Portage Lake (Portage and Goose pits), and Vault Lake (Vault pit) are temporary, spanning the construction and operational phases only. The loss of the Second Portage North Arm to construction of the tailings impoundment is permanent.

Rewatering will result in an increased size of Third Portage Lake, due to the addition of the Portage and Goose Island pits and impoundment areas. The overall size of Second Portage will be significantly reduced due to the presence of the permanent tailings deposit and loss of the Portage pit area to Third Portage Lake.

The impacts of Phaser Lake diversions to Turn Lake, installation of the Turn Lake culvert, consumptive use of freshwater, and effluent discharge occur at a small scale and will not alter water balance in the project lakes.

Water Quality

Dikes will be constructed to isolate portions of Second Portage, Third Portage, and Vault lakes to allow open pit mining. Construction of the dikes is expected to temporarily alter water quality of the project lakes while they are built. Potential impacts arise from two aspects: lake bed sediments will be disturbed during placement of rock fill in the lake; and soluble constituents of the construction materials (particulates, metals, blast residues) will be released from the surfaces of the construction materials as they are placed into the water. Preferential placement of material with low ARD and metal leaching potential on final surfaces will minimize the impact to geochemistry in the project area.

The tailing and waste rock storage facilities are designed to freeze, which will limit internal drainage as infiltrating runoff becomes frozen. Thermal modelling indicates that the tailings will freeze in time, and that the talik below Second Portage Arm will freeze long before seepage from the tailings impoundment can reach the groundwater below the permafrost.

During mine operation, effluent will be discharged to the receiving environment through Wally Lake from two sources: from Vault Lake attenuation pond to Wally Lake, and from Second Portage attenuation pond to Third Portage Lake north basin. Discharge from the Vault attenuation pond is small (0.08 m^3/s, open water season only) and consists of non-contact runoff, pit inflow water, and seepage from the Vault rock storage facility. No treatment is required, and water quality in Vault Lake is not predicted to exceed CCME (2001) criteria. Effluent discharged from Second Portage attenuation pond after four to five years of operation will consist of contact (runoff collected from potential contaminant sources by ditches) and non-contact water, and is not predicted to adversely affect water quality. After Year 5, this water will be merged with tailings supernatant, grey water, and treated sewage prior to attenuation, and will be treated before discharge to Third Portage Lake. Effluent quality is predicted to be well within MMER guideline concentrations for conventional parameters such as metals and cyanide.

When mining is completed, Portage and Vault pits will gradually be re-flooded with dikes in place to prevent mixing between the pit water and receiving lakes. Dikes will be breached to allow mixing with adjacent lakes once water quality in the pits meets MMER guidelines. There is a moderate potential for exceedance of CCME guidelines during initial mixing, but no long-term adverse impacts are expected.

During the final years of operations, the receiving environment water quality in Third Portage Lake is predicted to diminish slightly over time because of the relatively long residence time of water in the lake and conservative modeling assumptions. At the end of mine life, it is conservatively estimated that cadmium, chromium, and selenium may temporarily exceed CCME (2001) criteria in Third Portage Lake (north and east basin) by nominal amounts (less than two times) and copper by up to four times. These exceedances will diminish over time after closure is complete.

Vegetation Cover

The overall vegetation loss to build Meadowbank is estimated to be approximately 522 ha. The Heath Tundra unit will be subject to the greatest alteration (270 ha; ~8.6% of this habitat available in the LSA). Vegetation in the immediate vicinity of construction sites will receive fugitive dust deposition, primarily in downwind areas.

Wildlife

The primary potential effects of the proposed mine activities on wildlife will be direct and indirect loss of habitat, avoidance of foraging habitat in areas of human activity (i.e., reduced habitat usefulness), deflection from normal travel

routes, potential health risk from drinking contaminated water from the tailings pond, reduced habitat usefulness in areas close to noise and activity, possible injury or mortality from encounters with pits and other mine facilities, mortality due to collisions with vehicles or aircraft, contaminant loading from eating contaminated vegetation, and possible attraction of predators with increased local depredation rates. The domestic waste disposal facility may attract predators (e.g., wolverine) if waste is not properly disposed.

Based on survey information to date, no raptor nesting sites will be impacted due to proposed mine activities. Optimal nesting habitats for breeding raptors are limited in the Meadowbank area due to the absence of cliff topography.

Dewatering of portions of Second Portage and Third Portage lakes will likely have the greatest impact on waterfowl due to habitat loss. Development of the tailings facilities in Second Portage Lake may attract waterfowl to the tailings ponds with elevated levels of contaminated water and ingestion of contaminants from water or emergent vegetation may have adverse effects on the health and reproductive fitness of waterfowl.

Densities of breeding bird species observed during the June 2003 Breeding Bird surveys, indicate that the loss of a total of 522 ha of ecological land classification (ELC) vegetation communities will displace approximately 250 to 270 (1 pair per 2 ha) pairs of Lapland longspurs, 40 to 60 (1 pair per 10 ha) pairs of horned larks, 10 to 20 (1 pair per 35 ha) pairs of rock ptarmigan, 4 to 6 (1 pair per 104 ha) pairs of American pipits, 5 to 10 pairs of semipalmated sandpipers, and minor numbers of other passerine species.

Fish Populations & Habitat

The direct loss of habitat (% lake area) as a result of dike footprints is 0.6% in Third Portage Lake, 1.9% in Second Portage Lake, and 0.1% in Wally Lake. The surface area of the dikes is very small relative to lake area and will have insignificant impacts on lake productivity.

Fish passage between Second and Third Portage lakes will be temporarily affected as a result of the loss of one of three small connecting channels. An existing channel will be enhanced to accommodate typical flow from Third Portage Lake.

Operation of Portage, Goose, and Vault pits, and placement of tailings in Second Portage Lake will result in the effective temporary loss of productive habitat area in portions of Second Portage, Third Portage, and Vault lakes during the life of the mine. Fish will be removed from these areas before they are drained. After the mining is complete, the pits will be flooded. When the water quality is suitable, the dikes will be breached and the fish allowed to return to the newly created habitat.

The use of Second Portage Arm for tailings deposition represents a permanent loss of habitat.

The annual volume of effluent discharged to Wally Lake from the Vault Lake attenuation pond is small, and water quality is not predicted to exceed CCME (2001) criteria in the receiving environment lakes. The annual volume of effluent discharged to Third Portage Lake north basin is relatively uncontaminated prior to Year 5 and is predicted to fall well within MMER guideline concentrations for conventional parameters, metals, and cyanide. After Years 4 to 5, water quality in effluent and Third Portage north basin receiving environment will be treated and will be well within MMER concentrations although as noted above there may be small exceedances in CCME criteria for some metals.

Socioeconomic, Traditional Knowledge & Archaeology

During the 12 to 14 year project life, approximately 350 direct jobs will be created through construction (2 years), and 250 jobs through operations (8 to 10 years), translating into possible direct project wages paid to people in Baker Lake and the rest of the Kivalliq Region of over $3 M annually.

Essential to realizing the positive benefits of increased income is the capacity to manage that income in the interests of the household. Income that is not spent wisely does not generate the anticipated quality of life improvements. There are concerns about the association between increased disposable income and poor lifestyle choices.

The project will not significantly restrict access to, or productivity of lands used for, traditional activity. Project development will not affect traditional land use; however, with respect to potential project employees, there is concern that wage employment is a disincentive to traditional activity and that on-the-job cross-cultural contact may result in undervaluing of traditional ways of life.

The potential positive impacts of rotational employment include reduced cross-cultural contact within communities, time and resources for traditional ways of life, and workforce discipline while on-the-job contributing to long term capacity building. Potential negative impacts can include family stress, family conflict between generations and between spouses, breakdown of traditional values of sharing and mutual support, undervaluing of traditional ways of life, and increased substance abuse.

Project design was adjusted to ensure that heritage resources sites are away from planned infrastructure.

MITIGATION

Permafrost

Mitigation measures (e.g., avoiding ground ice-rich areas) will be taken to reduce the potential for permafrost thawing wherever the potential for interaction between mine facilities or structures exists. For site facilities, foundations will be located in areas of "dry" permafrost, built on suitable substrate to prevent frost damage and to maintain the underlying permafrost.

Air Quality

Some of the primary measures that will be implemented to minimize air quality impacts include: ensuring that all equipment (vehicles and power plant) operates efficiently; imposing vehicle speed limits to reduce fugitive dust; applying dust suppressants; minimizing blasting on windy days; ensuring complete combustion of organic wastes; avoiding fuel spills to avoid release of hydrocarbons; adequately collecting and venting any process emissions and designing the stack using best management practices; installing dust collectors at crushing and grinding facilities; enclosing feed conveyors; and covering dewatered tailings with non-potentially acid generating (non-PAG) aggregates to control wind erosion.

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

Noise

Mitigation measures applicable to all noise sources include: scheduling noisy construction activities during normal working hours to the extent possible; performing regular inspection and maintenance of construction vehicles and equipment to ensure that they have quality mufflers installed and worn parts are replaced; providing an air inlet silencer and exhaust silencers for combustion engines and other units; utilizing noise barriers, baffles or enclosures for particularly noisy equipment; developing a noise monitoring program; enforcing speed limits in relation to road conditions, and location of sensitive receptors such as camp site and important wildlife habitat; maintaining road surfaces in good repair to reduce tire noise; and assuring continuous traffic flow to avoid prolonged idling.

Surface Water Quantity

Potential impacts on surface water will be minimized through a series of measures that include the following: maintaining free-flow through all culverts; grading all disturbed areas to manage and collect runoff in a controlled manner and direct flows to attenuation ponds; diverting clean, non-contact water away from facilities with stable engineered diversion facilities; collecting, containing, and treating any runoff and seepage from rock storage facilities, open pits, and other disturbed areas using attenuation ponds to control rates; pacing rates of treatment plant releases from the tailings facility to match receiving water flows; minimizing closure impacts by decommissioning roads, removing culverts, recontouring and reclaiming disturbed areas to restore natural uninterrupted drainage patterns; and constructing permanent, stable drainage channels where required (e.g., tailings disposal facility, rock storage facilities).

To mitigate the loss of the westernmost connecting channel between Third Portage and Second Portage lakes, one of the remaining channels will be modified to handle increased flows. The new channel will have similar discharge relative to current conditions and improve fish passage to Third Portage Lake.

Instantaneous rewatering of the Vault, Portage, and Goose Island pits could lead to unacceptable drawdowns of Wally and Third Portage lakes. To ensure that drawdowns of these lakes fall within natural water level fluctuations, drawdowns will be occur during spring freshet over a number of years. Consideration is also being given to replacing some of the waste rock at the bottom of the pits, thus reducing the overall volume of water required to rewater the pits.

Water Quality

The water management plan is designed to minimize project impacts on the aquatic ecosystem of the lakes affected by the pits, including Third Portage, Second Portage, Turn, and Wally lakes. As part of the water management plan, infrastructure such as diversion ditches, sumps, and water attenuation facilities will collect and store surface water and groundwater that may have been physically or geochemically affected by mining activities. Water that can be intercepted and directed away from developed areas without contact with project facilities will be controlled by means of natural or constructed diversion channels draining to the neighbouring lakes. Any water that may come into contact with or used in mining activities will be intercepted, contained, analyzed, and if required treated, prior to discharge to the receiving environment.

Vegetation

Mitigation measures for vegetation communities will include: minimizing the footprint of mine facilities and clearly delineating the footprint in order to reduce habitat degradation in surrounding areas; minimizing potential degradation of vegetation by strict adherence to emissions and dust control protocols; constructing a containment berm around fuel storage areas and following hazardous materials handling guidelines; and minimizing the potential for habitat degradation through fugitive dust fall and spills. Where necessary, additional mitigation steps will be taken to facilitate revegetation by scarifying and/or re-contouring surfaces, stabilizing slopes, and restoring natural drainage patterns. Certain facilities will be reclaimed progressively during the life of the mine, such as camps, temporary work space, marshaling yards, waste rock piles, and storage areas. Other facilities will be reclaimed during the closure and post-closure phases of the project.

Wildlife

Important mitigation measures for wildlife include: minimizing blast noises and engine noises; maintaining and ensuring vehicles are properly muffled; establishing speed limits; giving right-of-way on all roads; minimizing the number of take-offs and landings; dust suppression; proper containment of fuel storage areas and explosives; establishing contingency plans (for fires, spills, and explosions); keeping wildlife away from harmful areas; complying with hazardous materials guidelines; establishing environmental awareness programs; incinerating all garbage and foods (domestic waste); enforcing restrictions on hunting; and establishing blasting windows if possible. Upon closure, tailings impoundments will be capped, reclaimed, and made accessible or inaccessible as necessary. Waste rock piles will be capped with non-PAG material, contoured to allow passage of wildlife such as caribou through the site, and revegetated.

To avoid “problem” animals, all domestic waste and garbage will be incinerated, such that no residue remains that is attractive to wildlife.

Domestic waste facilities will be tightly sealed to trap all odors. Care will be taken that aromatic substances (e.g., oil, grease, and paint), and other products (e.g., aerosol cans and batteries) are stored in sealed, bear-proof containers and eventually removed offsite. A safety education program on procedures for dealing with bear-human interactions and avoiding interactions with wildlife in general will be implemented for all personnel.

To avoid dependence of small mammals (e.g., Arctic ground squirrel) on human food, feeding will be prohibited, food will be properly and securely stored, and all food wastes will be incinerated. Whenever possible throughout the life of the mine, an attempt will be made to create habitat for microtone rodents on the slopes of waste rock dumps.

Specific mitigation measures for birds include: minimizing noise levels around active nests; using aversive methods to discourage birds from roosting on the runway and on road edges; deterring shorebirds and waterfowl from utilizing potentially contaminated areas through aversive techniques such as bangers; pumping potentially contaminated water out of pits to a settling area; creating habitat for shorebirds in shoreline and shallow water areas of flooded pits; creating habitat for ptarmigan and passerines on slopes and waste dump areas if substrates are not toxic; ensuring that new lake waters do not contain unacceptable levels of contaminants; and treating contaminated water inputs prior to discharge.

Fish Populations & Habitat

On-site compensation measures for fish habitat and fish populations during mine operation include modification of the external surface of containment dikes, and enhancement and improvement of connecting channels between lakes to facilitate fish movement to increase abundance of Arctic char. On-site compensation measures that are only feasible upon closure include enhancement of dike interiors, creation of shallow reefs and other habitat features within former lake habitat areas, and creation of new lake habitat as a result of flooding of former terrestrial habitat.

At closure, there will be more aquatic habitat created than destroyed. Total moderate- and high-value habitat created at post-closure is approximately 197.86 ha. Combined with operational habitat area, which will continue through post-closure (15.64 ha), the total amount of residual moderate- and high-value habitat is 213.50 ha. This value is higher than the total moderate- and high-value habitat loss of 175.4 ha resulting from major project activities caused by dike construction, dewatering, and development of the Portage pit and tailings disposal facility (39.4 ha), Goose Island pit (62.0 ha) and the Vault pit (74 ha). The main reason for the overall gain in habitat value is that formerly low-value habitat in Second and Third Portage lakes and terrestrial areas (i.e., Goose Island, other small islands, and the peninsula separating the Portage lakes) will become high-value aquatic habitat.

Socioeconomic

Cumberland's current exploration activity is subject to a land use lease benefit agreement with the KIA; however, the primary vehicle for project impact mitigation and benefit enhancement will be the final Inuit Impact and Benefit Agreement (IIBA) to be negotiated between Cumberland and the Kivalliq Inuit Association (KIA). The main objectives of the IIBA will be to:

- mitigate the impacts and enhance the benefits of project development
- create opportunities for the people of Baker Lake specifically and the Kivalliq Region generally to participate in the project, thereby enhancing self-determination
- establish Cumberland's role as an active member of the community and participant in the sustainable development of Baker Lake
- maintain goodwill and good relations with communities and their governments.

Sustainability criteria will be incorporated by emphasizing the need to enable local and territorial participation in employment and business opportunities, training, and partnerships with government and community.

Traditional Knowledge & Archaeology

According to traditional knowledge, historically there has been a lack of human activity in Meadowbank area. Presently, the area is not used by trappers, outfitters, tourist operators, or any other commercial organizations.

Project design was adjusted to ensure that heritage resources sites are away from planned infrastructure.

MONITORING

Permafrost

Ongoing monitoring of the permafrost with existing thermistors will continue and enable comparison with the current baseline data.

Several of the Meadowbank project earth structures will benefit from freezing conditions. During construction, operation, and closure of these facilities, additional thermistor strings will be installed and ground temperatures monitored to ensure predicted geothermal performance is in accord with actual performance.

Air Quality

Air quality monitoring will address one of the most prominent issues for mining projects: the concentration of suspended particle matter in the air surrounding the major areas of activity (dynamic monitoring) and the deposition rate of particles (static monitoring). Dynamic monitoring will be based on high volume air sampling for particulate matter of diameter equal or less than 10 µm (PM_{10}) or total suspended particulate. A monitoring sampler will be deployed at the plant boundary in the direction of prevailing wind away from any taller structures or hills. Static monitoring of dust deposition will follow D1739-98 Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter). This method involves the installation of a dust canister to measure the amount of dust that settles out of the atmosphere by the effect of gravity deposited on a unit area over a certain length of time.

Noise

The ambient noise monitoring program during the construction and operation phase will include full day (day and night) measurements during the first year of development and every second thereafter to determine noise parameters such as the equivalent continuous noise level (Leq) in decibels (dBA); the A-weighted sound pressure level that is exceeded fifty and ninety percent of the time over which a given sound is measured (LA50 and LA90); and frequency noise analysis. Measurements will be taken at noise-sensitive locations where noise levels are likely to be highest.

Surface Water Quantity

The hydrological monitoring program, which includes an on-site meteorological weather station (operational since 1997), as well as monitoring of lake levels, lake outlet discharges, and snow surveys, will be continued during construction, operation, and closure/post-closure. This monitoring program will be effective in documenting changes in lake discharge due to dewatering programs. Runoff quantity from waste dumps, tailings facilities, site infrastructure, and roads will also be monitored.

During pit flooding, hydrological conditions of contributing lakes (e.g., Third Portage and Wally lakes) will be carefully monitored to ensure that withdrawals do not lead to unacceptable water levels in contributing lakes.

A No-Net-Loss Plan will examine how aquatic habitat lost due to the proposed mine activities will be created (or compensated) so that in the end, no habitat has been lost.

Water Quality

Water quality conditions in attenuation ponds will be monitored on a regular basis to treat discharges and ensure that exceedances of water quality guidelines do not occur. Much of the water quality monitoring will be conducted through the Aquatic Effects Management Plan (AEMP) and application of the MMER. Groundwater quality will be monitored from the four monitoring wells located within the three main rock types in the area.

Vegetation & Wildlife

There are four primary targets of the wildlife monitoring program: habitat distribution, wildlife distribution, wildlife abundance, and wildlife health. All of these components will be monitored during the operational life of the mine and during the post-closure phase. An adaptive management approach will be taken to ensure that mitigation actions are as effective and current as possible.

Regular surveys within the local and regional study areas, maintenance of wildlife logs, and in the case of vegetation, ongoing phenology studies at established plots, will monitor habitat and wildlife conditions, distribution, and abundance and distribution. Opportunities to collaborate with other monitoring programs in the region (e.g., Nunavut Department of Sustainable Development) will be investigated.

A primary objective of the wildlife monitoring program will be to assess the success of preventative programs designed to proactively avoid the occurrence of “problem” animals. Wildlife health will be monitored by sampling soil and vegetation (e.g., lichens), which are known to assimilate metals and other substances in their environment, and comparing the samples to pre-development conditions. Risk assessments will be conducted to determine whether contaminant levels in vegetation are unacceptable.

Fish Populations & Habitat

There are three discrete monitoring programs specific to fish habitat and fish populations that have been designed and will be implemented upon initiation of the Meadowbank project. These are: (1) the AEMP, which describes the rationale, framework, strategy, methodology, and scope of management plans to be implemented during mine construction, operation and post-closure in Meadowbank project area receiving environment lakes and streams; (2) A detailed framework document for the application of the federal MMER, including Environmental Effects Monitoring (EEM), that provides a description of required environmental monitoring for effluent and receiving environment chemistry, toxicity testing, benthic community and fisheries surveys; and (3) an NNL framework document that quantifies the area and quality of receiving environment fish habitat that will be harmfully altered, disrupted, or destroyed as a result of mine development and proposes mitigation and/or compensation to ensure no net loss occurs.

Socioeconomic, Traditional Knowledge & Archaeology

The primary objectives of socioeconomic monitoring are to record the uptake of employment, business, and workplace training opportunities over time and analyze the trends in this uptake in relation to expectations and targets; monitor the implementation and effectiveness of education, training, and other community support initiatives; and evaluate the trends in community wellness and the relationship to project operations. Vegetation, water quality and fish health will also be monitored to ensure that fish, caribou and other traditional foods are not affected by mining activities.

RESIDUAL EFFECTS

The only significant residual impacts determined to result from project activities throughout the life of the mine were at a local level, and specifically related to the loss of a large portion of Second Portage Lake. Minor residual effects of the project (i.e., the effects that remain after all efforts to reduce impacts have been carried out) include: (1) change in water movement and surface area of Second Portage Lake because of the tailings deposits and Portage pit; (2) local changes in small mammals, bird, and fish populations due temporary habitat loss; (3) possible short-term increase in metal concentrations in Third Portage Lake; and (4) an increase in fish habitat at the mine site at closure (positive effect).

CLOSURE & DECOMMISSIONING

Cumberland's objective is to ensure that the environment is not unduly influenced after mining operations cease and that any materials that could potentially cause degradation to the land and/or waters of the project are stabilized, removed, and/or mitigated. A mine-decommissioning plan, which is summarized in this EIS, will guide all aspects of operation and ensure compliance with all regulations concerning the environment.

CUMULATIVE EFFECTS

The Meadowbank project is designed to minimize the area of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to post-mining use for traditional pursuits and wildlife habitat. No measurable significant cumulative effects on VECs are expected to occur as a result of the proposed development.

POPULAR SUMMARY

Cumberland Resources Ltd. (Cumberland) is proposing to develop an open pit gold mine on the Meadowbank property, located 70 km north of the Hamlet of Baker Lake. Cumberland has written this Draft Environmental Impact Statement (DEIS) based on guidelines issued by the Nunavut Impact Review Board (NIRB). This report and many others describe the proposed Meadowbank project, the land, the wildlife, and the people. These reports also identify potential effects of the project and the steps Cumberland will take to make sure that the water stays clean, the fish and wildlife stay healthy, and that local people benefit from the project. The information contained in the DEIS and supporting documents will be used by NIRB and other regulators to review the project and determine if additional information is required for the Final Environmental Impact Statement.

The Meadowbank property is located in the Kivalliq Region of Nunavut, approximately 70 km north of the Hamlet of Baker Lake on Inuit-owned surface lands. Cumberland has been actively exploring the Meadowbank area since 1995, and has so far identified deposits of more than 3 million ounces of gold. Meetings with the people of Baker Lake and extensive studies during this time have helped Cumberland to plan the construction and operation of the proposed mine. The economics of the project are sensitive to fuel prices and construction capital costs, both of which are common factors of northern mine development and operations. A feasibility study on the Meadowbank Gold project is expected to be completed in early 2005.

Cumberland has complied with all governmental policies and regulations pertaining to environmental and socioeconomic issues in developing the Meadowbank project, and has an exemplary local employment and safety record over nine years of exploration in Canada's Arctic.

Many alternatives were considered in developing the Meadowbank project, including the "no go alternative." Environmental and economic impacts were important in evaluating the alternatives and deciding the preferred options.

The Meadowbank mine is planned to have a 12- to 14-year project life (this includes 2 years of construction, 8 to 10 years of operations, and 2 years of closure and post-closure activities), during which approximately 350 direct jobs will be created through construction, and 250 jobs through operations. Similar to other gold and diamond mines currently operating in the Arctic, Meadowbank is planned as a "fly-in/fly-out" operation with personnel rotated every several weeks by air transportation. It is estimated that the proposed mine could create 60 to 90 jobs for Baker Lake and Kivalliq region residents during various project phases, depending on the workforce capacity, skill level, and training programs available. It is reasonable to expect that the mine life could be extended as a result of continued exploration.

THE MEADOWBANK PROJECT

More than 3 million ounces of gold has been found in five areas: North Portage, Third Portage, Bay Zone, Goose Island, and the Vault. It is proposed that three open pits be created to remove the gold. Of the three pits, which are called "Portage," "Vault," and "Goose Island," the largest would be Portage. Similar to the diamond mines in the NWT, some of the areas to be mined are under shallow lakes. Dikes, built from rock at the project, will allow lake water to be temporarily removed from these areas to a nearby lake. Mining will take place in the open pits behind the dikes and then at closure, the pits will be re-flooded.

In addition to the pits and dikes, the mine site will consist of a mill for ore processing, accommodations, fuel tank farm, explosives storage area, airstrip, roads, and water and mine rock management facilities. Supplies and equipment for the proposed project will be transported to a newly built barge landing facility and storage area located several kilometres east of the Hamlet of Baker Lake. The storage area will accommodate fuel tanks and other supplies. From Baker Lake, the supplies will be transported along a haulage road to the proposed mine site.

Mine Rock Management

Rock that is removed from the pits but does not contain gold is called “waste rock.” Waste rock will be used to build the dikes, airstrip, roads, and building pads, or safely stored in two separate waste rock storage sites. Rock that contains the gold is called “ore” and will be sent to the mill to be processed to remove the gold. The crushed rock left over from the gold removal process is called “tailings” and will be safely stored in the bottom of a partially drained arm of Second Portage Lake called the “tailings storage area”. The tailings and waste rock storage areas are designed to freeze, preventing any mine rock drainage from occurring. According to detailed thermal modeling, permafrost will develop and remain intact under the most extreme climate change predictions. At mine closure, the frozen piles will be shaped in a natural way and vegetation planted as necessary.

Water Management

Any water that comes in contact with the mine or is used at the site is called “contact water” and will be collected and treated as necessary before being released back to the environment. To keep the amount of contact water as small as possible, ditches and other methods will be used to divert rain, and melting snow away from the mine area. The tailings area will largely provide water for reuse at the process plant. Water will be drawn from Third Portage Lake for use in the accommodations building and for drinking.

Ore Processing

The gold-bearing rock at Meadowbank contains simple and common iron minerals such as pyrite and pyrrhotite. Minerals that can have a negative effect on the environment, such as arsenopyrite, sphalerite, and chalcopyrite, are not present.

The gold-bearing rock from the open pits will be hauled to the process plant where it will be crushed and ground into small pieces. Since gold is heavy, the crushing process will allow some of it to fall away from the rock and be retrieved. To separate the remaining gold from the ore, a mixture of water containing small amounts of cyanide will be used. When all the gold has been separated, it will be melted into gold bars. The remaining water mixture will be treated by a commonly used and accepted process, which will destroy the cyanide before the water is released along with the crushed rock to the tailings rock storage area.

Additional Mine Site & Baker Lake Facilities & Services

Facilities at Meadowbank will include a process plant, power plant, maintenance area, a fuel storage area, accommodations for about 250 people, a large kitchen, water treatment plant, and sewage treatment plant. In Baker Lake, storage areas will be built for fuel, equipment and other supplies.

BASELINE STUDIES

To conduct an environmental assessment of the Meadowbank project, Cumberland studied the rocks, weather, soil, fish, water, vegetation and wildlife, and collected traditional knowledge over a period of 9 years. Features of the land that are most important to people of Baker Lake and Nunavut are called "valued ecosystem components." They were chosen by talking to the people of Baker Lake and the government, and include: permafrost, air quality, noise, surface water quantity, water quality, vegetation cover (plants), ungulates (caribou and muskox), predators (grizzly bear, wolverine, and wolf), small mammals, raptors (hawks and owls), waterfowl (ducks and geese), other breeding birds (singing birds), fish populations, and fish habitat.

Issues concerning the people of Baker Lake and Nunavut are called "valued socioeconomic components." They are: employment (jobs), training and business opportunities, traditional ways of life, individual and community wellness (health), infrastructure and social services (buildings, roads and help for problems), and heritage sites (archaeology sites).

Permafrost

Permafrost, or permanently frozen land, in the area is generally thought to be up to 500 m thick, except near some of the large lakes that do not freeze to the bottom in winter. The surface of the land that melts each year during the summer is usually around 2 to 4 m thick, and is called the "active layer."

Water Quantity

The water levels in lakes and streams around Meadowbank have been measured since 2002, and climate data have been recorded since 1996. The highest water levels occur in the spring when the snow melts. The mine will temporarily affect the amount of water flowing in three lakes: Third Portage Lake, Second Portage Lake, and Vault Lake.

Groundwater occurs in two areas: (1) just below the surface, and (2) deep below the permafrost. Groundwater near the surface of the land flows to small ponds and lakes that sometimes flow into one of the larger lakes. Deep groundwater below the permafrost is sometimes connected by taliks, which are non-frozen areas below lakes.

Water Quality

The quality of surface water in the Meadowbank area is very good because there is little disturbance and there are no large streams that bring sediment into the lakes. There are many different rock types in the Meadowbank area. Groundwater quality differs depending on what type of rock it flows through.

Geochemistry

Cumberland has conducted extensive research on the chemistry of rocks in the Meadowbank area. These studies are necessary to avoid potential water quality problems during construction and operations and are used to design mine structures (such as roads and dikes), as well as the mine rock storage and water management systems.

Vegetation Cover

Vegetation at Meadowbank consists of lichens, mosses, willow and birch shrubs, heaths, herbs, grasses, and sedges. In 1999 and 2002, plant surveys found that the Meadowbank area has many of the same plants found in other areas of the Arctic. No sensitive or rare species of vegetation or habitat were identified.

Wildlife

According to traditional knowledge and conversations with Elders, caribou are not often hunted in the Meadowbank area because it is far from Baker Lake and there is uncertainty as to whether caribou will be present in the area. This has been confirmed by Cumberland during their 10 years of activity in the project area.

The number and location of caribou were studied from airplanes, helicopters, and from the ground in 1999, and between 2002 and 2004. Information on caribou also came from wildlife logs kept at Meadowbank, from the Baker Lake Hunter's and Trapper's Organization, and from Elders. Based on this information, we know that the Meadowbank area is not used as a calving area, but is used in the winter. These caribou come from several herds including the Beverly, Ahiak (Queen Maud), Lorillard, Wager Bay, and possibly the Boothia Peninsula and Qamanirjuaq.

Grizzly bears have only been seen once since 1996, while wolverines, wolves, and ermine are seen once in a while. Animals that are seen almost every day are Arctic fox, Arctic hare, ermine, sik sik, voles, and lemmings.

Birds that are common in summer are the Lapland longspur and horned lark. Ptarmigan are common all year. Peregrine falcon, rough-legged hawk, and gyrfalcon are sometimes seen, but no nests have been found, probably due to the absence of large cliffs. Canada goose, long-tailed duck, and loons are often seen in the summer, but no nests have been found.

Fish Populations & Habitat

Lake trout, Arctic char, and round whitefish are common fish species found in the Meadowbank area. The Arctic char are permanent residents because the St. Clair Falls on the Quoich River acts as a barrier preventing movement from the ocean. Around Baker Lake, fishing occurs all year but mostly in spring and early winter when ice is on the lakes. Lake trout are the most common fish caught. The Elders of Baker Lake have noted that the area around the proposed mine is not often used for fishing, probably because of its distance from Baker Lake.

Fish populations and water quality have been studied in lakes in the Meadowbank area since 1996. Lakes farther away have also been studied to see how they might differ from the lakes closer to Meadowbank. All of the species that have been identified are common and known to occur throughout the Arctic.

Socioeconomic Conditions, Heritage Resources & Traditional Knowledge

In 2001, about 7,500 people lived in the Kivalliq Region in seven towns. The largest town is Rankin Inlet (over 2,200 people) and the smallest is Whale Cove (less than 350 people). Baker Lake, with about 1,500 people, is the only town in the Kivalliq Region not on the ocean.

Compared to the rest of Canada, the unemployment rate in Baker Lake and the Kivalliq Region is extremely high. The government provides most of the jobs in the Kivalliq Region. There are few other jobs available, and most people looking for work often do not have enough education. As a result, family income is declining, which in Baker Lake is already much lower than other communities in the Kivalliq Region.

For most Baker Lake residents, a traditional lifestyle is necessary. Hunting and fishing are used to feed their families and to augment the income for those who are employed.

Baker Lake residents travel through the Meadowbank area on their way to Gjoa Haven or the Back River, a traditional winter hunting and fishing area. Cumberland, with the help of Elders and local Inuit heritage experts, studied the past and present land use in the Meadowbank area in 1999 and 2003. Forty-two sites were recorded during the 1999 survey, and 50 during the 2003 survey. Most of the sites identified (e.g., tent rings, qarmait, hearths, shelters, inuksuit, markers, blinds, caches, storage features, kayak stands, and fox traps) showed signs of recent (less than 50 years old) and temporary human activity. No ancient sites were found. Commercial outfitters and tourists are not known to use the area.

Meetings

Cumberland has held regular meetings in Baker Lake and will continue to meet with local people to talk about the project, collect information on traditional knowledge, and to tell everyone about project developments. These meetings have helped Cumberland plan and design the mine. Cumberland has opened an office in Baker Lake and has appointed a full-time community liaison representative.

Inuit Impact Benefit Agreement

Before construction of the proposed mine begins, a benefit agreement will be negotiated with the Kivalliq Inuit Association (KIA). Currently, Cumberland has a benefit agreement to accompany the exploration land lease. This agreement focuses on jobs, training, local hiring programs, contracting and how Cumberland will continue to consult the people of Baker Lake about the project.

ENVIRONMENTAL MITIGATION & IMPACT AVOIDANCE

Overall, the Meadowbank Gold project will have minor impacts on the existing environment in a regional context and low impacts in a site-specific context. The majority of the project impacts on the environment will be mitigated through project design or by following an effective Environmental Management System (EMS).

Permafrost

Buildings and structures will be placed on suitable ground in areas of “dry” permafrost to minimize the chance of melting the permafrost underneath.

Air Quality

Although the Meadowbank project will create some dust, studies have shown that the quality of air after the proposed mine development has taken place will be acceptable.

Operating equipment, vehicles, and the power plant will affect air quality, but studies have shown that these emissions will be extremely small. Measures taken to maintain air quality will include: keeping equipment running smoothly; enforcing vehicle speed limits to reduce dust; minimizing dust with water sprays; making sure that garbage is burned completely; avoiding fuel spills; collecting exhaust from the mine and venting from a tall, well-designed stack; using dust filters where rocks are being crushed and ground; and covering tailings with clean rock to control wind erosion.

Noise

The noise levels for the proposed mine were modeled using the best technology available. The results showed that noise generated by the mine would be within the acceptable range. Ways to reduce noise include: wearing hearing protection were required, making sure that vehicles are in good shape and that mufflers are working well; providing silencers on exhaust systems; installing noise barriers or enclosing noisy equipment; developing a noise monitoring program; enforcing vehicle speed limits; keeping roads in good shape to reduce tire noise; and making sure vehicles are not left idling.

Surface Water Quantity

Construction of the East and Bay Zone dikes will separate the small channel that connects Third Portage and Second Portage lakes. As a result, water levels in Third Portage Lake may be higher, the water flowing in two small creeks nearby may increase in speed, and erosion of the creek banks may occur. Pumping about 12 million cubic metres of water from Second Portage Lake into Third Portage Lake for pit development could increase the water levels in Third Portage Lake by up to 30 centimetres, which might cause some erosion of shoreline areas in a very wet year.

Some parts of Second Portage, Third Portage, and Vault lakes will be altered for only 8 to 10 years when the Portage and Vault pits are being developed. Altering part of Second Portage Lake for the frozen tailings storage area would be permanent.

When the mine is closed, the size of Third Portage Lake will increase as open pits are flooded. The overall size of Second Portage will be smaller because of the tailings storage area and addition of the Portage Pit area to Third Portage Lake.

Water will be managed by making sure that culverts are working well, runoff in disturbed areas is directed to storage ponds, and runoff from natural areas is directed to lakes. Also, any runoff and seepage from rock piles, open pits, and other disturbed areas will be collected, contained in water storage ponds and treated if necessary before discharge. At closure, the site will be contoured where necessary to restore natural drainage conditions; culverts will be removed; disturbed areas will be reclaimed, and permanent stable drainage channels will be constructed wherever they are needed.

Because the main creek between Third Portage Lake and Second Portage Lake will need to be removed, one of the other two creeks will be increased in size. The new creek will be able to handle the same water flows as the creek that was lost, and will allow more fish to move between the lakes than before the mine was constructed.

Vault, Portage, and Goose Island pits will be refilled with water from Wally and Third Portage lakes. These “draw downs” will happen in the spring when more water is present in the lakes, and will be done slowly so that not too much water is taken out of the lakes at one time.

Water Quality

To protect the quality of the water, comprehensive water and solid waste management plans have been developed. Ditches, sumps, and water storage ponds will collect and store surface water and groundwater from disturbed areas. This water will then be treated before being returned to the lakes. Water that does not come in contact with disturbed areas does not need to be treated and will be directed back into the lakes

The rock storage areas will be built and managed in a proven, conventional way. The rock pile and any associated water will quickly freeze. Studies have shown that the tailings will also freeze before any water can reach groundwater.

During mine operation, water will be released from Vault Lake water storage pond to Wally Lake, and from Second Portage water storage pond to Third Portage Lake. Water released from the Vault pond will be clean and will not need to be treated. Water released from the Second Portage pond in early years of mine operation is also expected to be clean and will not need to be treated. After approximately 5 years of project development, when tailings and grey water will also be included, the water will be cleaned before being released to Third Portage Lake. Although there may be a possible short-term increase in some metal concentrations in Third Portage Lake at closure, this is expected to be temporary.

Vegetation Cover

About 522 ha of vegetation will need to be removed to construct the proposed mine. Wherever and whenever possible, disturbed areas will be reclaimed, replanted, and restored to natural conditions. Dust may also fall on vegetation areas near construction sites, especially in downwind areas. Keeping the mine structures as close together as possible, controlling dust and emissions, and storing fuel safely will reduce impacts to vegetation.

Wildlife

Potential effects to wildlife could include: avoiding the mine site and area, loss of habitat, drinking water

from mine water storage ponds, coming into contact with vehicles or planes, or eating vegetation covered by dust. The garbage area may also attract predators, such as a wolverine, if it is not properly burned.

Hawk and falcon nests have not been found in the Meadowbank area, probably due to the absence of cliffs. The mine will therefore not affect these species. Removing water from Second Portage, Third Portage, and Vault lakes may affect waterfowl because some feeding areas will be lost. Storage ponds with untreated water may be a problem if waterfowl rest on them.

Ways to avoid hurting or disturbing wildlife include: keeping the noise level as low as possible, enforcing speed limits, no hunting policies, giving animals the right-of-way on all roads, keeping dust down, safely storing fuel and explosives, raising the environmental awareness of all employees, keeping animals away from areas that may be harmful, burning all garbage, and not allowing hunting. During closure, tailings and waste rock piles will be capped, reclaimed, replanted, and contoured to allow wildlife to move through the site.

To avoid animals that could create problems, all garbage will be burned. All items with a strong scent that could attract animals will be stored in airtight containers. Small animals will not be fed. A safety education program will be given to all workers to teach them how to deal with bears and to avoid problems with wildlife in general.

Impacts to birds will be reduced by keeping noise down around nests, scaring away birds that land on the airstrip or reclaim ponds, pumping possibly untreated water from pits to a settling area, creating new habitats wherever possible, keeping water quality high in all lakes, and treating mine water before it is directed to clean lakes.

Fish Populations & Habitat

During mine construction and operation, the removal of the one of two creeks between Third Portage Lake and Second Portage Lake may keep fish from moving between the lakes. As well, areas of Second Portage, Third Portage, and Vault lakes that are cut off by dikes to allow mining will temporally prevent fish from using these areas. Fish will be removed from these areas before they are drained. The area of Second Portage Lake where tailings will be stored will not be recovered for fish habitat. No fishing will be allowed by Meadowbank employees.

During the proposed construction and mining activities, important fish areas will be protected by silt curtains and dikes designed as fish habitat. Changing the creek between Third Portage and Second Portage lakes will also allow fish to move more easily between the lakes. After the mining is complete, the pits will be flooded. When the water quality is suitable, the dikes will be breached and the fish allowed to return to the newly created habitat.

It is anticipated that there will be more high value habitat for fish created than was removed because of mine development activities.

Socioeconomic Conditions & Heritage Resources

The project will not change traditional activity or impact heritage resources in the Meadowbank area; however, because 60 to 90 Baker Lake and Kivalliq region residents will have well-paying, full-time jobs, they may not be able to participate as regularly in traditional activities.

People with jobs at the mine will have more money to spend, and will need to manage it carefully.

Rotational employment (two weeks working, followed by two weeks not working) is attractive because of the regular income from work and time off for traditional activities. Some families may have difficulties adjusting to the absence of a family member for two weeks at a time.

Mitigation and management of socioeconomic impacts will be determined by the Inuit Impact and Benefit Agreement (IIBA), which will be negotiated between Cumberland and the Kivalliq Inuit Association (KIA). The main objectives of the IIBA will be to:

- reduce the impacts and increase the benefits of the proposed project development
- create opportunities for the people of Baker Lake specifically, and the Kivalliq Region generally, to participate in the project, thereby enhancing self-determination
- establish Cumberland's role as an active member of the community and participant in the sustainable development of Baker Lake
- maintain goodwill and good relations with the communities and their governments.

Sustainability criteria will be incorporated by emphasizing the need to enable local and territorial participation in employment and business opportunities, training, and partnerships with government and community.

MONITORING

Permafrost

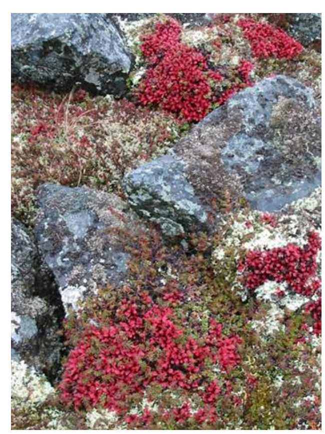
Climate and weather information has been collected at Meadowbank since 1997 and will be collected during all phases of the project. Thermometers buried in the ground allow the temperature of the ground to be monitored. Other instruments will be used to determine whether the tailings and waste rock piles are freezing as predicted.

Air Quality

Air quality will be monitored by assessing the number of particles in the air near the mine and the number of particles that fall to the ground.

Noise

Noise measurements will be taken at locations where noise levels are likely to be the highest.



Surface Water Quantity

Monitoring of lake levels, lake outlet flows, and snow surveys will be continued during all phases of the project. The monitoring program will also continuously monitor runoff quantity from waste rock piles, tailings, mine facilities and roads, and lake levels when water is pumped from one lake to another.

Water Quality

Water quality will be monitored in storage ponds on a regular basis so that it can be treated, if necessary, before it is pumped back to the lakes. Water from the surrounding lakes will be monitored on a regular bases to ensure mitigation measures are working. Groundwater quality will also be monitored from wells located within the different types of rock.

Vegetation & Wildlife

Vegetation and wildlife will be monitored by regularly surveying within the local and regional study areas, keeping wildlife logs, and conducting ongoing studies. Cumberland will cooperate with other monitoring programs in the region.

During construction and operations the health of wildlife will be monitored by sampling soil and vegetation (such as lichens) and comparing the results to samples taken before the mine development.

Fish Populations, Habitat & the Aquatic Environment

There are three monitoring programs for fish habitat and fish populations: (1) the Aquatic Environment Management Plan (AEMP), which describes management plans for lakes and streams for all mine phases; (2) an Environmental Effects Monitoring Plan, as required by the government, which will monitor pollution levels and health of fish; and (3) a No-Net-Loss Plan, which describes how aquatic habitat that is lost because of the mine will be created so that in the end, no habitat has been lost.

Socioeconomic Conditions & Heritage Resources

Opportunities for business, employment, training, and education will be monitored, as will trends in community wellness. Monitoring of vegetation, water quality and fish health will ensure that fish, caribou and other traditional foods are not affected by mining activities.

RESIDUAL EFFECTS

Minor residual effects of the project (i.e., the effects that remain after all efforts to reduce impacts have been carried out) include: (1) change in water movement and surface area of Second Portage Lake because of the tailings deposits and Portage pit; (2) local changes in small mammals, bird, and fish populations due temporary habitat loss; (3) possible short-term increase in metal concentrations in Third Portage Lake; and (4) an increase in fish habitat at the mine site at closure (positive effect).

CUMULATIVE EFFECTS

The Meadowbank project is not expected to cause any significant cumulative effects to valued ecosystem components within the Kivalliq region.

CLOSURE & DECOMMISSIONING

Once the mine is closed, Cumberland will reclaim the disturbed areas so that erosion does not occur, and will contribute to the regrowth of vegetation and return of wildlife. Any rocks or other substances that could pollute the land or waters of the area will be stabilized or removed to avoid long-term impacts. The closure plan will meet or exceed the expectations of the local people and government of Nunavut.

ᐱᓕᕆᐊᕆᔭᐅᓯᒪᔪᑦ ᑎᑎᕋᒃᓯᒪᔪᑦ

ᑲᐳᓚᓐᑯᑦ ᐅᔭᕋᒃᑕᓇᐊᖅᑎᑦ (ᑲᒻᐳᓚᓐ) ᐅᔭᕋᒃᑕᓇᐊᕈᐊᖅᑐᑦ ᓄᓇᐅᑉ ᖃᖓᓂ ᐊᑦᓯᓕᖅᐸᓕᐊᔪᒥᒃ, ᐊᐳᖅᑎᓐᓇᖅᑐᒥ. ᓄᓇ ᐊᐳᖅᑎᓇᖅᑐᒥ ᐅᔭᕋᑕᓇᐊᕕᐅᓯᐊᖅᑐᖅ ᑭᒡᓕᖃᖅᑐᖅ, ᐅᖓᓯᓂᖃᖅᓱᓂ 70 km. ᖃᒪᓂᑑᐊᕐᒥᑦ, ᓄᓇᓗ ᖃᖓ ᓇᒥᓂᕆᔭᐅᔪᖅ ᐃᓄᓂᑦ, ᓄᓇᕗᑦ ᐊᖏᕈᑎᖓ ᐊᑐᖅᓱᒍ. ᑕᑯᐊ ᑲᒻᐳᓚᓐᑯᑦ ᐅᑭᐅᒥ 1995ᒥ ᕿᓂᓇᐊᖅᑐᑦ ᑲᓄᕼᐊᕐᒥᒃ ᐊᐳᖅᑎᓇᖅᑐᒥ, ᓇᓂᓯᓯᒪᓕᖅᑐᑦ ᐅᕐᑯᒪᐃᓂᖃᖅᑐᒥᒃ 3,000,000 ᒥᓕᐊᓐ ozs. ᑕᑯᐊ ᑲᒻᐳᓚᓐᑯᑦ ᑲᑎᒪᖃᑎᖃᖅᑕᖅᓱᑎᒃ ᖃᒪᓂᑑᐊᒥᐅᓂᒃ, ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᐸᒃᓱᑎᒃ ᐸᕐᓇᒃᓯᒪᓕᖅᑐᑦ ᐊᒻᒪᓗ ᐸᕐᓇᒃᐸᓕᐊᑐᐃᓇᖅᓱᑎᒃ, ᓴᓇᕙᓕᐊᓯᐊᓕᒪᑕ ᐅᑯᐃᐸᓕᐊᓯᐊᓕᖅᓱᒍᓗ ᐅᔭᕋᒃᑕᓇᐊᕕᒃᓴᖅ.

ᑲᒻᐳᓚᓐᑯᑦ ᑲᕙᒪᓗᑕᑦ ᐱᕐᑯᔭᔪᐊᕐᑯᑎᖏᓂᒃ ᒪᓕᒃᑐᑦ ᐱᓕᕆᕙᓕᐊᑎᓗᒋᑦ, ᑕᒪᑯᐊ ᐱᕐᑯᔭᐃᓗ ᒪᓕᒐᐃᓗ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐊᑕᒪᑕ, ᐊᒻᒪᓗ ᐃᓄᓯᓕᕆᓂᕐᒧᑦ ᐃᓯᒪᒋᔭᐅᕙᒃᑐᑦ ᐱᓕᕆᐊᕆᑉᓗᒋᑦ. ᑕᒪᒥᒃ ᐃᓯᒪᒋᔭᐅᔪᑦ ᐊᐳᖅᑎᓇᖅᑐᖅ ᐅᔭᕋᑕᓇᐊᕕᒃ ᐱᓕᕆᐊᕆᔭᐅᑎᓗᒍ, ᐱᓕᕆᐊᕆᔭᐅᔪᑦ. ᐅᑭᐅᓂᒃ 9ᓂᒃ ᐱᓕᕆᑎᓗᒋᑦ, ᐊᒥᓱᑦ ᖃᒪᓂᑑᐊᒥᐅᑕᑦ ᐱᓕᕆᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐊᓂᖅᑐᖃᓚᐅᖅᓯᒪᖏᑐᖅ, ᐅᑭᐅᖅᑕᖅᑐᒥ ᑲᒻᐳᓚᓐᑯᑦ ᐱᓕᕆᓯᒪᓕᖅᑎᓗᒋᑦ.

ᑲᒻᐳᓚᓐᑯᑦ ᑲᕙᒪᓗᒃᑕᓂᒃ ᐅᐸᓗᒃᓱᑎᒃ ᓇᓚᒃᑐᑦ, ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐅᔭᕋᒃᑕᓇᐊᕕᒃᓴᖅ ᐸᕐᓇᒍᑕᐅᕙᓕᐊᑎᓗᒍ, ᐅᐱᒍᓱᒃᓱᑎᒃᓗ ᐊᒃᓯᕈᒃᓱᑎᒃᓗ ᐱᓕᕆᖃᑎᖃᖅᑐᑦ ᑲᕙᒪᓗᑕᓂᒃ, ᐅᔭᕋᒃᑕᓇᐊᕐᕕᒃᓴᖅ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᓯᕗᓂᕐᒥ ᐅᑯᐃᕐᑯᑉᓗᒍ ᐊᒃᓯᕈᒃᑐᑦ, ᑭᓯᐊᓂ ᐱᓕᕆᑦᓯᐊᓂᐊᖅᑐᑦ ᒪᓕᓗᑎᒃᓗ ᐱᕐᑯᔭᓗᒃᑕᓂᒃ, ᓄᓇᓗ ᐃᒪᕐᓗ ᐊᕙᑎᓗ ᐱᓕᕆᐊᕆᑦᓯᐊᓗᒍ, ᐊᒃᓯᕈᓂᐊᖅᑐᑦ. ᐊᒻᒪᓗ ᐱᓕᕆᖃᑎᒋᔭᐅᒃᑕᖏᑦ ᐱᓕᕆᖃᑎᒋᓂᐊᖅᑕᖏᑦ ᐅᐱᒍᓱᒃᓱᑎᒃ.

ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᖃᓄᕼᐊᖅᒥᒃ ᐅᔭᕋᒃᑕᓇᐊᕕᒃᓴᖅ, ᒪᓇ ᖃᐅᔨᓴᒐᐅᔪᖅ ᐱᐊᓂᓚᓯᑉᓗᓂᓗ.

ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᐅᔭᕋᒃᑕᓇᐊᕕᐅᓂᐊᖅᑐᖅ ᐃᖏᕋᓇᔭᖅᑐᖅ ᐅᑭᐅᓂᒃ 12-14 ᐊᑯᓂᖓᓂ. (ᒪᕈᒃ ᐅᑭᐅᒃ ᐅᑯᐃᐸᓕᐊᓂᖓᓄᑦ, 8-10 ᐅᑭᐅᑦ ᐅᔭᕋᒃᑕᓇᐊᓂᕐᒧᑦ, ᐊᒻᒪᓗ ᒪᕈᒃ ᐅᑎᐅᒃ ᐅᑯᐊᐸᓕᐊᓂᖓᓄᑦ), ᑕᒪᑯᐊ ᐃᒡᓗᔪᐊᓗᕐᑭᑦ ᓴᓇᔭᐅᕙᓕᐊᓕᖅᐸᑕ 350 ᖃᓂᖓᓂ ᐱᓕᕆᓇᔭᖅᑐᑦ, ᐊᒻᒪᓗ ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐅᑯᐃᖅᐸᑦ 250 ᖃᓂᖓᓂ ᐅᑭᐅᑕᒪᑦ ᐱᓕᕆᓇᔭᖅᑐ. ᐅᑭᐅᖅᑕᖅᑐᒥ ᐊᒥᓱᑦ ᐅᔭᕋᑕᓇᐊᕕᐅᔪᑦ ᐱᓕᕆᑎᑦᓯᓯᒪᑕ, ᐱᓕᕆᓚᐅᓗᑎᒃ ᐊᖏᕋᓚᐅᖅᐸᒃᓱᑎᒃᓗ ᐅᒃᑐᑎᕆᓗᒍ ᒪᕈᓄᑦ ᓴᓇᑕᐃᓕᒃᓄᑦ, ᑕᐃᒪᓇ ᐱᓕᕆᑎᑦᓯᓂᐊᖅᑐᑦ. ᑕᐃᑯᐊ ᐱᓕᕆᔩᑦ ᐅᔭᕋᑕᓇᐊᕕᒃᒧᑦ ᐊᒃᓴᒐᐅᑕᓂᐊᖅᑐᑦ ᑎᖕᒥᓯᑯᑦ. ᐃᓯᒪᓇᖅᑐᖅ ᐱᓕᕆᐊᒃᓴᑦ ᐊᒥᓯᑎᒥᓇᔭᖅᑐᑦ 60-90 ᑲᓂᖓᓂ ᓴᕿᓇᔭᖅᑐᑦ, ᑲᒪᓂᑑᐊᕐᒥᐅᓗ ᑭᕙᓪᓕᕐᒥᐅᓗ ᐱᓕᕆᑎᑕᐅᓇᔭᖅᓱᑎᒃ, ᐱᓕᕆᕙᓕᐊᓕᖅᐸᑕ. ᐱᓕᕆᐊᒃᓴᓗ ᐱᓕᕆᓂᐅᓂᐊᖅᑐᓗ ᓴᕿᓂᐊᕐᑐᑦ, ᑭᓯᐊᓂ ᐃᓯᒪᒋᔭᐅᔭᕆᐊᖃᖅᑐᑦ, ᐱᓕᕆᔪᓇᖅᑐᑦ ᐊᒥᓱᓂᖏ, ᐱᓕᕆᐊᒃᓴᓄᑦ ᐃᓕᓂᐊᖅᓯᒪᓂᖏᓗ ᐊᔪᖏᓂᐅᔪᓗ, ᐊᒻᒪᓗ ᓱᓇᑦ ᐱᓕᕆᐊᒃᓴᑦ ᐃᓕᓂᐊᒐᐅᔪᓗᐊᒪᖓᑕ. ᐃᓯᒪᓇᖅᑐᕐᓗ ᐱᓕᕆᐊᖅᓴᑲᓂᑦ ᓴᕿᑲᓂᕈᓇᖅᑐᑦ ᑲᒻᐳᓚᓐᑯᑦ ᕿᓂᑲᓂᖅᑐᐃᓇᕐᒪᑕ ᑲᓄᕼᐊᖅᒥᒃ ᐊᐳᖅᑎᓐᓇᑐᒥ.

ᑕᒃᑯᐊ ᐅᔭᕋᒃᑕᕆᐊᖅᑎᑦ ᑲᒻᐳᓚᓐᑯᑦ ᑕᕝᓯᒥᖓ, ᑎᑎᕋᒃᓯᒪᔪᒥᒃ ᐊᕙᑎᓕᕆᓂᕐᒥᒃ ᖃᐅᔨᓴᕐᓂᐅᔪᒥᒃ ᑐᓂᔨᓯᒪᓕᖅᑐᑦ ᓄᓇᕗᒥ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ. ᑕᒃᑯᐊ ᓄᓇᕗᒥ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔩᑦ ᑕᕝᓯᒥᖓ ᑎᑎᕋᒃᓯᒪᔪᒥᒃ ᑲᑎᒪᑦᑕᕐᓗᑎᒃ ᐃᓱᒪᓕᐅᕐᓂᐊᕐᑐᑦ, ᐅᔭᕋᕐᑕᕆᐊᕕᓴᖅ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᐅᑯᐃᕋᔭᒪᖓᑦ. ᑕᒻᓇ ᑎᑎᕋᒃᓯᒪᔪᖅ ᐊᓯᖏᓗ, ᑐᑭᓯᓇᖅᓯᒋᐊᖅᓯᒪᔪᖅ ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐅᑯᐃᐸᑦ ᖃᓄᐃᓂᐊᕐᒪᖓᑦ, ᓄᓇᓗ ᖃᓄᖅ ᐊᑐᓚᓂᖓᓗ ᖃᓄᐃᓂᐊᓚᖓᑦ, ᓂᕐᔪᑎᓗ ᐃᓄᐃᓗ ᐊᑐᓂᖏᓗ. ᐅᑯᐊ ᑎᑎᕋᒃᓯᒪᔪᒥ ᐃᓕᑕᕆᔭᐅᓯᒪᓕᒫᑦ, ᐃᓄᓯᖅ ᐊᑐᓚᐅᓂᖓ ᐃᓱᒪᒋᐸᓗᒍ, ᐃᒪᖅ ᓄᓇᒥ ᓴᓗᒪᕐᑯᐸᓗᒍ, ᓂᕐᔪᑎᑦ ᓄᓇᒥ ᓇᒪᕐᑯᐸᓗᒋᑦ, ᐃᓄᓱᒃᑕᓗ ᐃᑲᔪᓂᖅᑲᖅᑯᐸᓗᒋᑦ ᐅᔭᕋᒃᑕᕆᐊᕕᒃᒥᑦ. ᑕᒃᑯᐊ ᑲᒻᐳᓚᓐᑯᑦ ᐅᔭᕋᒃᑕᕆᐊᖅᑎᑦ ᐊᒃᓱᕈᓂᐊᖅᑐᑦ ᑕᒪᑯᓂᖓ.

ᐊᐳᖅᑎᓇᖅᑐᒥ ᐱᓕᕆᐊᕆᔭᐅᓯᒪᔪᑦ

ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᖃᓄᕼᐊᖅ ᐅᖁᒪᐃᑎᒋᔪᖅ 3,000,000 ozs. ᓇᓂᔭᐅᓯᒪᔪᖅ, ᐅᑯᓇᓂ ᕿᑭᖅᑕᓇᕐᒥ, (Goose Island), ᕿᑭᖅᑕᓗᔭᒥ(Bay Zone), ᕿᑭᖅᑕᓗᔭᑉ ᓯᓂᐊᓂ (North Portage), ᕿᑭᖅᑕᐅᑉ ᐊᑦᔪᐊᓂ (Vault Deposit), ᐊᑦᔪᒥᑐᖅ (PDF Showing). ᐊᒥᓱᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᖅᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐱᓕᕆᐊᕆᔭᐅᕙᓕᐊᑎᓗᒍ, ᐃᓱᒪᓇᐅᕐᒥᔪᑦ "ᐅᔭᕋᒃᑕᕆᐊᖏᒥᐊᖅᓕᑦ", ᑭᓱᐊᓂ ᑕᒪᑯᐊ ᐃᓱᒋᔭᐅᓚᐅᖅᑐᑦ. ᓄᓇᓗ, ᐃᒪᕐᓗ, ᐱᕙᓕᐊᓂᕐᓗ, ᐊᒥᓱᓗ ᐊᓯᖏᑦ ᐃᓱᒪᓕᐅᕈᑕᐅᓚᐅᖅᑐᑦ, ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐅᑯᐃᓂᐊᕐᒪᖓ ᐊᖏᖅᑲᑎᓇᑎᒃ.

ᒪᓇ ᐃᓱᒪᓕᐅᕈᑕᐅᓯᒪᓕᖅᑐᖅ ᐱᖓᓱᑦ ᓄᓇᒥ ᐊᑦᓯᓯᕙᓕᐊᔪᑦ ᖃᓄᕼᐊᕐᒥᒃ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᓂᐊᕐᒪᑕ. ᐅᑯᐊ ᐱᖓᓱᑦ ᑲᓄᕼᐊᕐᒥᒃ ᐅᔭᕋᑕᕆᐊᕝᕕᓂᐊᖅᑐᑦ, ᕿᑭᖅᑕᐅᑉ ᐊᑦᔪᐊᓂ (Portage), ᕿᑭᖅᑕᓗᔭᒥ (Goose Island), ᕿᑭᖅᑕᐅᑉ ᐊᑦᔪᐊᓂ (Vault), ᕿᑭᖅᑕᐅᑉ ᐊᑦᔪᐊᓂᖅ ᐊᖓᔾᔪᑎᒋᔪᖅ 5/6 km. ᐊᖏᓂᖅᐸᖑᔪᖅ ᕿᑭᖅᑕᐅᑉ ᐊᔪᐊᓂᖅ(Portage). ᐃᓚᖏᑦ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᐅᔪᑦ ᓄᓇᑦᓯᐊᕐᒥ ᐃᑦᑲᖅᑐᒥ ᐃᒪᕐᒥᒪᑕ, ᐃᓚᖏᑕᐅᖅ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᐅᓂᐊᖅᑐᑦ ᐃᒪᒥᑐᑦ. ᐃᒪᕐᒥᑐᑦ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᐅᓂᐊᖅᑐᑦ ᐃᒪᐃᔭᐅᑕᐅᓗᑎᒃ ᑭᓱᐊᓂ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᐅᓂᐊᖅᑐᑦ. ᐅᔭᕋᓂᒃᓗ, ᑐᐊᐸᒃᓂᒃᓗ, ᓯᐅᕋᓂᒃᓗ ᐊᕙᓗᓕᕐᓗᒍ ᐃᒪᖅ ᓴᐳᒥᔭᐅᓂᐊᖅᑐᖅ. ᐅᔭᕋᒃᑕᕆᐊᓚᓂᒃᑯᒥᒃ ᐅᔭᕋᒃᑕᕆᐊᕐᕕᐅᓚᐅᖅᑐᖅ ᐃᒻᒥᒐᐅᑲᓂᕐᓂᐊᕐᑐᑦ.

ᐅᔭᕋᒃᑕᕆᐊᕝᕕᒃᒥ ᒪᑯᐊ ᓴᓇᔭᐅᓂᐊᖅᑐᑦ, ᓄᓇᒥ ᐊᑦᓯᓕᖅᐸᓕᐊᔪᑦ ᐅᔭᕋᑕᕆᐊᕝᕕᑦ, ᐃᒪᕐᒥᒃ ᓴᐳᒥᕝᕕᑦ ᓯᐅᕋᓂᒃ ᓴᓇᓯᒪᔪᑦ, ᐅᔭᕆᓂᒃ ᓯᕐᑯᐸᑎᕆᕝᕕᒃ ᑲᓄᕼᐊᖅ ᐅᔭᕋᓂᑦ ᐊᑰᔭᐅᑕᓂᐊᕐᒪᑦ, ᐱᓕᕆᕝᕕᒃ ᐃᒡᓗᓴᖏᑦ, ᐅᖅᓱᐊᓗᐃᑦ ᐃᓂᒃᓴᖏᑦ, ᖃᖅᑕᖅᑐᑦ ᓯᕐᓗᐊᒃᓴᖓ, ᑎᖕᒥᓱᑦ ᒥᕝᕕᒃᓴᖓ, ᐊᖅᑯᑎᑦ, ᐃᒪᐃᔭᕐᕕᒃ ᐊᒻᒪᓗ ᐅᔭᕋᓗᓂᒃ ᓴᓂᕋᕝᕕᒃᓴᖅ. ᑕᒪᑯᐊ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᒥ ᐊᑐᖅᓂᐊᕐᒪᑦ ᐱᖁᑎᑦ ᐊᖏᔪᑦ, ᑎᑭᑎᑕᐅᓂᐊᖅᑐᑦ ᖃᒪᓂᑦᑐᐊᕐᒧᑦ ᓯᑲᐅᑯᑦ. ᓯᑲᐅᖅ ᑐᓚᕝᕕᒃᓴᖓ ᓄᑖᖅ ᓴᓇᔭᐅᓂᐊᖅᑐᖅ ᑯᓚᓐ ᓯᓂᐊᓂᓗᓂᑦ ᐅᖓᑕᓂᓗᓂᑦ, ᑕᕙᓂᓗ ᓯᓗᐊᓕᐅᕆᒪᖅᓗᑎᒃ. ᑕᐃᑯᐊ ᓯᕐᓗᐊᖑᓂᐊᖅᑐᑦ ᓴᓇᔭᐅᔪᒪᖅᑐᑦ ᐊᒻᒪᓗ ᖃᑕᐅᔪᐃᑦ ᓴᓇᔭᐅᓂᐊᕐᒥᔪᑦ ᐅᖅᓱᐊᓗᖃᕝᕕᒃᓴᑦ. ᑕᒪᑯᐊ ᐱᖁᑎᑦ ᐅᔭᕋᒃᑕᕆᐊᕝᕕᒃᒥ ᐊᑐᖅᓂᐊᖅᑐᑦ ᑕᒃᐸᐅᖓ ᐊᐳᖅᑎᓐᓇᖅᑐᒧᑦ ᐊᔭᐅᑕᓂᐊᖅᑐᑦ, ᐊᖅᑯᑎᒃᑯᑦ.

ᐅᔭᕋᒃᑕᕆᐊᕝᕕᒃᒥ ᐅᔭᕋᐃᑦ ᐱᓕᕆᐊᕆᔭᐅᓂᖓ

ᐅᔭᕋᒃᑕᕆᐊᕝᕕᒃᒥ ᑲᓄᕼᐊᖅ ᓄᓇᒥᑦ ᐅᔭᕋᑕᕆᐊᓚᐅᓕᖅᐸᑦ ᑕᒪᓇ ᐅᔭᕋᖅ ᑲᓄᕼᐊᖅᑲᖏᖅᑐᖅ ᓯᖁᑉᐸᑎᖅᓯᒪᔪᖅ, ᓯᐅᕋᓗ ᒥᕝᕕᓕᐅᕈᑕᐅᓂᐊᖅᑐᖅ, ᐊᑉᐸᑎᓕᐅᕈᑕᐅᓗᓂᓗ, ᐊᒻᒪᓗ ᐃᒡᓗᔪᐊᑦ ᑐᖓᕕᒃᓴᓇᓂᐊᓚᐃ. ᐃᓚᖏᑦ ᐅᔭᕋᐃᑦ, ᐊᑐᖏᑐᓗ ᐅᔭᕋᐃᑦ, ᓯᐊᕋᒃᓗ, ᓴᓂᕋᖅᑕᐅᓂᐊᖅᑐᑦ ᒪᑐᓄᑦ ᐅᔭᕋᖅᑲᕝᕕᒃᓴᓄᑦ. ᐅᔭᕋᐃᑦ ᑲᓄᕼᐊᖅᑲᖅᑐᑦ ᐊᖑᔭᐅᑕᓂᐊᖅᑐᑦ ᐃᒡᓗᕐᔪᐊᕐᒧᑦ ᐅᔭᕋᓂᒃ ᓯᖁᑉᐸᑎᕝᕕᒃᒧᑦ, ᐱᓕᕆᐊᕆᔭᐅᑕᓂᐊᕐᒪᑕ.

ᐅᔭᕋᐃᑦ ᑲᓇᕼᐊᕐᒥᒃ ᐊᒍᕕᐅᓚᐅᖅᑐᑦ ᐊᑐᓚᖓᒪᑕ ᓴᓂᕙᖅᑕᐅᓗᑎᒃ ᑐᑦᕐᑯᑕᐅᓂᐊᖅᑐᑦ, ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃᑯᑦ. ᐃᓚᖓ ᑕᒻᓇ ᐊᒃᑕᑯᕐᑲᕕᒃ ᑭᓂᐸᓂᐊᖅᑐᖅ, ᑭᓯᐊᓂ ᐅᔭᕋᓗᕐᑲᕕᒃ ᐊᒃᑕᑯ. ᑕᒻᓇ ᐅᔭᕋᓗᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ ᑕᓯᕕᓂᕐᒥ ᐃᒪᐃᔭᖅᓯᒪᔪᒥ ᐊᕐᑭᖅᓯᓯᒪᔪᖅ, ᑕᒻᓇ ᐃᒪᐃᔭᖅᓯᒪᔪᖅ ᑕᓯᐅᑉ ᐊᖏᓂᖅᓴᐅᑉ ᐃᓚᖓ. ᑕᒻᓇᓗ ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ, ᑕᓯᐅᑉ ᐃᓚᖓᓂᖅ ᑭᓯᐊᓂ ᐃᒪᐃᔭᖅᓯᒪᔪᖅ, ᑕᐃᔭᐅᔪᖅ "ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ". ᑕᒪᓇ ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ ᐊᕐᑭᖅᓯᒪᔪᖅ ᐅᑭᐅᒥ ᕐᑭᕐᑭᓕᖅᓇᕐᑯᑉᓗᒍ, ᑕᒪᓇ ᑭᓂᐸᓂᖅ ᐅᔭᕋᒃᑕᕆᐊᕕᒃᒥᑦ ᑯᒃᐸᓕᐊᕐᑯᓇᒍ. ᓯᕗᓂᕐᒥ ᐅᔭᕋᒃᑕᕆᐊᕕᒃ ᐅᒃᑯᐊᖅᐸᑦ, ᑕᑉᓯᒪ ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ ᖃᖓᓂ ᓄᓇ ᐱᕈᒃᐸᓕᐊᓂᐊᖅᑐᖅ.

ᐃᒪᐅᑉ ᐱᓕᕆᐊᕆᔭᐅᓂᖓ

ᐅᔭᕋᒃᑕᕆᐊᕕᒃᒥ ᐃᒪᖅ ᐅᔭᕋᒃᑕᕆᐊᕕᒃᑯᑦ ᐊᒃᑐᖅᓯᒪᔪᖅ ᑕᐃᔭᐅᔪᖅ "ᐃᒪᖅ ᐊᒃᑐᖅᓯᒪᔪᖅ", ᑕᒪ ᐃᒪᖅ ᖃᑎᖅᓯᓚᐅᑐᓂ ᓴᓗᒪᖅᓴᓚᐅᖃᑐᓂ, ᒪᓂᕋᒍᑦ ᐅᑎᖅᑎᑕᐅᓂᐊᖅᑐᖅ ᑯᕕᔭᐅᑐᓂ. ᐅᔭᕋᒃᑕᕆᐊᕕᒃ ᓄᓇᒥ ᐃᑎᖅᓴᖑᓂᐊᓚᑦ, ᐃᒥᕐᑯᓇᒍ ᐊᕙᑕ ᓯᐅᕋᒥᒃᓗ ᑐᐊᐸᒃᓂᒃᓗ ᐊᕐᑭᖅᓯᒪᓂᐊᖅᑐᖅ. ᐅᔭᕋᒃᑕᕆᐊᕕᒃ ᐊᕐᑭᒃᓯᒪᓂᐊᕐᑐᖅ ᑕᒪ ᐃᒪᖅ ᐃᖏᕋᕐᑯᓇᒍ, ᐅᔭᕋᑕᕆᐊᕕᐅᑉ ᐃᓗᐊᓄᑦ. ᐊᒪᓗ ᐃᒪᒥᒃ ᓴᐳᒥᕕᑦ ᓴᓇᔭᐅᓗᑎᒃ, ᑯᓚᓕᐅᖅᓯᒪᔪᓗᑎᒃᓗ. ᑕᐃᒻᓇ ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ ᐃᒪᕐᑲᓂᐊᑐᖅ ᐃᓚᖓ ᑭᓯᐊᓂ ᐃᒪᖅ ᑕᐃᑲᖓᑦ ᐊᑕᓚᐅᑲᓂᖅᑕᕐᓂᐊᖅᑐᖅ ᓴᓗᒪᓴᐃᔪᑕᐅᓗᓂ. ᑭᓯᐊᓂ ᑕᓯᕐᒥᑦ ᐃᒥᖅᑕᖅᑕᕐᓂᐊᖅᑐᑦ ᐱᓕᕆᔩᑦ ᓯᓂᒃᑕᕐᕕᖕᒐᓂᓗ, ᓂᕈᕕᒃᒥᓗ ᐊᑐᒐᒃᓴᒥᒃ.

ᐅᔭᕋᓕᕆᓂᐅᑉ ᐱᓕᕆᐊᕆᔭᐅᓂᖓ

ᐅᔭᕋᒃ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᑲᓇᕼᐊᓕᒃ ᐅᔭᕋᐅᑉ ᐃᓗᐊᓂᑐᖅ, ᑭᓯᐊᓂ ᑲᓇᕼᐊᖃᖏᑐᒥᒃ ᐅᔭᕋᖃᑲᓂᖅᑐᖅ ᐊᓯᖏᓂᒃ, ᐊᑎᖃᑐᓂᒃ ᐸᐃᕋᐃᑦ ᐊᒪᓗ ᐸᐃᕈᑕᐃᑦ. ᑭᓯᐊᓂ ᐅᔭᕋᒃᑕᖃᖏᑐᖅ ᐅᓗᕆᐊᓇᖅᑐᓂᒃ.

ᑕᒪ ᐅᔭᕋᒃ ᑲᓇᕼᐊᓕᒃ ᐊᓪᔭᒐᐅᑕᕐᓂᐊᖅᑐᑦ ᐅᔭᕋᓂᒃ ᓯᕐᑯᑉᑎᕆᕕᒃᑯᑦ, ᓄᓇᑯᕈᑎᑯᑦ. ᓯᕐᑯᑉᑎᒐᐅᓗᓂ ᐃᑯᒪᓄᖅᑐᓄᑦ ᒥᑭᓕᖅᑎᑕᐅᑕᓂᐊᖅᑐᑦ. ᑕᒪ ᐅᔭᕋᒃ ᓯᕐᑯᑉᑎᒐᐅᑎᓗᒍ ᑲᓇᕼᐊᖅ ᐅᕐᑯᒪᐃᓇᒥ ᑲᑕᒐᓕᕋᖓᑦ ᑲᑎᖅᓯᒐᐅᑕᕐᓂᐊᖅᑐᑦ. ᐅᔭᕋᐃᑦ ᑲᓇᕼᐊᖃᖅᑐᐃᓇᖅᑐᑦ ᑯᑐᐊᕐᕕᐅᓗᑎᒃ ᐃᒪᒥᒃ ᐃᓚᓯᒪᔪᒥᒃ ᓴᐃᔭᓇᐃᒥᒃ, ᖃᑎᖅᓯᒐᐅᑐᐃᓇᖅᓂᐊᖅᑐᖅ. ᑭᓯᐊᓂ ᐃᒪᖅ ᓴᐃᔭᓇᐃᓕᒃ ᐊᕐᑭᓯᖅᑕᐅᓯᒪᔪᖅ ᑕᒪ ᓴᐃᔭᓇᐃᑦ ᒥᑭᔪᓐᖑᓂᐊᕐᒪᑦ. ᑕᒪ ᑲᓇᕼᐊᖅ ᐅᔭᕋᖃᕈᓂᖅᑐᖅ ᐊᐅᒃᑎᑕᐅᓗᓂ ᐃᖅᑐᐊᑐᓇᖑᓕᖅᑎᓗᒋᑦ ᐊᕐᑭᒪᐅᓂᐊᖅᑐᑦ. ᐃᒪᖅ ᐊᑐᒐᐅᓚᐅᕐᑐᖅ ᓴᐃᔭᓇᐃᓕᒃ ᑲᑎᖅᓯᒐᐅᓗᓂ ᓴᓗᒪᓴᒐᐅᓂᐊᖅᑐᖅ, ᐊᑐᒐᐅᓯᖅᑐᑐᖅᑲᒥᒃ ᓴᓗᒪᖅᓴᐃᓂᕐᒥᒃ. ᑕᒪ ᓴᐃᔭᓇᐃᑦ ᓯᕐᑯᑉᑎᒐᐅᓂᐊᖅᑐᖅ, ᐃᒪᒥᑦ ᐊᒪᓗ ᑕᒪ ᐃᒪᖅ ᓴᓗᒪᖅᓴᒐᐅᓯᒪᔪᖅ ᑯᕕᔭᐅᓂᐊᖅᑐᖅ, ᐅᔭᕋᓄᑦ ᑲᑎᖅᓱᐃᕕᒃᑯᑦ.

ᐊᓯᖕᒋᑦ ᐅᔭᕋᒃᑕᓇᐊᕕᑦ, ᖃᒪᓂ'ᑐᐊᒥᓗ ᐱᕐᑯᑎᖃᕕᒃ, ᐊᒪᓗ ᐅᔭᕋᒃᑕᓇᐊᖅᑎᑦ ᐱᕐᑯᑎᖕᒋᑦ

ᑕᒪᑯᐊ ᐅᔭᕋᒃᑕᓇᐊᖅᑎᑦ ᐃᒡᓗᔪᐊᕐᑯᑎᖕᒋᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ, ᒪᑯᐊᖕᒍᓂᐊᖅᑐᑦ, ᐅᔭᕋᓂᒃ ᓯᕐᑯᑉᑎᓇᕕᒃ, ᐃᑯᒪᖃᐅᑎᖃᕕᒃ, ᓄᓇᑯᕈᑎᓄᑦ ᓴᓇᕕᒃ, ᐅᖅᓱᐊᓗᖃᕕᒃ, ᐃᒡᓗᔪᐊᖅ ᐃᓄᖃᕈᓇᖅᑐᖅ 250 ᐱᓕᕆᔩᓂᒃ, ᓂᕆᕕᒃᔪᐊᖅ, ᐃᒪᒥᒃ ᓴᓗᒪᖅᓴᐃᕕᒃ, ᐊᒪᓗ ᐃᒪᐃᔭᐃᔭᕐᕕ. ᖃᒪᓂ'ᑐᐊᒥᓕ ᓯᕐᓗᐊᓕᐅᓂᐊᖅᑐᑦ ᑕᒪᑯᐊ ᐅᔭᕋᒃᑕᓇᐊᖅᑎᑦ ᐱᕐᑯᑎᖕᒋᑦ ᐅᖅᓱᐊᓗᐃᓗ ᐃᓗᐊᓂᑕᓂᐊᕐᒪᑕ.

ᖃᐅᔨᓴᒐᐅᓂᑯᑦ

ᑕᒪ ᓄᓇᓗ, ᐃᒪᕐᓗ ᐊᕙᑎᓗ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᖃᐅᔨᓴᒐᐅᓂᖕᒐ ᑲᒻᐳᓚᓐᑯᓂᑦ ᐱᓕᕆᐊᕆᔭᐅᒥᔪᖅ. ᐊᒥᓯᑦ ᖃᐅᔨᓴᒐᐅᔪᑦ ᒪᑯᐊ, ᐅᔭᕋᐃᑦ, ᓯᓚ, ᓄᓇ, ᐃᖃᓗᐃᑦ, ᐃᒪᖅ, ᓄᓇᒥ ᐱᕈᕐᓯᒪᔪᑦ, ᐊᒪᓗ ᓂᕐᔪᑎᑦ. ᐊᒪᓗ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᑐᖃᖕᒋᑦ ᐱᖅᑯᓯᑐᖃᖕᒋᑦ ᖃᐅᔨᓴᒐᐅᓚᐅᒥᔪᑦ. ᑕᒪ ᖃᐅᔨᓴᕐᓂᖅ ᐱᓕᕆᐊᕆᔭᐅᓚᐅᖅᑐᖅ ᐅᑭᐅᓂᒃ 9ᓂᒃ. ᑕᒪᑯᐊ ᓄᓇᐃᑦ ᐃᓄᓗᒃᑕᑦ ᓄᓇᕗᒥᐅᓗ ᖃᐅᔨᒪᔭᖕᒋᑦ ᐃᑉᓕᕆᔭᖕᒋᓗ ᑕᐃᔭᐅᔪᑦ "ᓄᓇᐃᑦ ᐃᑉᓕᕆᔭᐅᔪᑦ". ᑕᒪᑯᐊ ᓄᓇᐃᑦ ᐊᓯᖕᒋᓗ ᐃᑉᓕᕆᔭᐅᔪᑦ ᖃᒪᓂ'ᑐᐊᕐᒥᐅᓂᑦ, ᑲᕙᒪᑯᓂᑦᓗ, ᖃᐅᔨᓴᒐᒃᓴᐅᑉᓗᑎᒃ ᓇᓗᓇᕈᓂᓚᐅᖅᑐᑦ ᒪᑯᐊᖕᒍᑉᓗᑎᒃᓗ; ᓄᓇᐃᑦ ᐃᓗᐊᓂ ᕿᕿᓂᐅᔪᑦ, ᐊᓄᕆᓗ ᓯᓚᓗ ᓇᒪᓂᖕᒐ, ᑐᓴᓇᖅᑐ ᓱᓇᒥᐊᑦ, ᐃᒪᕐᓗ ᑕᓯᓗ, ᓄᓇᒥ ᐱᕈᒃᓯᒪᔪᑦ, ᑐᒃᑐᓗ ᐅᒥᒃᒪᐃᓗ, ᐊᒃᓚᐃᑦ, ᖃᕝᕕᑦ, ᐅᒪᓗ ᐊᒪᕈᐃᑦ, ᓂᕐᔪᑎᑦ ᒥᑭᔪᑦ, ᑭᒃᒐᕕᑦ ᐊᒪᓗ ᐅᒃᐱᑦ, ᐃᒪᒥᐅᑕᑦ ᑎᖕᒥᐊᑦ ᐊᑎᒋᖕᒋᑐᑦ, ᖁᐸᓄᐊᑦ, ᐃᖃᓗᐃ ᐊᒥᓯᓂᖕᒋᑦ, ᐊᒪᓗ ᐃᖃᓗᖃᕕᑦ.

ᑕᒪᑯᐊᓕ ᖃᒪᓂ'ᑐᐊᒥᐅᑦ ᐃᓱᒪᒋᔭᐃ ᐊᒥᓯᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᐊᒪᓗ ᑕᐃᔭᐅᑉᓗᑎᒃ; "ᐃᑉᓕᕆᔭᐅᔪᑦ ᐃᓄᓯᓕᕆᓂᕐᒍᑦᓗ ᐱᕙᓕᐊᓂᕐᒍᓗ ᐊᑕᔪᑦ". ᒪᑯᐊ ᐃᓱᒪᓕᐅᕈᑕᐅᑉᓗᑎᒃᓗ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒥᔪᑦ; ᐱᓕᕆᐊᒃᓴᑦ, ᐃᓕᓂᐊᒐᒃᓴᓗ ᓇᒥᓂᖃᖅᑐᓗ ᐱᕙᓕᐊᔪᑎᒃᓴᖕᒋᑦ, ᐃᓄᓯᑐᖃᖅᓗ ᐃᓕᕐᑯᓯᑐᖃᓂᕐᓗ, ᐃᓄᐃᓗ ᓄᓇᓕᓗ ᐃᓱᒪᖃᑦᓯᐊᓂᖕᒐᓗ ᑎᒥᖃᑦᓯᐊᓂᖕᒐᓗ ᓴᓇᔭᐅᕙᓕᐊᔪᑦ ᐃᒡᓗᔪᐊᓴᑦ ᐊᑉᕐᑯᑎᒃᓴᑦᓗ, ᐊᒪᓗ ᓄᓇᒥ ᐃᑦᓴᓂᑕᑦ ᓄᓇᑐᖃᐃᑦ.

ᓄᓇᐅᑉ ᖃᖕᒐᓂ ᐅᔭᕋᐃᑦ

ᐅᔪᕈᓯᔪᐃᑦᓗ ᑐᐊᑉᖃᓂᐅᔪᓗ ᓄᓇᐅᑉ ᖃᒐᓂ ᐃᖕᒋᕋᑉᓗᑎᒃ ᐊᕐᑭᓯᒪᒪᑕ ᖃᒐᓴᖅ ᓯᑯ ᐃᖕᒋᕋᑎᓗᒍ ᐅᑎᐅᑦ ᐊᒥᓯᑦ ᑭᖕᒍᓂᕐᒥ. ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᖅ ᓄᓇᒥ ᐅᔭᕋᓯᔪᐃᓗ ᑐᐊᐸᐃᓗ ᓄᓇᐅᑉ ᖃᖕᒐᓂᑦ ᐃᑎᑎᕆᒪᑕ 3 m. ᑭᓯᐊᓂᑉᑕᐅᖅ ᐃᓚᖕᒐᓂ ᐃᑎᑎᕆᔪᑦ 10 m.

ᓄᓇ ᕿᕿᓂᖕᒐ

ᓄᓇ ᕿᕿᓂᖕᒐ ᐅᕙᓗᓂᑦ ᕿᕿᖕᒐᐃᓇᖅᑐᖅ ᓄᓇ, ᓄᓇᐅᑉ ᖃᖕᒐᓂᑦ ᐱᕆᐊᕐᓗᒍ ᐃᑉᔪᑎᕆᓯᕆᔭᐅᔪᖅ 500 m. ᑭᓯᐊᓂ ᐃᒪᐃᓗ ᑕᓯᑦᓗ ᐊᓗᐊᓂ ᓴᓂᕐᓴᐅᔪᑦ, ᐃᓚᖕᒐᑦ ᐃᒪᐃᑦ ᕿᕿᓕᔪᐃᑐᒪᑕ ᓯᑯᑉ ᐊᑕᓂ ᐅᑭᐅᒥ.

ᓄᓇᐅᑉ ᖃᖕᒐ ᐊᐅᔭᒥ ᐊᐅᒃᐸᑐᖅ ᑕᒪ ᐊᐅᒃᑕᖅᓂᖕᒐ ᐃᑉᔪᑎᕆᔪᖅ 2 - 4 m. ᖃᓂᖕᒐᓂ, ᑕᒪᓇᓗ ᑕᐃᔭᐅᑉᓗᓂ "ᓄᓇᐅᑉ ᖃᖕᒐᓂ ᐅᐊᔪᖅ"

ᐃᒪᐅᑉᓗ ᑕᓯᓗ ᐊᖏᓂᖓ

ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᐊᔪᕿᑦᑕᕆᐊᕕᐅᓂᐊᖅᑐᒥ ᐊᕙᑕᓂ ᐃᒪᖅᓗ ᑕᓯᓗ, ᑯᒐᐃᓗ ᖃᐅᔨᓴᒐᐅᓯᒪᓕᖅᑐᑦ, ᐱᒋᐊᕐᓗᑎᒃ ᐅᑭᐅᒥ 2002ᒥ. ᐊᒪᓗ ᓯᓚᓗ, ᓯᓚᑉᓗ ᐊᐅᒃᐸᓕᐊᑎᑦᓯᓂᖓᓗ ᕿᕿᓕᖅᑎᑦᓯᓂᖓᓗ ᖃᐅᔨᓴᒐᐅᓯᒪᒥᔪᖅ ᐱᒋᐊᕐᓗᑎᒃ ᐅᑭᐅᒥ 1996ᒥ. ᑕᒪᓇ ᐊᐳᑎᓗ ᓯᑯᑉᓗ ᐊᐅᒃᐸᓕᐊᓂᖓ ᐃᒪᖑᖅᐸᓕᐊᓂᖓ ᖃᐅᔨᓴᒐᐅᑎᓗᒍ ᓄᓇ ᐃᒪᖃᔪᐊᓂᖅᓴᐅᓯᓯᖅᑐᖅ ᐊᐅᒃᐸᓕᐊᓕᕆᖓᑦ ᐅᐱᖓᓴᒥ, ᐊᐳᑦ ᐊᐅᒃᐸᓕᐊᓕᕆᖓᑦ. ᐊᐳᖅᑐᓐᓇᖅᑐᒥ ᐅᔪᕿᑦᑕᕆᐊᕕᒃ ᐃᖏᕆᓕᖅᐸᑦ ᐱᖓᓱᑦ ᑕᓯᑦ ᐊᖏᓕᖅᑕᓂᐊᖅᑐᑦ ᐅᑯᐊ, ᐱᖓᔪᐊᑦ ᑕᓯᖅ (Third Portage Lake) ᑐᓪᓕᐊ ᑕᓯᖅ (Second Portage Lake), ᐊᑦᒍᒥᑐᖅ ᑕᓯᖅ ᐅᖓᓯᑎᒋᔪᖅ 5 - 6 km. ᑕᑯᓇᖓ ᑕᓯᕐᓂᑦ (Vault Lake).

ᒪᓂᕋᒥ ᐃᒪᖅ ᑭᓂᐸᓂᖅ ᒪᕈᓂᒃ ᑯᒃᑕᓕᐊᒪᑎᒃ ᓯᕙᓕᖅ ᑯᓂᖅ (1) ᓄᓇᐅᑉ ᐊᑕᓂᑦ ᐱᖃᑕ ᑯᓂᖅ (2) ᕿᕿᔪᖅ ᓄᓇᐅᑉ ᐊᑕᓂᑦ. ᑕᒪᓇ ᓄᓇᒥ ᐊᐅᒃᐸᓕᐊᓂᑯ ᑯᒃᐸᓕᐊᒪᑦ ᐃᒪᕐᓗᓴᓄᓗ, ᒥᑭᔪᓄᓗ ᑕᓯᕐᓄᑦ, ᐃᓚᖏᑦ ᑕᓯᓄᑦ ᐊᖏᓂᖅᓴᓄᑦ. ᓄᓇᐅᑉ ᐃᓗᐊᓂ ᐃᒪᖃᒥᔪᖅ ᑕᒪᑯᐊᓕ ᐊᑕᑐᕋᐅᑐᑦ, ᐃᓚᖏᑦ ᑕᓯᑦ ᐊᑕᓂ.

ᐃᒪᐅᑉ ᐃᒪᑦᓴᐅᓂᖓ

ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᓴᓂᐊᓂᓗ ᐊᕙᑕᓂᓗ ᐃᒪᖅ ᐃᒪᑦᓯᐊᖅ ᓴᓗᒪᔪᖅ ᑲᑭᐊᑐᖅ. ᓴᓗᒪᔪᖅ ᑕᒪᓇ ᓄᓇ ᐅᐊᔭᐅᖏᓇᒥ ᐱᓕᕆᐊᕆᔭᐅᖏᓇᒥᓗ, ᐊᒪᓗ ᑯᒐᒡᔪᐊᖅᑲᖏᓇᒥ ᐃᓚᓂᒃ ᑕᒪᑯᐊ ᑯᒐᐃᑦ ᑲᑭᓕᖅᑎᑎᑦᓯᓴᒪᑕ. ᐊᒥᓯᓗ ᐅᔪᕿᐃᑦ ᐊᑎᒋᖏᑐᑦ ᒪᓂᕋᒥᑐᑦ. ᑕᒪᓇ ᐃᒪᕐᐅᑉ ᓴᓗᒪᓂᖓ ᐊᑎᒋᖏᓂᖅᑐᖅ ᐅᔪᕿᐃᑦ ᐊᑯᓂᖓᒍᒪᑕ.

ᓄᓇᐅᑉ ᐊᑎᒋᖏᓂᖓ

ᑕᑯᐊ ᐅᔪᕿᒃᑕᕆᐊᓂᐊᖅᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᑲᒻᐳᓚᓐᑯᑦ ᖃᐅᔨᓴᓚᐅᕐᒪᑕ ᓄᓇᒥᒃ ᐅᔪᕿᓂᒃᓗ ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᐊᕙᑕᓂ. ᑕᒪᓇ ᖃᐅᔨᓴᓂᐅᔪᓇᐊᖅᑲᓚᐅᖅᑐᖅ ᐃᒪᖅ ᓴᓗᒪᕐᑯᑉᓗᒍ ᑕᒪᓇᓗ ᖃᐅᔨᓴᓂᖅ ᐸᕐᓇᒍᑕᐅᕙᓕᐊᑉᓗᓂ ᐅᔪᕿᒃᑕᕆᐊᕕᒃᓴᒥᒃ. ᑕᒪᑯᐊ ᐊᑉᕐᑯᑎᓗ, ᐃᒪᕐᒥᒃᓗ ᓴᐳᒥᕕᑦ, ᓴᓇᔪᐅᑎᓗᒥᑦ, ᐅᔪᕿᓂᒃᓗ ᖃᑎᖅᓯᕐᕕᑦ, ᑕᓯᓗ ᐃᒪᕐᓗ ᓴᓗᒪᕐᑯᑉᓗᒋᑦ.

ᓄᓇᐅᑉ ᖃᖓᓂ ᐱᕈᒃᓯᒪᔪᑦ

ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᓄᓇᐅᑉ ᖃᖓᓂ ᐱᕈᒃᓯᒪᔪᑦ ᒪᑯᐊᖑᔪᑦ; ᐅᔭᖃᑦ ᖃᖓᓂ ᐱᕈᒃᓯᒪᔪᑦ, ᐃᑉᔪᖅ, ᐊᕙᓇᕿᐊᑦ, ᐅᖅᐱᑦ, ᐊᑎᒋᖏᑐᑦ ᐱᕈᒃᓯᐊᑦ, ᐃᕕᑦ, ᐊᒪᓗ ᐊᑎᒋᖏᑐᑦ ᓄᓇ ᐱᕐᑯᓂᖓ. ᐅᑭᐅᒥ 1999ᒥ ᐊᒪ 2002ᒥ ᓄᓇ ᖃᐅᔨᓴᖅᑕᐅᑎᓗᒍ ᑕᒪᑯᐊ ᓄᓇᐅᑉ ᖃᖓᓂ ᐱᕈᒃᓯᒪᔪᑦ, ᑕᑯᒃᓴᐅᔪᑦ ᓇᓂᓗᒃᑕᖅ ᐅᑭᐅᖅᑕᖅᑐᒥ. ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᓴᓂᐊᓂᓗ ᐊᕙᑕᓂᓗ ᑕᒪᑯᐊ ᐱᕈᒃᓯᒪᔪᑦ ᐊᓯᕈᑎᑕᐅᑕᐃᓕᔪᑦ ᑕᑯᓇᓚᐅᖏᑐᑦ.

ᓂᕐᔪᑎᑦᓗ ᐅᒪᔪᓗ

ᑕᒪᑯᐊ ᐃᓄᑐᖃᐃᑦ ᐅᖃᓗᕕᐅᑕᖅᑎᓗᒋᑦ ᐊᒪᓗ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᒪᓕᒃᓱᒋᑦ ᐊᐳᑎᓐᓇᖅᑐᑉ ᓴᓂᐊᓂ ᑐᒃᑐᓕᐊᕐᔪᐊᔪᐃᑐᑦ ᖃᒪᓂᑑᐊᒥᐅᑦ, ᐅᖓᓯᓗᐊᕐᒪᑦ. ᐊᒪᓗ ᑐᒃᑐᖃᓂᐊᒪᖕᖓᑦ ᐅᖓᓯᓗᐊᕐᒥ ᓇᓗᓇᕐᒪᑦ. ᑕᒪᓇ ᑐᑭᓯᔭᐅᑎᓚᐅᖅᑐᖅ ᑲᒻᐳᓚᓐᑯᓂᑦ ᑐᒃᑐᖃᓗᐊᔪᐃᑐᓂᖕᖓᓂᒃ ᐅᑭᐅᓂᒃ 10 ᐱᓕᕆᓕᕐᒪᑕ.

ᑕᒪᑯᐊ ᑐᒃᑐᐃᑦ ᓇᓂᓂᖏ ᐊᒪᓗ ᐊᒥᓱᓂᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᑎᖕᒥᓱᑯᑦ, Hᐊᓕᑲᑉᑐᑯᑦ, ᐊᒪᓗ ᐱᓱᒃᐸᒃᓱᑎᒃ ᖃᐅᔨᓴᖅᑎᑦ. ᑕᒪᑯᐊ ᑐᒃᑐᐃᑦ ᖃᐃᔨᓴᖅᑕᐅᓚᐅᖅᑐᑦ ᐅᑭᐅᒥ 1999ᒥ, ᐊᒪᓗ 2002 - 2004 ᐊᑯᓂᖕᖓᓂ. ᑕᒪᑯᐊᓗ ᑐᒃᑐᐃᑦ ᑕᑯᔭᐅᑕᓂᑯᖏᑦ ᑎᑎᕋᑕᐅᓯᒪᔪᑦ ᓂᕐᔪᑎᓂᒃ ᖃᐅᔨᓴᖅᑎᐅᔪᓂᑦ, ᐊᒪᓗ ᐊᖑᓇᓱᒃᑎᑦ ᑎᑎᕋᕕᖕᖓᓂᑦ, ᐊᒪᓗ ᐃᓄᑐᖃᓂᑦ. ᑕᒪᑯᐊ ᖃᐅᔨᓴᓂᑯᑦ ᓂᕐᔪᑎᓂᒃ ᐊᑐᖅᓱᒋᑦ ᐊᐳᑎᓐᓇᖅᑐᑉ ᓴᓂᐊᓂ ᑐᒃᑐᓄᑦ ᓄᓇᕕᐅᖕᒋᑐᖅ ᑭᓯᐊᓂ ᐅᑭᐅᒥ ᑕᐅᓱᖓ ᑕᑯᓇᖅᐸᒃᑐᑦ. ᑕᐃᑯᐊ ᑐᒃᑐᑦ ᑕᐸᓂ ᑕᑯᓇᖅᐸᒃᑐᑦ ᓄᓇᓂᑦ ᐅᑯᓇᓂ ᑎᑭᑕᕈᕆᔭᐅᔪᑦ; ᑎᑉᔭᓕᒃᒥᑦ (Beverly), ᐊᓯᐊᒥᑦ (Queen Maud), ᐅᑯᓯᒃᓴᓕᐅᑉ ᓴᓂᐊᓂᑦ ᐊᒪᓗ ᐊᑉᒍᐊᓂᑦ (Lorillard & Wager Bay), ᐊᒪᓗ ᕿᕿᖅᑕᓂᑦ ᐊᑦᒍᒥᑦ (Boothia Peninsula) ᐊᒪᓗ ᖃᒪᓂᕐᔪᐊᒃᒥᑦ (Qamairjuaq).

ᐊᒃᓴᑦ ᑕᑯᔭᐅᓚᐅᖅᓯᒪᔪᑦ ᐊᑕᐅᓯᖅᓱᑎᒃ ᐅᑭᐅᒥ 1996ᒥ, ᑭᓯᐊᓂᓕ ᐃᓚᓂᒃ ᑕᑯᓇᖅᐸᒃᑐᑦ ᑎᓇᐊᑦ, ᖃᕝᕕᑦ, ᐊᒪᕈᓗ. ᐅᑉᓗᑕᒪᑦ ᑕᑯᔭᐅᓲᑦ ᐅᑯᐊ ᓂᕐᔪᑎᑦ; ᑎᓇᖕᖓᓂᐊᑦ, ᐅᑲᓕᑦ, ᑎᓇᐊᑦ, ᓯᒃᓯᒃ, ᐊᕕᖕᖓᑦ, ᐊᒪᓗ ᐅᒡᔪᓇᑦ.

ᐅᐱᖕᖓᒥᓕ ᖁᐸᓄᐊᑦ ᑕᑯᓇᕋᔪᒃᑐᑦ ᐅᑯᐊ; ᖁᐸᓄᐊᑦ, ᑐᑦᓕᑦ. ᐊᕿᒡᒍ ᐅᑭᐅᓗᒃᑕᖅ ᑕᑯᓇᖅᐸᒃᑐᑦ. ᑭᒡᒐᕕᑦ, ᑭᒡᒐᕕᐊᕋᑦ, ᑕᑯᔭᐅᕙᒃᒥᔪᑦ, ᑭᓯᐊᓂ ᒪᓂᖃᕕᖕᖏᑦ ᑕᑯᓇᑕᖕᖏᑐᑦ, ᓄᓇᐅᑉ ᒪᓂᓗᐊᓂᖕᖓᓄᑦ ᐃᒪᖃ. ᐊᐅᔭᒥᓕ ᑎᖕᒥᐊᑦ ᐊᑎᕆᖕᖏᑐᑦ ᑕᑯᒃᓴᐅᕙᒃᑐᑦ, ᑭᓯᐊᓂ ᒪᓂᖃᕕᖕᖏᑦ ᑕᑯᓇᔪᐃᑐᑦ. ᐊᒪᓗ ᖃᖅᓴᐅᑦ ᑕᑯᒃᓴᐅᕆᒥᔪᑦ ᐊᐅᔭᒥ, ᑭᓯᐊᓂᑉᑕᐅᖅ ᒪᓂᖃᕕᖕᖏᑦ ᑕᑯᔭᐅᓯᒪᖕᖏᑐᑦ.

ᐃᖃᓗᐃᑦ ᖃᐅᔨᓴᒐᐅᓂᖏᑦ

ᐃᑦᓲᕋᑦ, ᐃᖃᓗᒃᐱᑦ, ᑲᕕᓯᓕᑦ, ᑕᓯᕐᓂ ᖃᐅᔨᒪᔭᐅᔪᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᑕᓯᖕᒥᓂ. ᑕᑯᐊ ᐃᖃᓗᒃᐱᑦ ᑕᕆᓂᖕᖓᐃᓇᖅᓂᐊᑐᑦ ᑲᒡᕕᐅᑉ ᑯᒥᓂᖕᖓᒍᑦ ᐊᓂᒍᓂᖅ ᐊᔪᕋᒥᒃ. ᖃᒪᓂᑑᐊᒥᐅᑦ ᐃᖃᓕᐊᓗᐊᖅᐸᒃᑐᑦ ᐅᐱᖕᖓᓴᖅᐸᓕᐊᓕᕋᖕᖓᑦ ᐊᐅᒃᐸᓕᐊᓕᕋᖕᖓᑦ, ᐅᑭᐊᒃᓵᒥᓗ ᓯᑯ ᕿᕿᓕᓴᕋᖕᖓᑦ. ᑭᓯᐊᓂ ᐅᑭᐅᓗᒃᑕᖅ ᐃᖃᓕᐊᖅᐸᑐᑦ. ᑕᑯᐊ ᐃᓲᕋᑦ ᐊᒥᓱᓂᖅᓴᑦ ᐃᖃᓗᓂᑦ ᐃᖃᓕᐊᐸᒃᑐᓂᑦ ᖃᐅᔨᒪᔪᑦ. ᐃᓄᑐᖃᐃᑦ ᐅᖁᑐᖅᓯᒪᔪᑦ ᑕᕝᕙᓂ ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᓴᓂᐊᓂ ᐃᖃᓕᐊᓗᐊᖅᑐᖃᔪᐃᑐᒪᑦ ᐅᖓᓯᓂᖕᖓᓄᑦ, ᖃᒪᓂᑑᐊᕐᒥᑦ.

ᐃᖃᓗᐃᑦ ᐊᒥᓱᓂᖕᒋᒍ ᐃᒪᐅᑉᓗ ᓇᒪᓂᖕᒐ ᖃᐅᔨᓴᐅᓯᒪᔪᖅ ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᓴᓂᐊᓂᒍ ᐊᕙᑕᓂᒍ, ᖃᐅᔨᓴᕆᐊᖅᓱᑎᒃ ᐅᑎᐅᒥ 1996ᒥ. ᐊᐳᖅᑎᓐᓇᖅᑐᑉ ᐊᕙᑕᓂ ᑕᓯᑦ ᐅᖓᓯᒃᑐᑦ ᖃᐅᔨᓴᓚᐅᑕᐅᕐᒥᔪᑦ, ᖃᓄᖅ ᐊᓚᐅᒍᐊᖅᑎᒋᒪᖔᑕ ᐅᔭᕋᒃᑕᓇᐊᕕᐅᓂᐊᖅᑐᑉ ᓴᓂᐊᓂ. ᑕᐃᒃᑯᐊ ᐃᒪᕐᒥᐅᑕᒍᒃᑕᑦ ᐊᑎᒋᒥᐊᑐᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ.

ᐃᓅᓯᑕᓇᓂᕐᒍ, ᐃᑕᕐᑯᓯᖃᓂᕐᒍ, ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᒍ

ᐅᑭᐅᒥ 2001ᒥ, ᐃᓄᒍᒃᑕᑦ ᑭᕙᓕᕐᒥᐅᑕᑦ ᐊᒥᓱᑎᒋᓕᐅᖅᑐᑦ 7500 ᖃᓂᖕᒐᓂ, ᒪᕈᓂᒃᑯ ᓄᓇᓕᑦ (7) ᑭᕙᓕᕐᒥ. ᑭᕙᓕᕐᒥ ᓄᓇᓕᒃ ᐊᖏᓂᖅᐸᖅ ᖃᖏᖅᓯᓂᖅ (ᐃᓄᓕᒃ 2200 ᐅᖓᑕᓂ), ᐊᒪᓗ ᒥᑭᓂᖅᐸᖅ ᓄᓇᓕᒃ ᑎᑭᕋᔪᐊᖅ (350 ᐃᓄᓕᒃ ᖃᓂᖕᒐᓂ). ᖃᒪᓂᑦᑐᐊᕐᒥ ᐃᓄᒍᒃᑕᑦ ᐊᒥᓱᓂᖕᒋ 1500 ᖃᓂᖕᒐᓂ, ᐊᒪᓗ ᑕᒪ ᓄᓇᓕᒃ ᑕᓇᐅᒥᒃ ᐊᒃᑐᐊᖕᒋᑐᖅ.

ᑲᓇᑕᒧᒃᑕᖅ ᑕᐅᑐᒃᑯᒍ, ᐱᓕᕆᖕᒋᑐᑦ ᖃᒪᓂᑦᑐᐊᕐᒥ ᑭᕙᑦᓕᕐᒥᒍ ᐊᒥᓱᒍᐊᖅᑐᑦ. ᑭᕙᓕᕐᒥᐅᑕᑦ ᐱᓕᕆᔪᑦ ᑲᕙᒪᑯᓂ ᐊᒥᓱᓂᖅᓴᑦ. ᑭᓯᐊᓂ ᐃᓚᖏᑦ ᐱᓕᕆᔫᓗᐃᑦ, ᐊᒥᓯᖏᑐᑦ, ᐃᓚᖏᒍ ᐱᓕᕆᓯᐊᖅᑐᓗᒍᐃᑦ ᐃᓕᓂᐊᖅᓯᒪᖏᓂᕐᒧᑦ ᐱᓕᕆᐊᖅᑕᓂᖅ ᐊᔪᖅᑐᑦ. ᑕᒪᒃᑯᐊ ᕿᑐᖕᒐᓇᑦ ᑭᓇᐅᔭᓕᐅᕐᓂᖏᑦ ᒥᑭᓕᖅᐸᓕᐊᔪᑦ ᐊᒪᓗ ᑭᓇᐅᔭᓕᐅᕐᓂᑦ ᒥᑎᓂᖅᐸᑦ ᑭᕙᓕᕐᒥ, ᐊᒥᓯᑦ ᐱᓕᕆᖏᒪᑕ.

ᖃᒪᓂᑦᑐᐊᕐᒥᐅᑦ ᐊᒥᓯᑦ ᐱᓕᕆᑉᓗᑎᒃᑯ, ᒪᖃᐃᑉᓗᑎᒃᑯ ᐃᓄᔪᑦ, ᕿᑐᖕᒐᖏᒍ ᓄᑕᕋᐃᒍ ᓂᕿᖅᑲᑕᕐᓂᐊᕐᒪᑕ. ᑐᒃᑐᓕᐊᓗᑎᒃᑯ, ᐃᖃᓕᐊᓗᑎᒃᑯ ᒪᖃᐃᑕᖅᑐᑦ, ᐱᓕᕆᖕᒋᓕᕋᖕᓚᒥᒃ, ᕿᑐᖕᒐᖏᑦ ᓂᖃᖃᓂᐊᕐᒪᑕ.

ᖃᒪᓂᑦᑐᐊᕐᒥᐅᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᑯᑦ ᐊᑉᖁᓴᔪᔪᑦ ᐅᖅᓯᖅᑐᒧᑦ ᑐᔪᕐᒥᐅᓂᐊᖅᑎᓗᒋᑦ, ᐅᕙᓗᓂᑦ ᓴᓂᖕᒐᓯᒧᑦ ᒪᖃᐃᓂᐊᖅᑎᓗᒋᑦ. ᓴᓂᖕᒐᔪᕐᒍ ᒪᖃᐃᕕᑐᖃᖅ ᑐᒃᑐᓄᑦ ᐃᖃᓗᒃᓄᒍ. ᐅᑭᐅᒥ 1999ᒥ ᐊᒪᓗ 2003ᒥᒍ ᑕᑯᐊ ᑲᒻᐸᓚᓐᑯᑦ ᖃᐅᔨᓴᓚᐅᖅᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᒥᒃ, ᖃᓄᖅ ᑭᖑᓂᕐᒥ ᐊᒪᓗ ᒪᓇᒍ ᐊᑐᕐᓂᖃᓚᐅᕐᒪᖔᑦ. ᐊᐱᖅᓱᕈᑕᓚᐅᖅᑐᑦ ᐃᓄᑐᖃᐃᑦ ᐊᒪᓗ ᐃᑦᓴᓂᑕᓕᓇᕌᑐᖃᑦ ᐃᓄᐃᑦ. ᐅᑭᐅᒥ 1999ᒥ ᐊᒥᓯᑎᒋᔪᑦ 42 ᓄᓇᐃᑦ ᐊᑐᓚᐅᔪᑐᖃᐅᕙᒃᑐᑦ ᑎᑎᕋᒃᑕᐅᓚᐅᖅᑐᑦ ᓄᓇᖑᐊᕐᓄᑦ. ᑕᐃᒪᑉᑕᐅᖅ ᐅᑭᐅᒥ 2003ᒥ ᐊᒥᓯᑎᒋᔪᑦ 50 ᒪᖃᐃᕕᑐᖃᐃᑦ ᑎᑎᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᓄᓇᖑᐊᕐᓄᑦ. ᑕᒪᒃᑯᐊ ᖃᐅᔨᓴᕐᓂᑯᑦ ᓄᓇᖑᐊᓄᑦ ᑎᑎᕋᖅᑕᐅᕙᒃᓱᑎᒃ ᒪᓄᐊᖑᔪᑦ; ᑐᐱᕐᕕᑯᓂᑦ, ᖃᕐᒪᐃᑦ, ᑭᒃᓗᑯᓂᑦ, ᐅᖁᐊᑦ, ᐃᓄᒃᓱᐃᑦ, ᓇᓗᓇᐃᑯᑕᐃᑦ, ᐃᔨᖅᓯᒪᕕᑦ, ᐱᕈᔭᖅᕕᑦ, ᓱᓇᑐᐃᓇᓂᒃ ᐱᕈᕕᑦ, ᖃᔭᖅᕕᑦ, ᐊᒪᓗ ᑎᓇᖕᓚᓂᐊᓄᑦ ᓴᐳᒥᕕᑦ. ᑕᒪᑯᐊᒍ ᐅᑭᐅᓂᒃ 50 ᑭᖑᓂᕐᒥᑦ ᒪᓇᒧᑦ ᐊᑐᓚᐅᓂᑯᑦ ᓄᓇᒥ, ᓄᓇᖑᐊᕐᓄᑦ ᑎᑎᖅᑕᐅᓚᐅᕐᒥᔪᑦ. ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐊᑐᓚᐅᓯᐃᑐᖅ ᑭᓇᐅᔭᓴᕙᒃᑐᓄᑦ ᑐᒃᑐᓕᐊᕐᐸᑐᓄᑦ, ᐃᖃᓕᐊᕐᐸᒃᑐᓄᒍ, ᐃᓚᖏᑦ ᐃᓄᐃᑦ ᒪᖃᐃᑎᑦᓯᓯᒪᑕ ᖃᑉᓗᓇᓂᒃ, ᑭᓯᐊᓂ ᑕᕙᓐᓇ ᐊᑐᔪᐃᑦ.

ᑲᑎᒪᓂᖅ

ᑕᑯᐊ ᑲᒻᐸᓚᓐᑯᑦ ᖃᒪᓂᑦᑐᐊᕐᒥᐅᓂᒃ ᑲᑎᒪᑎᑦᓯᕙᒃᑐᑦ, ᑲᑎᒪᑎᑦᓯᕙᒃᑐᐃᓇᕐᓗᑎᒃ. ᑲᑎᒪᑎᑦᓯᔭᕋᖕᓚᒥᒃ ᑐᓴᖅᑎᑦᓯᕙᒃᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᐱᕙᓕᐊᔪᓂᒃ. ᐃᓚᓂᒃ ᑲᑎᒪᔪᓄᑦ ᑲᑎᒪᔭᖅᑐᕐᓗᑎᒃ, ᐊᒪᓗ ᐃᓚᓂᒃ ᑎᑎᖅᑲᑎᒍᑦ ᑐᓴᒃᓴᕐᑎᒍᑦ ᐱᕙᓕᐊᔪᓂᒃ ᑐᓴᖅᑎᑦᓯᕙᒃᓱᑎᒃ. ᐃᓚᓂᒃ ᖃᑎᖅᓯᐃᑉᓗᑎᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᓐᓂᒃ, ᐱᕙᓕᐊᔪᓂᒃᑯ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᑐᓴᖅᑎᑦᓯᕙᒃᓱᑎᒃ.

ᑕᒪᑯᐊ ᑲᑎᒪᓂᐅᔪᑦ ᐃᑲᔪᕐᓂᖅᑐᑦ ᐅᔭᕋᒃᑕᕆᐊᕕᒃᓴᖅ ᐊᐳᖅᑎᓇᖅᑐᖅ ᐸᕐᓇᒍᑕᐅᑎᓗᒍ. ᑕᑯᐊᓗ ᑲᒻᐳᓚᓐᑯᑦ ᑎᑎᕋᕕᖅᑲᓕᖅᑐᑦ ᖃᒪᓂᑑᐊᕐᒥ ᑐᓴᖅᑎᑦᓯᔾᔨᒥᒃ ᐃᖅᑲᔪᖅᑎᒥᒃᓗ ᐱᓕᕆᔩᖅᑲᖅᓱᑎᒃ ᖃᒪᓂᑑᐊᒥᐅᑕᕐᑭᒥᒃ.

ᐅᔭᕋᒃᑕᕆᐊᓂᒥᑦ ᐃᓄᐃᑦ ᐃᑲᔪᒐᐅᓂᖓᑦ ᐊᖏᕈᑎᓂ

ᐊᐳᖅᑎᓇᖅᑐᕐᒥ ᐅᔭᕋᒃᑕᕆᐊᕕᒃ ᓴᓇᔭᐅᖅᑲᖅᑎᓐᓇᒍ, ᖃᓄᖅ ᐃᓄᐃᑦ ᐃᑲᔪᒐᐅᓂᐊᕐᒪᖔᑕ ᐊᖏᕈᑦ ᐱᓕᕆᐊᕆᔭᐅᓕᐊᖅᑐᖅ, ᑭᕙᓪᓕᖅ ᐃᓄᐃᒃ ᑲᑐᔾᔨᖃᑎᒋᒃᑯᓂᒍ (KIA) ᑲᒻᐳᓚᓐᑯᓂᒍ. ᒪᓇ ᑲᒻᐳᓚᓐᑯᒍ ᑭᕙᓪᓕᕐᒥ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖃᑎᒋᒃᑯᒍ ᐊᖏᕈᑎᖃᖅᑐᑦ ᖃᓄᖅ ᐃᓄᐃᑦ ᐃᑲᔪᒐᐅᓂᐊᕐᒪᖔᑕ ᐊᒪᓗ ᑲᒻᐳᓚᓐᑯᑦ ᓚᐃᓴᖃᖅᑐᑦ ᓄᓇᒥᒃ ᐊᑐᕐᑐᐊᓂᕐᒥᒃ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ. ᖃᓄᖅ ᐃᓄᐃᑦ ᐃᑲᔪᖅᑕᐅᓂᐊᕐᒪᖔᑕ ᐊᖏᕈᒥ ᐅᔩᓇᓗᐊᖅᑐᖅ ᒪᑯᐊ; ᐱᓕᕆᐊᒃᓴᑦ, ᐃᓕᓂᐊᕐᓂᖅ, ᖃᒪᓂᑑᐊᕐᒥᐅᑦ ᐱᓕᕆᓂᖅᓴᐅᑎᓗᒋᑦ ᐅᔭᕋᒃᑕᕆᐊᕕᒃᒥ ᐊᒪᓗ ᖃᒪᓂᑑᐊᕐᒥᐅᑦ ᐊᐱᕆᔭᐅᑕᓂᐊᖅᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐱᓕᕆᐊᕆᔭᐅᑎᓗᒍ, ᑐᓴᖅᑎᑕᐅᑕᓗᑎᒃᓗ.

ᓄᓇᒥᒃᓗ ᐃᒪᕐᒥᒃᓗ ᐊᕙᑎᓗᒃᑕᒥᒃᓗ ᐊᓯᕈᐃᓗᐊᑎᑦᓯᑕᐃᓕᓂᖅ

ᑕᒪᐃᓂᒃ ᓄᓇᒥᒃᓗ ᐃᒪᖅᒥᒃᓗ ᐊᐳᖅᑎᓐᓇᑐᑉ ᐊᕙᑕᓂ ᐊᓯᕈᐃᓗᐊᓚᖏᑐᑦ ᐅᔭᕋᒃᑕᐊᖅᑎᓗᒋᑦ. ᐅᔭᕋᒃᑕᐊᐱᓗᐊᕕᒃᒥᓗ ᐊᓯᕈᐃᓗᐊᓚᖏᑐᑦ ᓄᓇᒥᒃ. ᓄᓇᓗ ᐃᒪᕐᓗ ᐊᓯᕈᓗᐊᓚᖏᑐᑦ ᐅᔭᕋᕐᑕᕆᐊᕕᒃ ᐸᕐᓇᒃᓯᒪᑦᓯᐊᐸᑦ ᐅᕙᓗᓂᑦ ᒪᓕᑦᓯᐊᕐᐸᑦ ᐊᕙᑎᓕᕆᓂᕐᒥᒃ ᐊᐅᓚᑦᓯᓂᖅ ᐊᕿᓯᒪᔪᓂᒃ.

ᓄᓇᐅᑉ ᕿᕿᓂᖓ

ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᐃᒡᓗᔪᐃᑦ ᓴᓇᔭᐅᒥᐊᖅᐸᑕ ᑐᖓᕕᒥᓂᐊᑕᖏᑦ ᐊᕿᑦᓯᐊᓗᐅᓂᐊᖅᑐᑦ, ᓄᓇᐅᑉ ᐃᓗᐊᓂ ᕿᕿᔪᑐᖃᖅ ᐊᐅᑉᐸᓕᐊᕐᑯᓇᒍ.

ᐊᓄᕆ ᐊᓯᕈᑕᐃᓕᓂᖓ

ᐅᔭᕋᒃᑕᐊᓕᖅᐸᑕ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᓯᐅᕋᒃ ᐳᔪᖅᑲᑕᓂᐊᖑᒐᓗᐊᖅ, ᑭᓯᐊᓂ ᖃᐅᔨᓴᓂᑯᓂ ᑐᑭᓯᓇᖅᑐᖅ ᐊᓄᕆ ᓇᒪᒃᑐᐃᓇᓂᐊᕐᒪᑦ.

ᓄᓇᑯᕈᑎᔪᐃᓗ, ᓄᓇᑯᕈᑎᓗ, ᐃᑯᒪᖅᑲᐅᑎᖅᑲᕕᒃᓗ ᐳᔪᖅᑲᑕᖅᑎᑦᓯᓂᐊᖅᑐᒐᓗᐃᑦ, ᑭᓯᐊᓂ ᖃᐅᔨᓴᓂᖅ ᑕᐅᑐᒃᑯᒍ ᑐᑭᓯᓇᖅᑐᖅ ᐳᔪᓗᐊᓚᖏᑐᖅ. ᑕᒪᓇ ᐳᔪᕐᓂᖅ ᓇᒪᕐᑯᑉᓗᒍ ᒪᑯᐊ ᐊᕿᓯᒪᓂᐊᖅᑐᑦ; ᓄᓇᑯᕈᑎᑦ ᐊᐅᓚᑦᓯᐊᓂᐊᕐᒪᑕ ᓴᓇᓯᒪᑦᓯᐊᓗᑎᒃ, ᓄᓇᑯᕈᑎᑦ ᓇᑭᖅᓴᓂᖔᕐᒥᑦ ᐊᕿᓯᒪᓗᑎᒃ, ᐳᔪᓗᐊᓕᕋᖕᒐᑦ ᐃᒪᒥᒃ ᑎᖕᒥᖅᑲᖅᑎᓯᓗᑎᒃ, ᐊᒃᑕᑯᑦ ᐃᑯᐊᓚᒃᑎᑦᓯᐊᓗᒥᑦ, ᐅᖅᓯᐃᑦ ᑯᕕᑕᐃᓕᓗᒥᑦ, ᐃᒡᓗᓂ ᐃᒐᓕᑦ ᑕᑭᑎᓗᒥᑦ ᐊᒪᓗ ᑕᒪ ᐃᕼᐃᖅ ᖃᑎᖅᓯᓚᐅᓗᓂ ᐃᒐᓕᕐᓂᑦ, ᐊᒪᓗ ᐅᔭᕋᓂᒃ ᓯᕐᑯᑉᑎᕐᕕᒃ ᐳᔪᓗᐊᕐᑕᐃᓕᔪᑎᓂᒃ ᓴᓇᓯᒪᓗᑎᒃ, ᐊᒪᓗ ᐅᔭᕋᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᒃ ᑕᓗᕆᒃᓗᒍ ᑐᐊᐸᒃᓂᒃᓗ ᐅᔭᕋᓂᒃᓗ, ᐊᓄᕆ ᐊᓯᕈᐃᓯᒪᑦ.

ᑐᓴᓇᓂᕐᒧ ᓂᐱᕐᑲᓂᕐᒧ

ᑕᒪ ᓂᐱᕐᑯᑐᒧᐊᓂᖅ ᐱᓕᕆᕕᒃᒥ ᐅᕙᕋᒃᑕᕆᐊᕕᒃᒥ, ᐊᕐᑭᓚᐅᖅᑐᖅ ᑕᒪᑯᐊ ᐱᓕᕆᔪᑎᑦ ᓴᓇᔭᐅᑦᓯᐊᖅᓯᒪᔪᑦ ᐊᑐᕐᒧᒥᑦ. ᑕᒪ ᐊᕐᑭᓯᒐᐅᑎᒧᒍ ᐅᔭᕋᑕᕆᐊᕕᐅᑉ ᓂᐱᕐᑯᑐᓂᖓ ᓇᒪᓂᐊᖅᑐᖅ. ᐅᔭᕋᑕᕆᐊᕕᒃ ᓂᐱᕐᑯᑐᕐᑯᓇᒍ ᒪᑯᐊ ᐊᕐᑭᓯᒪᓂᐊᕐᑐᑦ; ᓄᓇᑯᕈᑎᒧᒃᑕᑦ ᓴᓇᓯᒪᑦᓯᐊᒧᑎᒃ ᐃᓚᓕᖏᒧ ᐊᕐᑭᓯᒪᑦᓯᐊᕐᒧᑎᒃ, ᓄᓇᑯᕈᑎᒧ ᐃᓚᓕᖏᑦ ᓂᐱᕐᑯᑐᒧᐊᖏᔪᑎᓂᒃ ᐃᓕᓇᓯᒪᒧᑎᒃ, ᓂᐱᕐᑯᑐᒧᐊᑐᓂᒃ ᓴᐳᒥᕕᑦ ᐊᒪᒧ ᐃᑯᒪᐃᑦ ᓂᐱᕐᑯᑐᒧᐊᖅᑐᑦ ᐃᒻᒧᔪᐃᒧᓂᑦ ᐃᒧᐊᓂᑎᑎᐅᒧᑎᒃ, ᐱᓕᕆᐊᕆᒧᑎᑦ ᖃᓄᖅ ᑕᒪ ᓂᐱᕐᑯᑐᒧᐊᕐᓂᖅ ᑲᒪᒋᔭᐅᓂᐊᕐᒪᖔᑦ. ᓄᓇᑯᕈᑎᑦ ᓇᑭᓂᖏᑦ ᐊᕐᑭᓯᒪᒧᑎᑦ, ᐊᒪᒧ ᐊᑦᕐᑯᑎᑦ ᐊᑦᕐᑭᓯᒪᑦᓯᐊᕐᒧᑎᑦ ᓄᓇᕐᑯᕈᑎᑦ ᐊᒃᓴᒧᐊᖏᑦ ᓂᐱᕐᑯᑐᒧᐊᓂᐊᖏᒪᑕ, ᐊᒪᒧ ᓄᓇᕐᑯᕈᑎᑦ ᓄᕐᑲᓚᔪᑦ ᐃᑯᒪᖏᑦ ᐊᐅᓚᖅᑎᑕᐅᑕᖏᒧᑎᑦ.

ᐃᒪᕐᑯᑐᓂᖔ

ᐅᔭᕋᒃᑕᕆᐊᕕᒧᐊᕕᒃᒥ ᐊᕙᒧᕐᑲᓂᐊᕐᒪᑦ, ᑕᒪᓇᒧ ᐊᕙᒧ ᓴᐳᒥᒪᑦ ᐃᒪᒥᒃ, ᑭᓯᐊᓂ ᑕᒪ ᓴᐳᒥᕕᒃ ᓇᑲᑦᓯᓂᐊᖅ ᑲᖏᕐᑲᒧᒥᒃ. ᑭᓯᐊᓂ ᖃᖏᕐᑲᒧᑉ ᐃᓚᖔ ᓴᐳᒥᔭᐅᓂᖅᓴᐅᔪᑉ ᐃᒪᕐᑯᑐᓕᖅᑕᓂᐊᖅᑐᖅ ᒪᕈᓂᒃ ᑯᓚᓇᕐᑲᕐᒥ. ᑕᑯᐊᒃ ᑯᓚᓇᒃ ᑯᒥᒃᓂᐊᓕᖅᑐᒃ. ᑐᑯᐊᒃᒧ ᑯᓚᓇᒃ ᑯᒥᓂᖔᓄᑦ, ᐊᖏᓕᓚᔭᕐᓂᐊᖅᑐᒃ. ᑕᒪ ᐃᒪᖅ ᖃᖏᕐᑲᒧᒥ ᐃᖏᕋᑐᐃᓇᕐᓂᐊᕐᒪᑦ, ᐃᒪᖅ ᐃᖏᕋᔪᖅ 12,000,000 cu.mtrs. ᐊᖏᑎᒋᔪᖅ. ᑲᖏᕐᑲᒧᑉ ᐃᓚᖔᓂ ᓇᕐᑲᓯᒪᔪᒥ ᐃᒪᕐᑯᑐᓂᖅᓴᐅᓂᐊᕐᑐᖅ ᐃᑎᓕᕐᑲᓂᕐᒧᓂ 30 centimeters. ᑕᒪ ᐃᑎᓕᑲᓂᕐᓂᖔ ᓯᔭᒥᒃ ᐊᓚᖑᖅᑎᑦᓯᒥᓇᓄᐊᓕᒃ, ᐊᓚᖑᒧᐊᖏᒧᒍ, ᑭᓯᐊᓂ ᐊᐅᔭᒥ ᓂᐸᒧᓚᔪᒧᐊᖅᐸᑦ.

ᑕᑯᐊ ᐅᔭᕋᒃᑕᕆᐊᕕᑦ ᐱᖔᓯᒪᑕ, ᒪᕈᒃ ᑲᖏᕐᒧᒥ, (Second & Third Porage) ᐊᒪᒧ ᖃᖏᕐᑲᒧᑉ ᐊᑦᑯᐊᓂ (Vault). ᑕᑯᓄᖔ ᐅᔭᕋᑕᕆᐊᕕᓄᑦ ᐊᒃᑐᐊᔪᑦ ᑕᓯᑦᒧ ᐃᒪᐃᒧ, ᐊᓚᖑᕐᓂᐊᖅᑐᑦ ᐅᑭᐅᓄᑦ 8 – 10. ᑭᓯᐊᓂᓕ ᑲᖏᕐᑲᒧᑉ ᐃᓚᖔ ᓇᑲᑕᐅᓯᒪᔪᑉ ᐃᒪᐃᔭᕐᒧᒍ, ᐅᔭᕋᒧᓂᒃ ᑲᑎᖅᓱᐃᕕᐅᓂᐊᖅ, ᑕᒪᓇᒧ ᐊᓚᖑᖅᓯᒪᓂᕐᑲᐃᓇᕐᓂᐊᖅᑐᖅ.

ᐊᐳᖅᑎᓐᓇᖅᑐᖅ ᐅᔭᕋᒃᑕᕆᐊᕕᒃ ᐅᒃᑯᐊᖅᐸᑦ ᑲᖏᕐᑲᒧᒃ ᐊᖏᓕᑲᓂᓇᐊᕐᓂᐊᕐᑐᖅ. ᐅᑯᐊ ᐅᔭᕋᒃᑕᕆᐊᕕᑦ ᓄᓇᐅᑉ ᐃᒧᐊᓄᑦ ᐊᑦᓯᑭᓕᖅᐸᓕᐊᔪᑦ, ᐃᒥᑲᓂᓇᐊᕐᓂᐊᕐᒪᑕ, ᐊᖏᓕᕈᑕᐅᓂᐊᕐᑐᑦ, ᐊᑦᑐᒥᓂᖅᓴᒥᒃ ᑲᖏᕐᑲᒧᑉ ᐃᓚᖔᓂᒃ. ᑭᓯᐊᓂ ᐅᕐᑯᒥᓂᕐᓴᖅ ᐅᔭᕋᒃᑕᐊᕐᕕᒃ ᒥᑭᓕᖅᑎᑦᓯᓂᐊᕐᑐᖅ ᑕᓯᕐᒥᒃ, ᐅᔭᕋᓂᒃᒧ ᐊᑐᖏᓕᖅᑐᓂᒃ ᖃᑎᖅᓱᐃᕕᒃ ᐊᒪᒧ ᐅᔭᕋᒃᑕᕆᐊᕕᑲᓂᖅ ᒥᑭᓕᕈᑕᐅᒧᑎᒃ.

ᑕᒪ ᐃᒪᖅ ᐃᖏᕋᑦᓯᐊᓂᖔ ᖃᐅᔨᓴᖔᐃᓇᕐᒧᒍ ᑲᒪᒋᔭᐅᓂᐊᕐᑐᖅ, ᒪᑯᐊ ᐊᕐᑯᑎᑦ ᐊᑕᖁᑦ ᑯᒻᕕᑦ ᐊᕐᑭᒋᐊᕐᐸᒧᒥᑦ. ᐊᒪᒧ ᖃᒥᓂᑯᑦ ᓄᓇᒥ ᑕᓯᕐᓄᑦ ᑯᒃᑎᑕᕐᒧᒥᑦ. ᑭᓯᐊᓂ ᓴᒧᒪᐃᑐᔭᖅᑐᑦ ᖃᒥᓂᑯᑦ ᑲᑎᖅᓱᓚᐅᓂᐊᕐᒥᐊᑦ. ᑕᒪᑯᓇᖔᑦ ᐅᔭᕋᓂᒃ ᑲᑎᕐᓱᐃᕕᒃᓂᑦ ᖃᒥᓂᑯᑦ ᐊᒪᒧ ᐅᔭᕋᑕᕆᐊᕕᒃᓂᑦ ᖃᒥᓂᑯᑦ ᖃᑎᖅᓱᒧᒥᑦ ᓴᒧᒪᕐᓴᕐᒧᒥᑦ ᑲᑎᖅᓱᓚᐅᓂᐊᑦ, ᐃᒪᒥᒃ ᖃᑎᖅᓱᐃᕕᒃᑯᑦ. ᐅᔭᕋᒃᑕᕆᐊᕐᕕᐅᓚᐅᖅᑐᑦ ᐅᔭᕋᑕᕆᐊᕐᕕᐅᓚᓂᒃᐸᑕ ᒪᓂᒃᓴᓚᐅᒧᑎᒃᒧ ᐊᕐᑭᓚᐅᑦᓯᐊᒧᑎᒃᒧ, ᐱᓕᕆᐊᕆᔭᐅᓂᐊᑦ ᐃᒪᖅ ᑯᑦᓯᐊᕐᓂᐊᕐᒪᑦ ᑯᒃᕕᒋᔭᕐᒥᓄᑦ. ᐊᒪᒧ ᐊᕐᑯᑎᒧ ᐊᑕᓂ ᑯᒃᕕᑦ ᐊᓯᕙᖅᑕᐅᒧᑎᒃ, ᑕᐅᑐᕐᑲᓚᐅᒥᓄᑦ ᓄᓇ ᐊᕐᑭᕐᑯᐸᒧᒍ. ᐊᒪᒧ ᓄᓇ ᐊᑐᒧᐊᓂᖔ ᐊᕐᑲᓯᒧᒍ ᐱᓕᕆᐊᕆᔭᐅᓂᐊᕐᑐᑦ, ᓄᓇ ᐱᕐᑯᐊᓚᓂᐊᕐᒪᑦ ᑕᐅᑐᓚᐅᒥᓄᑦ. ᐊᒪᒧ ᑯᒪᐃᑦ ᐊᕐᑭᒋᐊᕐᑲᖅᐸᑕ ᐊᕐᑭᒧᒥᑦ.

ᑲᖏᖅᖢᒃᒥᑦ ᑯᒃᑐᖅ ᐊᑦᔪᒥᑐᒧᑦ ᑕᓯᕐᒧᑦ, ᑯᓚᖅ ᑯᓚᐅᔪᓂᕐᓂᐊᖅᑐᖅ ᐅᔭᕋᑕᓇᐊᕕᒃᒥᑦ. ᑭᓯᐊᓂ ᑲᒪᐅᑉ ᐱᖃᑕ ᑯᒥᒃᓴᓂᐊᕐᑐᖅ. ᑯᒥᒃᓴᒐᓗᐊᕈᒥ ᐃᓗᐊᖅᓯᕆᓇᕐᓂᐊᖅᑐᖅ ᐃᖃᓗᐃᑦ ᑯᒐᓇᑯᔪᒐᒥᒃ, ᐊᒪᓗ ᐊᒥᓯᓂᖅᓴᑦ ᐃᖃᓗᐃᑦ ᐊᓂᒍᕐᑕᓗᑎᒃ ᐱᓂᐊᒪᑕ. ᐊᒥᓯᓂᖅᓴᑦ ᐃᖃᓗᐃᑦ ᐃᑲᕐᑕᕐᓂᖅᓴᐅᓂᐊᓕᖅᑐᑦ, ᐊᒥᓱᖏᓂᕐᓴᑦ ᐃᑲᕐᑕᓚᐅᕐᒪᑕ ᐅᔭᕋᒃᑕᓇᐊᕐᕕᖃᖏᑎᓗᒍ.

ᐊᑦᔪᒥᑐᖅ ᐅᕙᕋᒃᑕᓇᐊᕕᒃ(Vault) ᐊᒪᓗ ᑲᖏᖅᖢᒥᑐᖅ ᐅᔭᕋᒃᑕᓇᐊᕕᒃ(Portage) ᐊᒪᓗ ᕿᕿᑕᒥᑐᖅ ᐅᔭᕋᒃᑕᓇᐊᕕᒃ(Goose Island) ᑕᑯᐊ ᐊᑐᐊᓂᒃᐸᑕ ᐃᒥᒐᐅᓂᐊᕐᑐᑦ. ᐃᒥᒐᐅᓂᐊᖅᑐᑦ ᑕᓯᕐᓂᑦ ᖃᓂᑕᒥᓂᑦ. ᑕᑯᐊ ᐅᔭᕋᒃᑕᓇᐊᕕᐅᓚᐅᖅᑐᑦ ᑯᓪᕕᐅᓗᑎᒃ ᐊᐳᓗ ᓯᑯᓗ ᐊᐅᒃᐸᓕᐊᓕᕐᐸᑦ ᑯᒃᑎᑕᓗᒥᑦ ᑕᑕᑕᐅᓂᐊᕐᑐᖅ. ᑭᓯᐊᓂ ᑕᑕᓚᒃᓯᓇᓚᖏᑐᑦ ᐃᒪᖅ ᐅᑭᐅᓂᒃ ᐱᖓᓱᓂᒃ ᑯᒃᑎᑕᕐᓗᒍ, ᑕᑕᓂᐊᕐᑐᑦ, ᑕᑯᐊ ᓄᓇᐅᑉ ᐃᓗᐊᓄᑦ ᐊᑦᓯᑐᑐᒪᑕ. ᐊᒪᓗ ᑕᑕᑎᒐᐅᓚᒃᓯᓇᕈᒥᒃ ᑕᒪᓇ ᑯᒥᓂᖓ ᑲᑭᓕᖅᑎᑦᓯᓂᐊᕐᒪᑦ ᐃᒪᒥᒃ.

ᐃᒪᑦᓴᐅᓂᖅ

ᐃᒪᕐᓗ, ᑕᓯᓗ, ᑯᒐᐃᓗ ᐃᒪᑦᓴᐅᕐᑯᐸᓗᒥᑦ ᑕᒪᓇ ᐃᒪᓕᕆᓂᖅ ᐱᓕᕆᐊᕆᔭᐅᖕᒐᐃᓇᕐᓂᐊᖅᑐᖅ. ᑕᒪᑯᐊ ᐃᒪᑦᓴᐅᖏᑐᑦ, ᑯᕕᖅᑕᕕᑦ, ᐃᒪᐃᔭᕕᑦ, ᖃᑎᖅᓱᒐᐅᓂᐊᕐᑐᑦ ᐊᑕᐅᓯᕐᒧᑦ ᑯᕕᖅᑕᕕᖃᓂᐊᑐᑦ. ᐊᒪᓗ ᐃᒪᖅ ᖃᒥᓂᑯ ᐅᔭᕋᒃᑕᓇᐊᕕᒃᓂᑦ ᖃᑎᖅᓱᒐᐅᓂᐊᕐᒥᔪᑦ. ᑕᒪ ᐃᒪᖅ ᖃᑎᖅᓱᒐᐅᓂᑯ ᓴᓗᒪᓴᕐᓗᒍ ᑯᕕᔭᐅᑲᓂᕐᓂᐊᖅᑐᖅ ᑕᓯᕐᓄᑦ. ᑕᒪᓇᓕ ᐃᒪᖅ ᒪᓂᕋᒥ ᓴᓗᒪᔪᑐᖅᑲᖅ ᑯᒃᑎᑕᐅᓂᐊᕐᑐᖅ ᑕᓯᕐᓄᑦ.

ᐅᔭᕋᓗᓂᒃ, ᐅᔭᕋᓂᒃᓗ ᐊᒪᓗ ᑐᐊᐸᓂᒃ ᖃᑎᖅᓱᐃᕕᒃ ᑲᒪᕆᔭᐅᓂᐊᕐᒥᔪᑦ, ᐊᕐᑭᓯᒪᒥᔪᖅ. ᐅᔭᕋᓂ ᑲᑎᖅᓯᓯᒪᔪᓂ ᑕᒪᓇ ᐃᒪᖅ ᖃᒥᓂᑯ ᕿᕿᓕᓚᒃᓯᓇᕐᓂᐊᖅᑐᖅ, ᑕᒪᓗ ᖃᐅᔨᒪᔭᐅᔪᑐᖅᑲᖅ. ᐊᒪᓗ ᖃᐅᔨᓴᕐᓂᐅᔪᓂ ᑐᑭᓯᓇᖅᑐᖅ ᑭᓂᐸᔪᓂᒃ ᐊᒃᑯᖅᑲᕕᑦ ᐊᒪᓗ ᐅᔭᕋᓂᒃᓗ ᐊᒃᑯᖅᑲᕕᑦ ᕿᕿᓕᓚᓯᓇᔪᒪᑕ. ᕿᕿᓕᓚᓯᓇᕋᖕᒐᒥᒃ ᓄᓇᐅᑉ ᐃᓗᐊᓄᑦ ᖃᒥᓚᖏᒪᑕ.

ᐅᔭᕋᑕᓇᐊᑎᓗᒥᑦ ᐊᑦᔪᒥᑐᖅ ᐃᒪᖅᑲᕕᒃ(Vault Lake) ᑯᒃᑎᑕᐅᕆᐊᓂᐊᕐᑐᖅ ᑕᓯᕋᓇᒧᑦ(Wally Lake). ᐊᒪᓗ ᑲᖏᖅᖢᐸ ᓴᓂᐊᓂ ᐃᒪᖅᑲᕕᒃ(Second Portage) ᑯᒃᑎᑕᐅᓂᐊᕐᑐᖅ ᑕᓯᕋᒧᑦ(Third Portage). ᐃᒪᕐᓕ ᑯᒃᑎᑕᐅᔪᖅ ᐊᑦᔪᒥᑐᒥᑦ ᐃᒪᖅᑲᕕᒃᒥᑦ(Vault Lake)ᓴᓗᒪᓂᐊᕐᒪᑦ ᓴᓗᒪᖅᓴᒐᐅᓚᖏᑐᖅ. ᐃᒪᖅᑕᐅᖅ ᖃᖏᖅᖢᐸ ᓴᓂᐊᓂᑐᖅ ᑯᒃᑎᑕᐅᔪᖅ ᓴᓗᒪᓂᐊᕐᒪᑦ ᓴᓗᒪᖅᓴᒐᐅᓚᖏᑐᖅ, ᓴᓗᒪᓂᐊᑐᖅ ᐅᔭᕋᑕᓇᐊᓕᓴᕐᑎᓗᒥᑦ. ᐅᑭᐅᓂᒃ 5ᓂᒃ ᖃᓂᒐᓂ ᐅᔭᕋᒃᑕᓇᐊᓕᖅᐸᑕ, ᐅᔭᕋᓂᒃ ᐊᒃᑯᖅᑲᕕᒃ ᐊᒪᓗ ᐃᒪᖅᑲᓕᖅᐸᑦ ᑲᑭᑐᒥᒃ, ᑕᑯᐊᒃ ᑯᒃᑎᑕᓂᐊᑐᒃ ᑕᓯᕐᒧᑦ, ᑲᖏᖅᖢᐸ ᓴᓂᐊᓂᑐᒥ(Third Portage Lake). ᑲᖏᖅᖢᐸ ᓴᓂᐊᓂᑐᖅ ᑕᓯᖅ(Third Portage Lake)ᓴᕕᕐᓗᖃᓂᐊᖕᒍᒐᓗᐊᖅ ᐃᒪᕐᒥ ᐅᔭᕋᒃᑕᓇᐊᕕᒃ ᐅᑯᐊᖅᐸᑦ ᑭᓯᐊᓂ ᓴᕕᓗᖃᓗᐊᓕᖏᒪᑦ, ᑕᒪᓇ ᐃᖃᓗᓄᓗ ᓂᕐᔪᑎᓄᓗ ᐃᓗᐃᔪᑕᐅᓕᖏᑐᖅ.

ᐱᕈᑦᓯᒪᔪᑦ ᓄᓇᐅᑉ ᖃᓐᒐᓂ

ᓄᓇᐅᑉ ᖃᓐᒐ ᐊᓐᒋᑎᒋᔪᖅ 522 ha ᐊᑐᒐᐅᓂᐊᖅᑐᖅ ᐅᔭᕋᑕᕆᐊᑎᓗᒋᑦ, ᐊᒪᓗ ᖃᓐᒐ ᐊᓯᕙᖅᑎᒐᐅᓗᓂ. ᐅᔭᕋᒃᑕᕆᐊᕕᐅᑉ ᓴᓂᐊᓂ ᓄᓇᐅᑉᓗ ᓯᐅᕋᐅᑉᓗ ᐳᔪᕐᓂᓐᒐ ᑲᑕᓂᐊᖅᑐᖅ. ᐅᔭᕋᒃᑕᕕᐅᔪᑦ ᐅᕐᑯᐊᓂ ᐳᔪᕐᓂᖅᑲᓂᐊᖅᑐᖅ. ᑕᒪᒃᑯᐊ ᐅᔭᕋᑕᕐᕕᒃᒥ ᐃᒡᓗᔪᐃᓗ, ᐅᖅᓯᐊᓗᖅᑲᕕᓗ ᖃᓂᑐᕋᐅᓂᖕᒋ ᐳᔪᖅᑎᕐᓯᓗᐊᓚᖕᒋᑐᑦ, ᐊᒪ ᐱᕈᑦᓯᒪᔪᑦ ᒪᓂᕋᐅᑉ ᖃᓐᒐᓂ ᐊᓯᕈᓗᐊᓚᖕᒋᑐᑦ. ᒪᓂᕋᑉ ᐊᑉᑐᒐᐅᔪᖅ ᐅᔭᕋᑕᕐᑎᓗᒋᑦ, ᐊᕐᑭᒐᐅᓂᐊᕐᑐᖅ, ᐱᕈᑦᓯᒪᔪᓗ ᐱᖅᑯᑎᑲᓂᕐᓂᓗᑉᓗᒋᑦ, ᑕᐅᑐᑐᖅᑲᓚᐅᒥᓄᑦ ᐊᑦᕐᑭᖅᑯᐸᓗᒋᑦ.

ᓂᕐᔪᑎᑦ

ᓄᓇ ᐊᓐᒋᑎᒋᔪᖅ 522 ha ᐊᑐᒐᐅᑎᓗᒍ ᓂᕐᔪᑎᑦ ᐊᑉᑐᒐᐅᓂᖅᑲᓂᐊᖅᑐᑦ ᑕᒪ ᐃᓗᐃᔪᑕᐅᔪᓇᖅᑐᖅ. ᒪᑯᐊ ᓂᕐᔪᑎᓄᑦ ᐃᓗᐃᔪᑕᐅᔪᓇᖅᑐᑦ; ᓂᕐᔪᑎᑦ ᐃᒥᕈᒥᒃ ᐃᒪᑦᓴᐅᖕᒋᑐᖅᑲᕕᒃᒥᑦ, ᑐᓗᒐᐅᒍᒥᒃ ᓄᓇᑯᕈᑎᓂᓗ ᑎᖕᒥᓯᓂᓗ, ᓂᕆᒍᒥᒃ ᐳᔪᓂᖅᑲᑐᒥᒃ ᒪᓂᕋᒥᒃ. ᐊᑉᑕᑯᖅᑲᕕᒃᑕᐅᖅ ᐃᓗᐃᔪᑕᐅᓇᔭᖅᑐᖅ ᓂᕐᔪᑎᓂᒃ, ᐃᓚᖕᒋᑦ ᓂᕐᔪᑎᑦ ᓂᕆᓯᒪᑕ, ᑭᓯᐊᓂ ᐊᑉᑕᑯᑦ ᐃᑯᐊᓚᒃᑎᑕᐅᖕᒐᐃᓇᖅᑕᕐᓂᐊᖅᑐᑦ.

ᑭᒡᒐᕕᓗ, ᕿᓄᐊᔪᓗ, ᑲᔪᐊᓗ ᒪᓂᖅᑲᕕᖕᒋᑦ ᑕᑯᔭᐅᓯᒪᖕᒋᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᐅᑉ ᓴᓂᐊᓂ, ᐃᒪᖅᑲ ᖅᑯᑦᓯᑉᑐᓂᒃ ᖃᐃᖅᑐᖅᑲᖕᒋᒪᑦ. ᑕᒪᒃᑯᐊᓗ ᑕᑯᑉᓴᐅᓗᐊᔪᐃᑐᒪᑕ, ᐃᓗᐃᓂᖅᑲᓚᖕᒋᑐᑦ. ᐃᓚᖕᒋᑦ ᐅᔭᕋᕐᑕᕕᑦ, ᑲᖕᒋᖅᑲᓗᒥᑐᕐᒥᓗ, ᐊᑦᒍᒥᓗ ᐅᔭᕋᒃᑕᕐᕕᒃ, ᐃᒪᐃᔭᒐᐅᓂᐊᕐᒪᑕ ᑕᒪ ᐃᓗᐃᔪᑕᐅᓂᐊᖅᑐᖅ ᑎᖕᒥᐊᓄᑦ. ᐃᓚᖕᒋᑦ ᑎᖕᒥᐊᑦ ᓂᕆᕕᒋᓯᒐᐃᑦ ᓯᒡᔭ ᐃᓚᓂᐊᕐᒪᑕ ᐃᒪᒥᒃ. ᓴᓗᒪᖅᓴᖅᓯᒪᖕᒋᑐᖅ ᐃᒪᖅᑲᕕᒃ ᐃᓗᐃᔪᑕᐅᒋᓇᕆᐊᓚᑦ ᑎᖕᒥᐊᓄᑦ, ᑕᒪᒃᑯᐊ ᐃᒪᖅᑲᕕᒍᐊᖅᑕᕐᐸᑕ.

ᓂᕐᔪᑎᑦ ᐃᓯᒪᒋᐸᓗᒋᑦ ᒪᑯᐊ ᐱᓚᓇᐊᓇᔭᐅᓂᐊᖅᑐᑦ; ᓂᐱᖅᑯᑐᓗᐊᖅᑐᑦ ᐱᓚᓇᔪᑎᑦ ᓂᐱᖅᑯᑐᓗᐊᖅᑕᐃᓚᓗᒋᑦ, ᓄᓇᑯᕈᑎᑦ ᓇᕿᖅᓴᓗᐊᖅᑕᐃᓚᓗᒋᑦ, ᓂᕐᔪᑎᑦ ᐊᑉᖅᑯᑎᓂᒃ ᐃᑲᓇᐊᖅᐸᑕ ᓯᕗᓚᐅᑎᓗᒋᑦ, ᐳᔪᕐᑎᓗᐊᖅᑕᐃᓚᓗᒍ ᐅᔭᕋᒃᑕᕐᕕᑦ, ᑕᒪᒃᑯᐊᓗ ᐅᓗᓇᐊᓇᖅᑐᑦ ᐅᖅᓯᐊᓗᐃᓗ ᖃᖅᑕᕐᑐᓗ ᑐᖅᑯᓯᐊᑕᕐᓗᒋᑦ, ᐱᓚᓇᔫᓗ ᐅᔫᖅᑐᖅᑯᓗᒋ ᓯᓇᓗᒃᑕᓂᒃ ᓄᓇᒥᒃᓗ, ᐊᑉᑕᑯᓗ ᐃᑯᐊᓚᒃᑎᐸᓗᒋᑦ, ᐊᒪᓗ ᐊᖑᓇᓯᐊᖅᑕᖕᒋᓗᑎᒃ ᐱᓚᓇᔫᑦ. ᐅᔭᕋᒃᑕᕐᕕᓗᒃᑕᑦ ᒪᑐᑦᓯᐊᒐᓂᐊᖅᑐᑦ, ᓴᐅᔭᐅᓂᐊᖅᑐᓗ, ᒪᓂᕋᓗ ᒪᓂᒃᓴᒐᐅᓗᓂ, ᓄᓇ ᐱᕈᑦᓯᐊᓂᐊᕐᒪᑦ ᐊᒪᓗ ᓂᕐᔪᑎᑦ ᓇᒪᖅᑯᐸᓗᒋᑦ, ᐅᔭᕋᑕᕆᐊᕕᒃ ᐅᑯᐊᒐᐅᑉᐸᑦ. ᓂᕐᔪᑎᑦ ᖃᓐᒐᒍᑕᕈᓇᖅᑯᐸᓗᒋᑦ ᐅᔭᕋᒃᑕᕕᕕᓂᖅᓂᑦ.

ᑐᒃᑐ, ᐅᒥᒪᐃᓗ ᖃᓪᓕᓗᐊᖅᐸᑕ ᐅᓐᒐᕙᖅᑎᑕᐅᑕᕐᓂᐊᕐᑐᑦ ᓂᐱᖅᑯᑐᔪᒥᒃ ᑐᓴᓇᖅᑐᒥᒃ.

ᑕᒪᑯᐊ ᓂᕐᔪᑎᑦ ᐃᓗᐃᔪᑕᐅᕐᑯᓇᒋᑦ ᐊᒃᑕᑯᓗᒃᑕᑦ ᐃᑯᐊᓚᒃᑎᑕᐅᑦᑕᕐᓂᐊᖅᑐᑦ. ᑕᒪᑯᐊᓗ ᓱᓇᒥᐊᑦ ᐱᕐᑯᑎᓗ ᑎᐱᑐᔪᑦ ᐳᓚᐅᑦᓯᐊᑦᑕᕐᓂᐊᖅᑐᑦ ᓂᕐᔪᑎᑦ ᓇᓄᐊᕐᑯᓇᒋᑦ. ᐊᒪᓗ ᓂᕐᔪᑎᑦ ᒥᑭᔪᑦ ᑕᑯᓗᓚᐅᑦᑕᕐᓂᐊᙱᑐᑦ. ᐱᓇᓄᕆᑦ ᐃᓇᓂᐊᖅᑎᑕᐅᑕᓂᐊᕐᑐᑦ ᐊᓂᓚᐅᑕᐃᓇᓂᕐᒥᒃ ᓂᕐᔪᑎᓂᑦ, ᐊᓂᓚᐅᑕᐃᓇᓂᕐᒥᒃᓗ. ᐃᓇᓂᐊᑎᑕᐅᓂᐊᖅᑐᑦ ᐊᒃᓚᓂᒃ ᑎᑭᑕᐅᓂᕈᒥᒃ ᖃᓄᖅ ᐊᓂᓚᐅᓇᔭᙱᓚᖓᑕ ᑕᒪᑯᓂᖓᓗ.

ᑕᒪᑯᐊ ᑎᖕᒥᓱᖅᑐᑦ ᓂᕐᔪᑎᑦ ᐊᓐᓂᕐᑯᓇᒋᑦ ᓂᐱᕐᑯᔪᑦ ᐱᓇᓄᔪᑎᑦ ᓂᐱᕐᑯᓗᐊᖅᑕᐃᓇᔭᐅᑕᓂᐊᖅᑐᑦ, ᐊᒪᓗ ᒥᕝᕕᒃᓂᑦ ᑎᖕᒥᑎᑕᐅᑕᓂᐊᖅᑐᑦ, ᐃᒪᐃᔭᕕᓂᓗ ᑎᖕᒥᑎᑕᐅᑕᓗᑎᒃ, ᒪᓂᖅᑲᕕᓇᐅᓗᒋᓗ ᐊᔪᓇᖏᐸᑦ, ᑕᓯᓗ ᑯᓚᐃᓗ ᓴᓗᒪᑎᑕᐅᖓᐃᓇᕐᓂᓗᒃᓗᒋᑦ, ᐊᒪᓗ ᐃᒪᖅ ᐊᑐᓚᐅᓂᑯ ᓴᓗᒪᖅᓴᓗᒍ ᐊᑐᐊᓂᑲᖓᑦ ᑯᕕᔭᐅᑕᓂᐊᕐᒪᑕ ᑕᓯᕐᓄᑦ.

ᐃᖃᓗᐃᑦ ᐊᒥᓱᓂᖏᑦ ᐊᒪᓗ ᐃᖃᓗᖃᕖᑦ

ᐅᔭᕋᒃᑕᕝᕕᒃ ᓴᓇᔭᐅᓇᖅᐸ ᐊᒪᓗ ᐅᔭᕋᒃᑕᕝᕐᑲᓇᖅᐸᑦ, ᐊᑕᐅᓯᖅ ᑯᓚᖅ ᑯᒍᓂᕐᓂᐊᕐᒪᑦ ᑯᓚᐅᔪᓂᕐᓗᓂ. ᑕᒻᓇ ᑯᓚᖅ ᑯᒃᑐᖅ ᑕᓯᕐᒥᑦ ᐅᕐᑯᒥᑐᒥᑦ (Third Portage Lake) ᑯᒃᑑᓂ ᑕᓯᒃᑲᓂᕐᔪᑦ ᐊᑦᑯᒥᑐᔪᑦ (Second Portage Lake). ᑕᐃᒻᓇ ᑯᓚᖅ ᑯᒍᓂᖅᑐᖅ ᐊᑦᑯᑕᐅᓚᐅᖅᑐᖅ ᐃᖃᓗᓂᒃ. ᐊᒪᓗ ᐱᖓᓱᑦ ᐅᔭᕋᒃᑕᕝᕕᑦ ᐅᑯᐊ, ᐊᑦᑐᒥᑐᖅ ᐅᔭᕋᒃᑕᕐᕝᕕᒃ (Vault) ᐅᕐᑯᒥᑐᖅ ᑕᓯᕐᒥ (Third Portage) ᐊᒪᓗ ᑲᖏᖅᑑᒥᑐᖅ (Second Portage) ᓯᒥᒃᓯᒪᑎᑦᓯᒪᑕ ᑕᓯᕐᓂᒃ. ᓯᒥᒃᓯᒪᔪᑕᐅᔪᖅ ᐊᕙᓗᓕᐅᖅᓯᒪᔪᖅ ᐅᔭᕋᒃᑕᕝᕕᒃᓂ. ᑕᒪᑯᐊ ᐃᖃᓗᓂᒃ ᐃᓗᐃᔪᑕᐅᓚᐅᓂᐊᖅᑐᑦ ᐃᖃᓗᐃᑦ ᐃᖏᕋᑕᓚᖏᒪᑕ ᑕᓯᖅ ᑕᑭᔪᖅ ᓯᒥᒃᓯᒪᑎᓗᒍ. ᐃᓚᖓᑦ ᐅᔭᕋᒃᑕᕝᕕᒃ ᐊᑦᑐᒥᓂᖅᓴᖅ (Second Portage) ᓴᓂᐊᓂ ᐅᔭᕋᓗᒃᓂᒃᓗ, ᑭᓂᐸᔪᓂᒃᓗ ᓴᓗᒪᐃᑐᓂᒃ ᐊᒃᑕᑯᕐᑲᕕᐅᒪᑦ, ᐃᖃᓗᖃᙱᑐᖅ ᑕᓯᕐᒥᒃ ᒥᑭᓕᖅᑎᑦᓯᓂᐊᕐᒪᑦ.

ᐅᔭᕋᒃᑕᕐᕝᕕᒃ ᓴᓇᔭᐅᑎᓗᒍᓗ ᐅᔭᕋᑕᓕᖅᐸᑕᓗ ᐃᖃᓗᖃᕖᑦ ᒥᐊᓂᕆᔭᐅᓂᐊᖅᑐᖅ ᑕᒻᓇ ᐅᔭᕋᒃᑕᕝᕕᐅᑉ ᐃᒪᒥᒃ ᐊᑐᐊᔪᑦ ᓯᓂᖓ ᓯᐅᕋᓕᖅᑐᓂᐊᕐᑐᑦ, ᐃᖃᓗᖃᕐᑯᓗᒍ. ᑯᓚᖅ ᑯᒃᑐᖅ ᑕᓯᕐᔪᑦ ᐊᔭᒃᑕᓇᐊᕕᐅᑉ ᓴᓂᐊᓂ, ᐊᖏᓕᖅᑕᐅᓂᐊᖅᑐᖅ ᐃᖃᓗᐃᑦ ᐃᑲᑦᓯᑯᑉᓗᒋᑦ, ᐱᖅᑕ ᑭᒐᑉ ᑯᒍᓂᕐᓂᐊᕐᒪᑦ. ᐅᔭᕋᒃᑕᕐᕝᕕᒃ ᐅᑯᐊᕐᐸᑦ ᑕᑯᐊ ᐅᔭᕋᑦᓯᕐᕕᐅᓚᐅᖅᑐᑦ ᐃᒥᑲᓂᓂᐊᒪᑕ, ᐃᒪᖅ ᑯᒃᑎᑕᐅᓗᓂ, ᐃᓄᐊᓄᑦ. ᑕᒻᓇ ᐃᖅᑎᑦᓯᓂᐊᑐᖅ ᐃᓇᖓ ᐃᒪᖅ ᐃᑎᓂᐊᒪᑦ.

ᐃᓱᒪᓕᖅᑐᖅ ᐃᖃᓗᖃᓗᐊᑲᓂᕐᓂᐊᖅᑐᖅ ᑕᒪᑯᐊ ᐃᖃᓗᖃᕖᑦ ᓴᐳᒃᑲᓂᐊᕐᒪᑕ ᐅᔭᕋᑕᓗᓂᒃᐸᑕ.

ᐃᓅᓯᓕᕆᓂᖅ ᐊᒪᓗ ᐃᓕᕐᑯᓯᖅᑐᖅᑲᓕᕆᓂᖅ

ᑕᒪᑯᐊ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᖅᑐᖅᑲᖏᑦ ᐊᓚᖑᑕᐅᓂᐊᙱᑐᑦ ᐅᔭᕋᓐᓇᐊᑎᓗᒋᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᐊᒪᓗ ᑕᒪᑯᐊ ᐃᓄᐃᑦ ᐱᑐᖅᑲᖏᑦ ᓄᓇᒥ ᐊᓚᖑᓂᐊᙱᑐᑦ. ᑭᓯᐊᓂ ᐃᓱᒪᖅᑐᖅ 60 – 90 ᐊᑯᓂᖓᓂ ᑭᕙᓪᓕᕐᒥᐅᑦ ᐱᓇᓄᓂᐊᖅᑐᑦ ᐊᐳᖅᑎᓐᓇᖅᑐᒥ ᑭᓇᐅᔭᓕᐅᑦᓯᐊᓂᐊᕐᒥᒃ, ᐃᓅᓯᖅᑲᒥᓂᒃ ᐊᑐᓗᐊᓚᖏᕐᑯᖅᑐᑦ.

ᐅᔭᕋᒃᑕᕐᕕᒃᒥ ᐱᓕᕆᔫᑦ ᑭᓇᐅᔭᖅᑲᓂᖕᓴᐅᓂᐊᕋᒥᒃ, ᖃᐅᔨᒪᔭᕆᐊᖃᑦ ᑭᓇᐅᔭᓕᕆᑦᓯᐊᓂᕐᒥᒃ. ᑭᓇᐅᔭᓕᐅᓕᕋᒥᒃ ᐃᓚᖏᑦ ᐃᓄᓯᖅᑲᑦᓯᐊᓚᖏᑐᓇᕐᓕᐊᑦ, ᐃᓚᖏᑦ ᐃᓄᖅᑲᑎᒥᓂᒃ ᐊᒃᓱᕈᒃᑎᑦᓯᒋᓇᓱᐊᖅᑐᑦ, ᕿᑐᖕᒐᒥᓂᒃᑯ, ᐊᒻᒪ ᓄᓇᓕᐅᖅᑎᒥᓂᒃ.

ᐱᓕᕆᔩᑦ ᒪᑭᓂᒃ ᓴᓇᑕᐃᓕᓂᒃ ᐱᓕᕆᔪᑎᒃ ᐊᒻ ᒪᑭᓂᒃ ᓴᓇᑕᐃᓕᓂᒃ ᐱᓕᕆᖕᒋᔪᑎᒃ, ᑕᒪ ᐊᑐᕈᐊᓇᖅᑐᔭᖅᑐᖅ. ᐱᓕᕆᖕᒋᐊᓚᓚᐅᕐᔪᓂ ᐊᖕᒍᓇᓯᓇᖅᓱᓂᑯ ᐃᓄᓯᓂᒃ ᖁᕕᐊᒋᔭᕐᓂᒃ ᐃᓄᔪᑐᐊᕋᕕᑦ. ᐃᓚᖏᑦ ᐱᓕᕆᔪᑦ ᒪᑭᓂᒃ ᓴᓇᑕᐃᓕᓂᑦ ᐱᓕᕆᑎᑐᒥᑦ ᐅᔭᕋᒃᑕᕐᕕᒃᒥ ᐊᐃᓯᒪᓚᖕᒥᒪᑕ, ᑕᒪ ᐅᐃᓯᒪᖕᒥᓂᖅ ᐊᒃᓯᕈᓇᖅᓯᓇᓇᐊᓕᒃ ᐃᓚᖏᓄᑦ. ᐃᓚᖏᑦ ᐃᓄᓯᖅᑲᑦᓯᐊᖕᒋᒋᓇᓱᐊᖅᑐᑦ ᐊᐃᓯᒪᖕᒥᓂᒥᓂ.

ᑕᒪ ᐃᓄᓯᓕᓂᕐᓗ ᐱᕙᓕᐊᓕᓂᕐᓗ ᐃᓄᒃᓄᑦ ᐃᑲᔪᓂᖅᑯᕐᓗᒍ, ᐊᖏᕈᑦ (IIBA) ᑲᒻᐸᓛᑯᓂᓗ ᑭᕙᓕᕐᒥ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖅᑲᑎᒋᑯᓗ(KIA), ᐱᓕᕆᐊᕆᔭᐅᑦᓯᐊᕆᐊᓕᒃ. ᑕᒻᓇᓗ ᐊᖏᕈᑦ ᐱᓕᕆᐊᕆᔭᐅᕙᓗᓂ ᑕᑯᓐᓇᖕᒪᑦ. ᐊᖏᕈᑎᓂ ᐅᑯᐊ ᐊᒃᓱᕈᑎᒋᔭᐅᔪᑦ;

- ᑕᒪᑯᐊ ᐅᔭᕋᒃᓯᐅᓂᕐᒥᑦ ᓇᒪᖕᒋᑐᑦ ᓴᕿᑕᐃᓕᒋᐊᕐᓗᒋᑦ, ᐊᒻᒪ ᐊᑐᖅᓂᖅᑲᑦᓯᐊᑐᑦ ᐊᒃᓱᕈᑎᒋᓗᒋᑦ.
- ᖃᒪᓂ'ᑐᐊᒥᐅᑦ ᐃᑲᔪᕐᓂᖕᓴᐅᓂᓗᒻᓗᒋᑦ ᐱᓕᕆᐊᒃᓴᖃᓗᓂᒃ, ᑭᕙᓕᕐᒥᐅᓗ ᐃᓚᐅᖅᑕᐅᑎᑦᓯᐊᓗᒋᑦ, ᓇᒥᓂᖅ ᐱᔪᓇᕐᓂᖅᑯᕙᓗᒋᑦ.
- ᑕᑯᐊ ᐅᔭᕋᒃᑕᓇᐊᑎᑦ ᑲᒻᐸᓛᑯᑦ ᓄᓇᓕᖕᒥ ᐃᓚᐅᖅᑕᐅᑎᓗᒋᑦ, ᐊᒻᒪ ᐱᕙᓕᐊᔪᓂᒃ ᖃᒪᓂ'ᑐᕐᒥ ᐃᓚᐅᖅᑕᐅᓗᑎᒃ.
- ᑲᒻᐸᓛᑯᑦ ᐱᓕᕋᖅᑲᑎᖅᑲᑦᓯᐊᕐᓗᑎᒃ ᓄᓇᓕᖕᓂᒃ ᐊᒻᒪ Hᐊᒻᓚᕐᑯᑎᖕᒥᓂᒃ.

ᑕᒪ ᓇᒥᓂᖅ ᒪᑭᑕᓂᖅ ᐊᕐᑭᒐᔭᖅᑐᖅ ᐊᒃᓱᕈᑎᒋᓗᒋᑦ ᐃᓄᒡᒍᑦ ᐃᓚᐅᖅᑕᐅᓗᑎᒃ ᐱᕙᓕᐊᓂᕐᒧᑦ. ᓄᓇᓕᒡᒍᑦ ᐃᓚᐅᖅᑕᐅᓗᑎᒃ ᐱᕙᓕᐊᔪᓂᒃ, ᓴᕿᕐᑯᕙᓗᒋᑦ ᐊᒥᓱᑦ ᓇᒥᓂᓴᐅᔪᑦ ᐱᓕᕆᕖᑦ. ᐊᒻᒪ ᐱᓕᕆᓂᕐᒧᑦ ᐃᓕᓂᐊᒐᒃᓴᑦ ᐱᓕᕆᐊᕆᓗᒋᑦ, ᑲᕙᒪᑯᓗ ᓂᓇᓕᓗ ᐱᓕᕆᖅᑎᒋᓗᒋᓗ.

ᖃᐅᔨᓴᕐᓂᖅ

ᓄᓇᐅᑉ ᕿᕿᓂᖕᒐᓂᒃ

ᓯᓚ ᖃᐅᔨᓴᒐᐅᖕᒐᐃᓇᖅᑐᖅ ᐅᑭᐅᒥᑦ 1997-ᒥ ᖃᐅᔨᓴᒐᐅᕆᐊᖅᓱᓂ ᐊᒻᒪ ᐅᔭᕋᒃᑕᕐᑎᓗᒋᑦ ᓯᓕ ᖃᐅᔨᓴᒐᐅᑐᐃᓇᕐᓂᐊᖅᑐᖅ. ᑕᒪᑯᐊ ᓯᓚᒥᒃᑯ ᒪᓂᕋᒥᒃᑯ ᖃᐅᔨᓴᕈᑎᑦ ᐊᑐᕐᓗᒋᑦ ᒪᓂᕋᐅᑉ ᓂᓪᓕᓇᕐᓂᖕᒐ ᖃᐅᔨᓴᒐᐅᑕᓂᐊᕐᑐᖅ, ᕿᕿᓕᕐᓂᖕᒐ. ᑕᑯᐊ ᖃᐅᔨᓴᕈᑎᑦ ᐊᑐᕐᓗᒋᑦ ᓂᓪᓕᓇᕐᓂᖕᒐ ᑎᑎᕋᒐᐅᑕᕐᓂᐊᖅᑐᖅ. ᐊᓯᖕᒋᓗ ᖃᐅᔨᓴᕈᑎᑦ ᒪᓂᕋᒧᑦ ᐃᓕᔭᐅᓗᑎᒃ ᖃᐅᔨᓴᒐᐅᑕᕐᓂᐊᒥᔪᑦ, ᐅᔭᕋᓗᒻᓂᒃᑯ ᑭᓂᕙᔪᓂᒃᑯ ᐊᒃᑕᑯᖅᑲᕕᒃ, ᐊᒻᒪ ᐅᔭᕋᓂᒃ ᐊᑐᖕᒋᓕᖅᑐᓂᒃ ᖃᑎᖅᓯᐃᕕᒃ. ᑕᒪ ᖃᐅᔨᔪᑕᐅᑕᕐᓂᐊᖅᑐᖅ ᓄᓇᐅᑉ ᐃᓗᐊ ᕿᕿᓕᖅᑕᕋᓗᐊᕐᒪᖔᑦ, ᐊᒃᑕᑯᓗ ᐅᔭᕋᓗᖅᑲᕕᒃᑯ ᐊᑕᓂ ᕿᕿᓕᕋᓗᐊᕐᒪᖔᑦ.

ᐊᓄᕆᐅᑉ ᖃᐅᔨᓴᕐᓂᖓ

ᑕᒪᓇ ᐊᓄᕆ ᐅᔭᕋᒃᑕᕕᐅᑉ ᓴᓂᐊᓂᓗ ᐊᕙᑕᓂᓗ ᖃᐅᔨᓴᒐᐅᑕᓂᐊᕐᒥᔪᖅ. ᖃᐅᔨᓴᖅᑐᓂ ᑕᒪᑯᐊ ᐳᔪᑦ ᑕᐅᑐᓇᖏᑐᑦ ᓴᕿᕙᒃᒪᑕ. ᑕᒪᑯᐊ ᑕᐅᑐᓇᖏᑐᑦ ᒪᓂᒐᒧᑦ ᐃᖏᕋᒪᑕ. ᑕᒪᓇᓗ ᐃᓯᕐᓂᑯ ᖃᐅᔨᓴᖅᑕᐅᓚᖏᑐᖅ ᐃᓯᕐᓂᑯᑦ ᑕᒪᖅᐸᒪᑕ ᓯᓚᒧᑦ.

ᐊᑎᒋᖕᒋᑐᑦ ᑕᓴᓇᖅᑐᑦ ᖃᐅᔨᓴᕐᓂᖓ

ᑕᒪᑯᐊ ᑐᓴᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᕈᑎᑦ ᓂᓇᓗᑕᖅ ᐃᓕᔭᐅᓂᐊᖅᑐᑦ, ᑕᒪᑯᐊ ᓂᐱᕐᑯᑐᓂᖕᒋ ᖃᐅᔨᒪᔭᐅᓂᐊᕐᒪᑕ. ᐊᒪᓗ ᓇᓂ ᓂᐱᕐᑯᑐᓂᖅᓴᐅᒪᖕᒐᑦ ᖃᐅᔨᓇᕐᓂᐊᕐᒪᑦ.

ᑕᓯᑦ ᐃᒪᕐᑯᑐᓂᖕᒋᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ

ᑕᒪᑯᐊ ᑕᓯᑦ ᐃᒪᖅᑲᓂᓗ ᐊᒪᓗ ᐊᐳᑎᕐᑯᖅᑐᓂᖅ ᖃᐅᔨᓴᒐᐅᓂᐊᕐᒥᔪᖅ, ᐅᔭᕋᑕᓇᐊᕐᑎᓗᒋᑦ. ᑕᒪᑯᐊᓗ ᑭᓂᐸᔪᓂᒃᓗ ᐅᔭᕋᓗᒃᓂᒃᓗ ᐊᒃᑕᑯᖅᑲᕕᑦ, ᖃᒥᓂᖕᒋᑦ ᖃᐅᔨᓴᖅᑕᐅᑕᕐᓂᐊᒥᔪᑦ. ᐊᒪᓗ ᒪᓂᕋᐅᑉᓗ, ᐊᑉᕐᑯᑎᓗ, ᐊᑯᓂᖕᒋᑕ ᖃᒥᓂᖕᒋᑦ ᖃᐅᔨᓴᖅᑕᐅᑕᕐᓂᐊᕐᒥᔪᑦ. ᐊᒪᓗ ᑕᓯᑦ ᐃᒪᐃᔭᒐᐅᔭᕋᖕᒐᒥᒃ ᑕᒪᑯᐊ ᖃᐅᔨᓴᕐᓂᑯᑦ ᑎᑎᕋᒃᑕᐅᑕᕐᓂᐊᕐᑐᑦ.

ᐃᒪᐅᑉ ᖃᐅᔨᓴᓂᖓ

ᑭᓂᐸᔪᓂᒃᓗ, ᐃᒪᑦᓴᐅᖕᒋᑐᒥᒃᓗ ᑲᑎᖅᓯᐃᕕᒃ ᖃᐅᔨᓴᖅᑕᐅᑕᕐᓂᐊᕐᒥᔪᖅ, ᐊᒪᓗ ᐃᒪᖅ ᓴᓗᒪᖅᓴᒐᐅᑕᓗᓂ, ᓴᓗᒪᖅᓴᓇᐊᖅᑲᖅᐸᑦ. ᑭᓯᐊᓂ ᓴᓗᒪᖅᓴᒐᐅᒐᓂᑲᖕᒐᑦ ᑯᕕᔭᐅᑕᕐᓂᐊᖅᑐᖅ ᑕᓯᕐᓄᑦ. ᓄᓇᐅᑉ ᐃᓗᐊᓂ ᐃᒪᖅ ᖃᐅᔨᓴᒐᐅᑕᕐᓂᐊᕐᒥᔪᖅ, ᖃᐅᔨᓴᕐᕕᖅᑲᖅᑕᕐᓂᐊᒪᑦ ᓄᓇᒥ ᐳᐊᓇᑕᖅᓯᒪᔪᒥ, ᓄᓇᒥᓗ, ᐅᔭᕋᖅᑲᓂᕐᒥᓗ.

ᐱᕈᒃᓯᒪᔪᓗ, ᓂᕐᔪᑎᓗ ᖃᐅᔨᓴᓂᖓ

ᒪᓂᕋᒥ ᐱᕈᒃᓯᒪᔪᑦ ᐊᒪᓗ ᓂᕐᔪᑎᑦ ᖃᐅᔨᓴᒐᐅᑕᓂᐊᕐᒥᔪᑦ. ᐊᔭᕋᒃᑕᕕᐅᔪᑦ ᓴᓂᐊᓂᓗ ᐊᕙᑕᓂᓗ ᓂᕐᔪᑎᑦᓗ ᐱᕈᒃᓯᒪᔪᓗ ᖃᐅᔨᓴᒐᐅᑕᓂᐊᕐᑐᑦ, ᐊᒪᓗ ᓂᒃᔪᑎᑦ ᑕᑯᔭᐅᔪᑦ, ᐊᒥᓱᓂᖕᒋᓗ ᑎᑎᕋᒐᐅᑕᕐᓗᑎᒃ. ᐊᒪᓗ ᑕᑯᐊ ᑲᒻᐳᓚᓐᑯᑦ ᖃᐅᔨᓴᖅᐸᒃᑐᓂᒃ ᐊᑎᒋᖕᒋᑐᓂᒃ ᐱᓕᕆᖅᑲᑎᖅᑲᐸᓗᑎᒃ, ᓄᓇᕗᒥ. ᑕᒪᓇᓗ ᖃᐅᔨᓴᕐᓂᖅ ᐃᖕᒋᕋᓂᐊᖅᑐᖅ ᓯᕗᓂᕐᒧᑦ.

ᐃᖃᓗᐃᑦ ᐊᒥᓱᓂᖕᒋᑦ ᐊᒪᓗ ᐃᖃᓗᖅᑲᕕᑦ

ᑕᐃᒪ ᐃᖃᓗᐃᓗ ᐃᖃᓗᖅᑲᕕᓗ ᖃᐅᔨᓴᒐᐅᓂᖕᒋᑦ ᐱᖕᒐᓯᒪᑕ ᐅᑯᐊᖑᑉᓗᑎᒃ; (1) ᐃᒪᕐᒥᐅᑕᑦ ᐊᐅᓚᓂᖕᒐᓂ ᐸᕐᓇᒃᓯᒪᓂᖅ, (AEMP) ᑕᑯᐊ ᖃᐃᔨᓴᕐᓂᐅᔪᑦ ᑕᓯᓗ ᐃᒪᐃᓗ ᑯᒐᐃᓗ ᖃᓄᖅ ᐊᐅᓚᑕᐅᓂᐊᒪᖕᒐᑕ ᐅᔭᕋᒃᑕᓇᐊᖅᑎᓗᒋᑦ; ᐊᒪᓗ <u>(2)</u> ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᓂᖅ ᐅᔭᕋᒃᑕᓇᐊᑎᓗᒋᑦ, ᑕᒪᓇᓕ ᑲᕙᒪᑐᖅᑯᓂ ᒪᓕᒐᐅᒐᒥ ᐊᑐᓇᐊᖅᑐᖅ ᖃᐅᔨᓴᓂᖅ; ᐊᒪᓗ (3) ᐃᖃᓗᖅᑲᐱᓂᒃ ᖃᐅᔨᓴᓂᖅ, ᑕᒪᓇᓕ ᐊᕐᑭᓯᒪᔪᖅ ᑕᒪᑯᐊ ᐃᖃᓗᖅᑲᕕᑦ ᐊᓯᐅᐸᑕ ᑕᑯᐊ ᐅᔭᕋᒃᑕᓇᐊᑐᑦ ᓴᓇᓇᔭᕐᒪᑕ ᐃᖃᓗᖅᑲᐱᒃᓴᒥᒃ, ᑕᐃᒻ ᐊᓯᐅᔪᖅ ᐃᖃᓗᖅᑲᐱᒃ, ᐃᓇᖕᒋᖅᑕᐅᓂᐊᕐᒪᒃ.

ᐃᓄᓯᓕᕆᓂᖅ ᐊᒪᓗ ᐃᓕᖅᑯᓯᑐᖃᖅ

ᑕᒪᑯᐊ ᓇᒥᓂᓕᒃᓄᑦ ᐱᕙᓕᐊᓂᖅ, ᐱᓕᕆᐊᖃᓂᒃᓗ ᐱᓕᕆᐊᒃᑕᓗ, ᐱᓕᕆᐊᒃᓴᓂᒃᓗ ᐃᓕᓂᐊᕐᓂᖅ, ᐊᒪᓗ ᐃᓕᓂᐊᒐᒃᓴᓕᕆᓂᖅ ᖃᐅᔨᓴᖅᑕᐅᓗᓂᓗ ᐊᒪᓗ ᓂᓇᓕᖅᑲᑦᓯᖃᓂᖅ ᖃᐅᔨᓴᖅᑕᐅᓂᐊᕐᒥᔪᖅ.

ᓴᓗᒪᖅᓴᒐᐅᒐᓂᒃᓯᒪᔪᒥ ᐊᔪᓕᓂᑯᑦ

ᒥᑭᔪᒐᓗᐃᑦ ᓴᓗᒪᖅᓴᒐᐅᓚᐅᖅᑐᓂ ᓴᓗᒪᐃᓂᑯᐃᑦ, ᐱᓕᕆᐊᕆᔭᐅᓂᐊᕐᒥᔪᑦ ᐅᑯᐊ; (1) ᐅᔭᕋᑕᕆᐊᕕᒃᒥᓗ ᓴᓂᐊᓂᓗ (Second Portage Lake) ᑕᓯᖅ ᓴᓗᒪᐃᑯᑦ ᐊᒪᓗ ᐅᔭᕋᓗᒃᓂᒃ ᐊᒃᑕᑯᖃᕕᒃᒥ, ᐅᕙᕋᒃᑕᕆᐊᕕᒃᒥᓗ ᑕᓯᐅᑉ ᓴᓂᐊᓂᑐᖅ (Portage Pit); ᐊᒪᓗ (2) ᐊᒪᓗ ᓂᕐᔪᑎᑦ ᒥᑭᔪᑦ, ᐃᖃᓗᐃᓗ, ᐃᖃᓗᖃᕕᓗ ᐊᓇᖑᓂᖏᑦ ᐅᔭᕋᒃᑕᕆᐊᖅᑎᓗᒋᑦ, ᐊᒪᓗ (3) ᑕᓯᖅ ᐅᔭᕋᑕᕆᐊᕕᒍᑦ ᐊᒃᑐᐊᔪᖅ (Third Portage Lake) ᑕᓐᓇ ᑕᓯᖅ ᓴᕕᒃᓗᖃᖅᓯᓇᕆᐊᖃᕐᒪᑦ ᐅᔭᕋᒃᑕᖅᑎᓗᒋᑦ. ᐊᒪᓗ ᐃᖃᓗᐃᑦ ᐊᒥᓱᖑᓂᐊᕐᒪᑕ ᐃᒪᕐᒥ ᐅᔭᕋᒃᑕᕆᐊᕕᐅᑉ ᓴᓂᐊᓂ, ᑕᒪᓐᓇ ᖁᕕᐊᓇᖅᑐᓂ.

ᐃᖏᓕᖅᐸᓕᐊᓂᖏᑦ ᐃᓗᐊᖏᑐᑦ ᐅᔭᕋᑕᐊᒐᓂᒃᐸᑕ

ᐅᔭᕋᒃᑕᕆᐊᕕᒃᒥ ᐅᐳᖅᑎᓐᓇᖅᑐᒥ ᐅᔭᕋᒃᑕᕆᐊᑎᓗᒋᑦ ᐊᒪᓗ ᐅᔭᕋᒃᑕᕆᐊᒐᓂᒃᐸᑕ ᑕᒪᑯᐊ ᓴᓗᒪᐃᓂᐅᔪᓴᖅᑐᑦ ᐊᖏᓕᖅᐸᓕᐊᓚᖏᑐᑦ ᑕᕙᓂᓗ ᑭᕙᓕᕐᒥᓗ.

ᐅᔭᕋᒃᑕᕆᐊᒐᓂᒃᐸᑕ ᐅᒃᑯᐊᓂᖓ ᐊᒪᓗ ᓴᓗᒪᖅᓴᓂᖓ

ᐅᔭᕋᒃᑕᕆᐊᒐᓂᒃᐸᑕ ᐅᔭᕋᒃᑕᕆᐊᕕᒃ ᐅᑯᐊᖅᐸᑦ, ᑕᑯᐊ ᐅᔭᕋᒃᑕᕆᐊᖅᑎᑦ ᑲᒻᐳᓚᓐ (Cumberland) ᓴᓗᒪᖅᓴᕐᓂᐊᖅᑐᑦ ᐊᒪᓗ ᐃᓪᓗᕐᔪᐊᑦ ᐊᓯᕚᖅᑎᕐᓗᒋᑦ, ᑕᓐᓇ ᓄᓇ ᐱᕈᒃᐸᓕᐊᕐᑯᑉᓗᒍ. ᑭᓯᐊᓂ ᓴᓗᒪᑦᓯᐊᕐᓗᒍ ᓂᕐᔪᑎᑦ ᐅᑎᖅᑕᓗᑎᒃᓗ ᓇᒪᒃᓂᐊᕐᒪᑕ. ᑕᒪᑯᐊᓗ ᓄᓇᖁᕈᑎᔪᐃᑦ ᓄᑕᐅᓗᑎᑦ ᐊᖏᔪᓗ ᐱᖁᑎᑦ ᓄᑕᐅᓗᑎᒃ. ᐅᔭᕋᔪᐃᓗ ᐊᕿᒋᐊᓗᒋᑦ ᐊᒪᓗ ᓄᓇ ᒪᓂᒃᓴᕐᓗᒍ, ᐅᓗᕆᐊᓇᖅᑐᓗ ᐊᓯᕚᖅᓗᒋᑦ. ᑕᓐᓇ ᐅᔭᕋᒃᑕᕆᐊᕕᐅᑉ ᐅᑯᐊᓂᖓ ᐃᓄᐃᓗ ᑲᕙᒪᑯᓗ ᓇᒪᒋᔭᖏᓂᑦ ᐊᑐᕐᓗᓂ ᐅᑯᐊᖅᑕᐅᓂᐊᖅᑐᖅ. ᐅᑯᐊᓂᖓᓗ ᓇᒪᖁᐸᓗᒍ ᐊᒃᓱᕈᑎᒋᔭᐅᓂᐊᖅᑐᖅ, ᖁᕕᐊᓯᒪᑕᐅᓂᐊᖁᑐᖅ ᐱᓕᕆᐊᕆᔭᐅᑦᓯᐊᓂᐊᕐᒪᑦ ᐊᒃᓱᕈᑎᒋᔭᐅᓗᓂ, ᐃᓄᓂᓗ ᐊᒪᓗ ᓄᓇᕗᑦ ᑲᕙᒪᑯᖏᓂᑦ.

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4.21.2.4 Vegetation	4.21.2.4 Vegetation - Terrestrial Ecosystems (Baseline) - CEA (IA) - Terrestrial Ecosystem (Mgmt Plan) - Access & Air Traffic (Mgmt Plan) - Hazardous Materials (Mgmt Plan) - Spill Contingency (Mgmt Plan) - Emergency Response (Mgmt Plan) - Reclamation & Closure (Mgmt Plan)
4.21.2.5 Wildlife	4.21.2.5 Wildlife
Caribou	Caribou
Grizzly Bear	Grizzly Bear
Musk-Oxen	Musk-Oxen
Wolves, Wolverines, and Foxes	Wolves, Wolverines, and Foxes
4.21.2.6 Birds	4.21.2.6 Birds - Terrestrial Ecosystems (Baseline) - CEA (IA) - Terrestrial Ecosystem (Mgmt Plan) - Access & Air Traffic (Mgmt Plan) - Hazardous Materials (Mgmt Plan) - Spill Contingency (Mgmt Plan) - Emergency Response (Mgmt Plan) - Reclamation & Closure (Mgmt Plan)
4.21.2.7 Aquatic Organisms and Habitats	4.21.2.7 Aquatic Organisms and Habitats
4.21.3 Biological Diversity	4.21.3 Biological Diversity
4.21.4 Social, Economic and Cultural Components	4.21.4 Social, Economic and Cultural Components
4.21.5 Impacts of the Environment on the Project	4.21.5 Impacts of the Environment on the Project
4.22 Cumulative Effects Assessment	4.22 Cumulative Effects Assessment
4.23 Summary of Impacts	4.23 Summary of Impacts
4.24 Environmental Management and Mitigation	4.24 Environmental Management and Mitigation

NIRB's Terms of Reference	Cumberland's Environmental Impact Statement
4.24.1 Overview	4.24.1 Overview
4.24.2 Management of Impacts on Physical Environment	4.24.2 Management of Impacts on Physical Environment
4.24.2.1 Caribou	4.24.2.1 Caribou
4.24.2.2 Fish	4.24.2.2 Fish - Aquatic Ecosystem (Baseline) - Fish Habitat (Baseline) - Aquatic Ecosystem/Fish Habitat (IA) - CEA (IA) - No-Net-Loss (Mgmt Plan) - AEMP (Mgmt Plan) - MMER (EEM) (Mgmt Plan) - Terrestrial Ecosystem (Mgmt Plan) - Access & Air Traffic (Mgmt Plan) - Hazardous Materials (Mgmt Plan) - Spill Contingency (Mgmt Plan) - Emergency Response (Mgmt Plan) - Reclamation & Closure (Mgmt Plan)
4.24.2.3 Bears	4.24.2.3 Bears
4.24.3 Management of Impacts on Socio-Economic Environment	4.24.3 Management of Impacts on Socio-Economic Environment
4.24.3.1 Human Resources	4.24.3.1 Human Resources
4.24.3.2 Occupational Health and Safety	4.24.3.2 Occupational Health and Safety
4.24.3.3 Nunavummiut Involvement	4.24.3.3 Nunavummiut Involvement
4.24.3.4 Public Involvement	4.24.3.4 Public Involvement
4.24.3.5 Impact and Benefits Agreements	4.24.3.5 Impact and Benefits Agreements
4.24.3.6 Pollution Prevention	4.24.3.6 Pollution Prevention
4.25 Residual Impacts	4.25 Residual Impacts
4.26 Monitoring and Follow-Up	4.26 Monitoring and Follow-Up
4.26.1 Overview	4.26.1 Overview
4.26.2 Community Liaison Committees	4.26.2 Community Liaison Committees
4.27 Auditing and Continual Improvement System	4.27 Auditing and Continual Improvement System
4.28 Closure and Reclamation	4.28 Closure and Reclamation
4.29 Outstanding Issues	4.29 Outstanding Issues
4.30 List of Consultants	4.30 List of Consultants
4.31 List of Organizations	4.31 List of Organizations

GLOSSARY

Aquifer	An underground layer of rock or soil that contains important amounts of water.
Archaeology	The scientific study of the material remains of the cultures of historical or prehistorical peoples.
Bioaccumulation	The uptake and retention of contaminants by an organism from its environment.
Biochemical oxygen demand	A measure of the amount of oxygen consumed in the biological processes that breakdown organic matter in water. The greater the biochemical oxygen demand, the greater the degree of pollution.
Biodiversity	A measure of the variety of plants and animals in a particular habitat or ecosystem.
Borrow pit	A pit from which material is taken for building roads and for similar activities.
Cumulative effects	The impacts of a development taken in combination with the impacts of other past, current, or reasonably foreseeable future developments.
Demography	The statistical study of populations, with particular reference to births, deaths, migratory movements, age and sex.
Ecosystem	The organisms of a natural community together with their environment.
Esker	A winding ridge made of sand and gravel deposited by a melting glacier.
Faulting	Cracks or breaks within a body of rock, causing one part of the body of rock to slip or slide relative to the other.
Fines	Very small particles of rock, mineral or sediment.
Geochemistry	The study of the chemical composition of the earth and the physical and chemical processes responsible for it.
Geology	The study of Earth in terms of its development as a planet. Commonly thought of as the study of rocks.
Geomorphology	The scientific discipline that studies the surface features of the Earth, including land forms.
Geotechnical	Relating to the application of engineering to geology.
Gradient	The angle of a slope, or its steepness.
Greenhouse Gas	A gas released into the atmosphere, often by human activities such as burning fossil fuels, that increases the capacity of the lower atmosphere to trap heat from the sun, thereby contributing to global warming.
Hydrocarbons	Any substance containing carbon and hydrogen in various combinations (e.g., gasoline and oil).

Glossary – Continued

Hydrology	The science that deals with the occurrence, circulation, distribution, and properties of the waters of the Earth, including their reactions with the environment.
Leaching	The process by which a liquid (e.g., water) passes through a substance, picking up some of the material and carrying it to other places. Can occur underground in soil and rock, or above ground through piles of material.
Limnology	The study of life in lakes, ponds, and streams.
Lithology	The description of the physical characteristics of a rock, often based on its colour, structure, mineral components, and grain size.
Nitrate	A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water, and that can have harmful effects on humans and animals.
Nitrite	A chemical compound produced when ammonia in wastewater is oxidized by bacterial or chemical reactions and ultimately becomes nitrate.
Nitrogen dioxide	The result of nitrate oxide combining with oxygen in the atmosphere. Nitrate oxide is a gas formed by combustion under high temperature and pressure, for example in a vehicle engine. Nitrogen dioxide is a major component of photochemical smog.
Nunavummiut	The indigenous inhabitants of Nunavut.
Ore	A rock or mineral that contains a valuable constituent, such as diamonds or a metal, for which it is mined and processed.
Overburden	Material that must be removed to allow access to an ore body, particularly in a surface mining operation.
Palaeobotany	The study of ancient and fossil plants and vegetation.
Palaeontology	The study of life in the past as recorded by fossil remains.
Periphyton	Very small plants that live attached to a surface in freshwater but do not move around.
Permafrost	Permanently frozen ground.
Phenology	The study of periodic phenomena in plants, such as the time of flowering in relation to climate.
Phytoplankton	Very small plants that float or drift in lakes.
Plume	A visible or measurable discharge of a contaminant from a given point of origin. Plumes may occur in water or air.
Pore	A very small hole, such as may occur in some types of rock.

Glossary – Continued

Post-closure	The period of time, considered to be up to 30 years, following the shut-down of a mine or other facility, during which monitoring of its effects should be continued.
Post-project audit	An evaluation after a development of all of its environmental and social impacts and of the mitigation measures applied to it.
Proponent	The individual or organization that wishes to carry out a development project.
Raptor	A bird that hunts by snatching its prey.
Riparian	The land-water interface. Also refers to organisms living or located on the bank of a stream, river or lake.
Rock glacier	Boulders and fine material cemented by ice about a meter below the surface.
Rock heave	The movement of rocks as a result of freezing and thawing.
Rotary-wing aircraft	A helicopter.
Sacred site	A place on the land created or used by Inuit spiritual leaders in the past for religious ceremonies, such as: a platform or formation leading to an “altar”; a hill, mountain, stone, boulder, river, lake, or Inukshuk designated as a sacred site; an offering place where people might plead for good fortune and well-being, often found along the coast, but also inland; a place where an unusual event might have happened, or an event that led to a death or a story of survival; a place known to Elders in legend where a significant story occurred. (See Ittarnisalirijiit Conference on Sacred Sites and Spiritual Places, Rankin Inlet, 1996).
Seismicity	The phenomenon of earth movements, in extreme cases in the form of earthquakes, and their geographic distribution.
Sulfur dioxide	A gas formed when sulfur burns in the presence of oxygen, as for example in the burning of gasoline or diesel fuel in a vehicle engine. It is a major air pollutant that is corrosive and harmful to plants and animals, especially trees.
Tailings pond	An engineered structure for storing those portions of washed, processed or milled ore that are regarded as too poor to be treated/processed further.
Talik	Permanently unfrozen ground in regions of permafrost. Usually applies to a layer that lies above the permafrost but below the active layer.
Thermal inversion	A phenomenon in which a layer of cold air above a layer of warm air close to the ground prohibits the dispersion of atmospheric pollution, such as vehicle exhausts.
Thermal stability	The degree to which something, such as permafrost, has the capacity to remain at the same temperature over time.
Toponym	A place name.

Glossary – Continued

Toxin	A poisonous substance.
Vascular plant	A plant with a particular type of tissue for carrying water and mineral salts and for assisting the plant to stand upright.
Zooplankton	Very small animals that float or drift in lakes.

UNITS OF MEASURE

Above mean sea level	amsl
Ampere	A
Centimetre	cm
Cubic centimetre	cm^3
Cubic feet per second	ft^3/s or cfs
Cubic foot	ft^3
Cubic inch	in^3
Cubic metre	m^3
Cubic metres per annum	m^3/a
Cubic yard	yd^3
Day	d
Decibel adjusted	dBa
Decibel	dB
Degree	°
Degrees Celsius	°C
Foot	ft
Gram	g
Grams per litre	g/L
Grams per tonne	g/t
Greater than	>
Hectare (10,000 m^2)	ha
Horsepower	hp
Hour	h
Hours per day	h/d
Hours per week	h/wk
Hours per year	h/a
Inch	"
Kilo (thousand)	k
Kilogram	kg
Kilograms per cubic metre	kg/m^3
Kilograms per hour	kg/h
Kilograms per square metre	kg/m^2
Kilojoule	kJ
Kilometre	km
Kilometres per hour	km/h
Kilopascal	kPa
Kilowatt	kW
Less than	<
Litre	L
Litres per minute	L/m
Megavolt-ampere	MVA
Megawatt	MW
Metre	m
Metres above sea level	masl
Metres per minute	m/min

Units of Meausre – Continued

Metres per second	m/s
Metric ton (tonne)	t
Micro siemen	μS
Microgrames per cubic metres	μg/m^3
Micrometre (micron)	μm
Milligram	mg
Milligrams per litre	mg/L
Millilitre	mL
Millimetre per second	mm/s
Millimetre	mm
Million tonnes	Mt
Million	M
Minute (time)	min
Month	mo
Nephelometric tubidity units	NTU
Ounce	oz
Parts per billion	ppb
Parts per million	ppm
Pascal (newtons per square metre)	Pa
Percent	%
Pound(s)	lb
Square centimetre	cm^2
Square foot	ft^2
Square inch	in^2
Square kilometre	km^2
Square metre	m^2
Tonne (1,000 kg)	t
Tonnes per day	t/d
Tonnes per hour	t/h
Tonnes per year	t/a
Total dissolved solids	TDS
Total suspended solids	TSS
Volt	V
Week	wk
Yard	yd
Year (annum)	a

ABBREVIATIONS & ACRONYMS

(U.S.) Environmental Protection Agency	EPA
Acid rock drainage	ARD
All-terrain vehicle	ATV
Ambian air quality objectives	AAQO
American Petrolium Institute	API
Ammonium nitrate	AN
Ammonium nitrate and fuel oil	ANFO
Approximately	approx. / ~
Aquatic Environment Management Plan	AEMP
Baker Lake Prospectors Association	BLPA
Beverly & Qamanirjuaq Caribou Management Board	BQCMB
Canadian Council of Ministers of the Environment	CCME
Canadian Environmental Assessment Act	CEAA
Canadian Environmental Quality Guidelines	CEQG
Canadian Metal Mining Effluent Regulations	MMER
Carbon-in-pulp	CIP
Committee on the Status of Endangered Wildlife in Canada	COSEWIC
Community & Land Resources Committee	CLARC
Conference Board of Canada	CBoC
Cumulative Effects Assessment	CEA
Department of Culture, Language, Education & Youth	CLEY
Department of Sustainable Development	DSD
Dissolved organic carbon	DOC
Ecological Land Classification	ELC
Electromagnetic	EM
Environment Canada	EC
Environmental Effects Monitoring	EEM
Environmental Impact Assessment	EIA
Environmental Impact Review Board	EIRB
Environmental Impact Screening Committee	EISC
Environmental Impact Statement	EIS
Environmental Management Plan	EMP
Environmental Management System	EMS
Geological Survey of Canada	GSC
Global positioning system	GPS
Government of Nunavut	GN
Greenhouse Gas	GHG
Gross Domestic Product	GDP
Harmfully altered, disrupted or distroyed	HADD
Hazardous Materials Management Plan	HMMP
Horizontal-to-vertical ratio	H:V
Hunters' & Trappers' Organization	HTO
Indian and Northern Affairs Canada	INAC
Intergovernmental Panel on Climate Change	IPCC
Interim Sediment Quality Guideline	ISQG
Intermediate volcanic	IV
Inuit Impact Benefit Agreement	IIBA

Abbreviations & Acronyms – Continued

Iron formation rock	IF
Jacques Whitford Environment Ltd.	JWEL
Kivalliq Inuit Association	KIA
Local Study Area	LSA
Metal leaching	ML
National Pollutant Release Inventory	NPRI
Neutralize Potential ratio	NPR
No Net Loss	NNL
Northwest Territories	NWT
Northwest Territories Resources, Wildlife & Economic Development	NWTRWED
Nunavut Department of Sustainable Development	DSD
Nunavut Impact Review Board	NIRB
Nunavut Land Claims Agreement	NLCA
Nunavut Planning Comission	NPC
Nunavut Tunngavik Inc.	NTI
Nunavut Water Board	NWB
Occupational Health & Safety Plan	OHSP
Particulate matter	PM
Peak particle velocity	PPV
Potential for Acid Generation	PAG
Potential of Hydrogen	pH
Program for Regional & International Shorebird Monitoring	PRISM
Quality assurance / quality control	QA/QC
Quartzite	QTZ
Regional Study Area	RSA
Royal Canadian Mounted Police	RCMP
Sediment Quality Guidelines	SQG
Semi-autogenous grinding	SAG
Sexually Transmitted Disease	STD
Sivummut Economic Development Strategy	SEDS
Total dissolved solids	TDS
Total organic carbon	TOC
Tungavik Federation of Nunavut	TFN
Ultramafic rock	UM
UN Food & Agriculture Organization	FAO
Valued Ecosystem Component	VEC
Valued Socioeconomic Component	VSEC
Volatile compound	VOC
Worker's Compensation Board	WCB
World Wildlife Fund	WWF

COMMON CHEMICAL SYMBOLS

Aluminum	Al
Ammonia	NH_3
Antimony	Sb
Arsenic	As
Bismuth	Bi
Cadmium	Cd
Calcium	Ca
Calcium carbonate	$CaCO_3$
alcium oxide	CaO
Calcium sulphide dehydrate	$CaSO_4 \cdot 2H_2O$
Carbon	C
Carbon monoxide	CO
Chlorine	Cl
Chromium	Cr
obalt	Co
Copper	Cu
Cyanide	CN
Fluorine	F
Gold	Au
Hydrogen	H
Iron	Fe
Lead	Pb
Magnesium	Mg
Manganese	Mn
Manganese dioxide	MnO_2
Manganous hydroxide	$Mn(OH)_2$
Molybdenum	Mo
Nickel	Ni
Nitrite	NO_2
Nitrogen	N
Nitrogen oxide compounds	No_x
Oxygen	O_2
Palladium	Pd
Platinum	Pt
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Sulphur	S
Thallium	Tl
Tin	Sn
Titanium	Ti
Tungsten	W
Uranium	U
Zinc	Zn

1.0 PURPOSE OF NIRB REVIEW

The proposed Meadowbank project is subject to the environmental review and related licensing and permitting processes established by Part 5 of the Nunavut Land Claims Agreement (INAC and TFN, 1993). Cumberland has written this Draft Environmental Impact Statement (DEIS) based on guidelines issued by the Nunavut Impact Review Board (NIRB). This report and many others describe the proposed Meadowbank project, the land, the wildlife, and the people. These reports also identify potential effects of the project and the steps Cumberland will take to make sure that the water stays clean, the fish and wildlife stay healthy, and that local people benefit from the project. The information contained in the DEIS and supporting documents will be used by NIRB and other regulators to review the project and determine if additional information is required for the Final Environmental Impact Statement.

2.0 PROJECT DEFINITION

The Meadowbank Gold project represents construction, operation, maintenance, reclamation, closure, and monitoring of an open pit gold mine in the Kivalliq Region of Nunavut. The project is located on Inuit-owned land approximately 70 km north of Baker Lake (see Figures 2-1 and 2-2). The total gold resource is estimated to be 3.8 M ounces. This resource will be extracted during the roughly 8- to 10-year operational lifespan of the mine. The project is designed as a “fly in/fly out” operation with an airstrip at Meadowbank providing the main access to the site (see Figure 2-3). All construction and operating supplies for the project will be transported on ocean freight systems to facilities constructed at the Hamlet of Baker Lake, which will include barge unloading facilities, laydown area, and fuel tank area (see Figure 2-4). A haulage route from Baker Lake to the project will provide access and re-supply, while onsite mine access roads will connect the open pit areas to site infrastructure. Onsite facilities include a mill, power plant, maintenance facilities, tank farm for fuel storage, water treatment plant, sewage treatment plant, airstrip, and accommodations for 250 people. A site layout is provided in Figure 2-5.

Open pit mining will occur in three separate areas and water retention dikes will be constructed from mined rock to allow for the mining of ore beneath shallow lakes. A low permeability vertical slurry wall will be constructed in the center of the dikes to minimize seepage from surrounding lakes into the work area. Construction of the dikes will use floating silt curtains to minimize the release of suspended solids into surrounding lake waters.

Mined rock will be placed in tailings impoundments and waste rock storage piles. A classification system will be used to identify both potentially acid-generating (PAG) and metal leaching rock; PAG mine rock will be stored in designated areas designed for long-term stability. Acidic runoff will be appropriately handled. Ore processing will involve cyanide leaching, cyanide destruction, and refining doré bars. The combined leach residue slurry will be treated with metabisulphite to detoxify the free cyanide in the tailings stream. The freshwater supply for the mine and camp will be pumped from the Third Portage Lake. Mine process water will be primarily reclaimed from the tailings pond, and treated sewage will be discharged to the tailings pond.

Figure 2-1: Location Map within Nunavut Showing Western Churchill Geological Province Boundary

Figure 2-2: Parks & Conservation Areas in Kivalliq Region

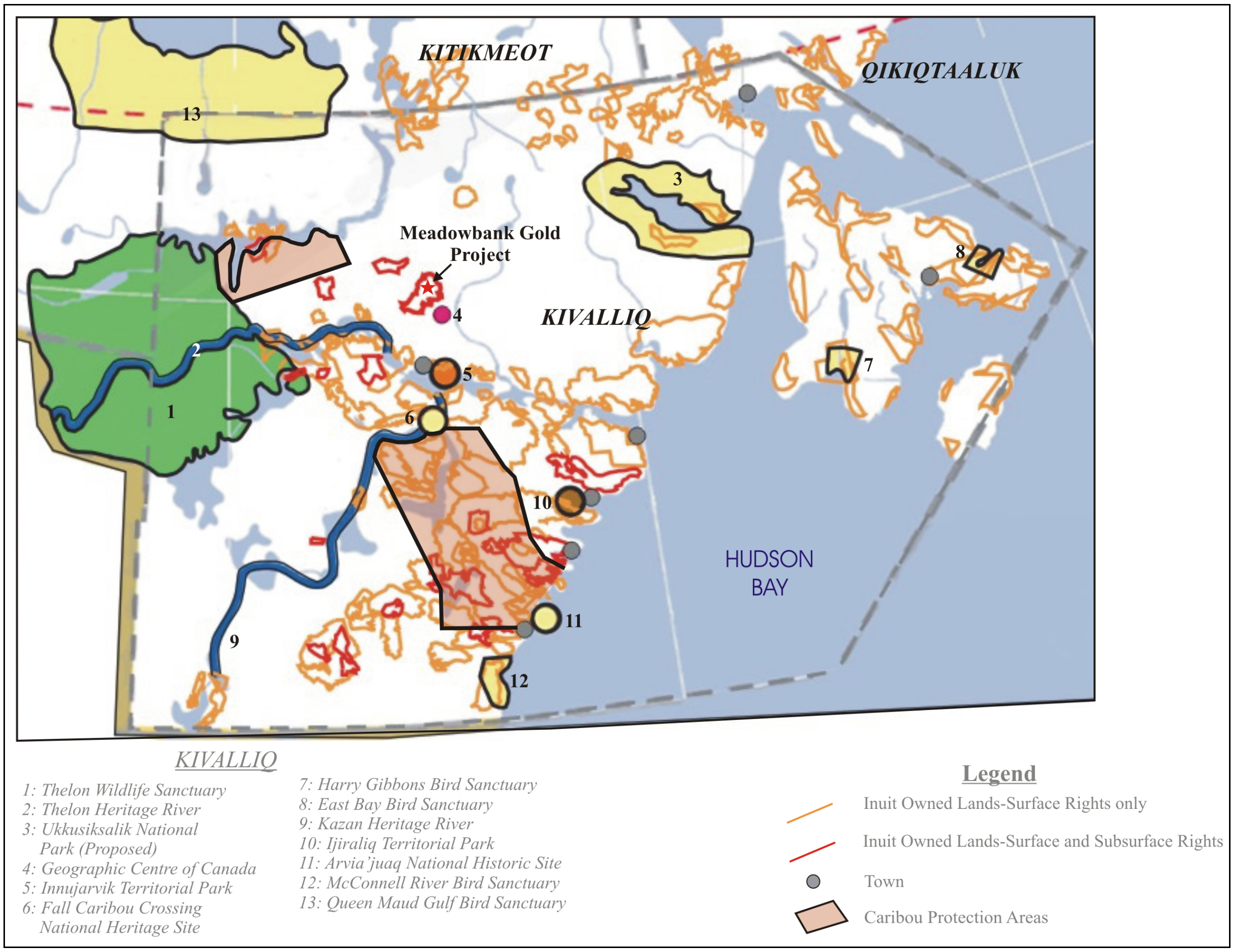
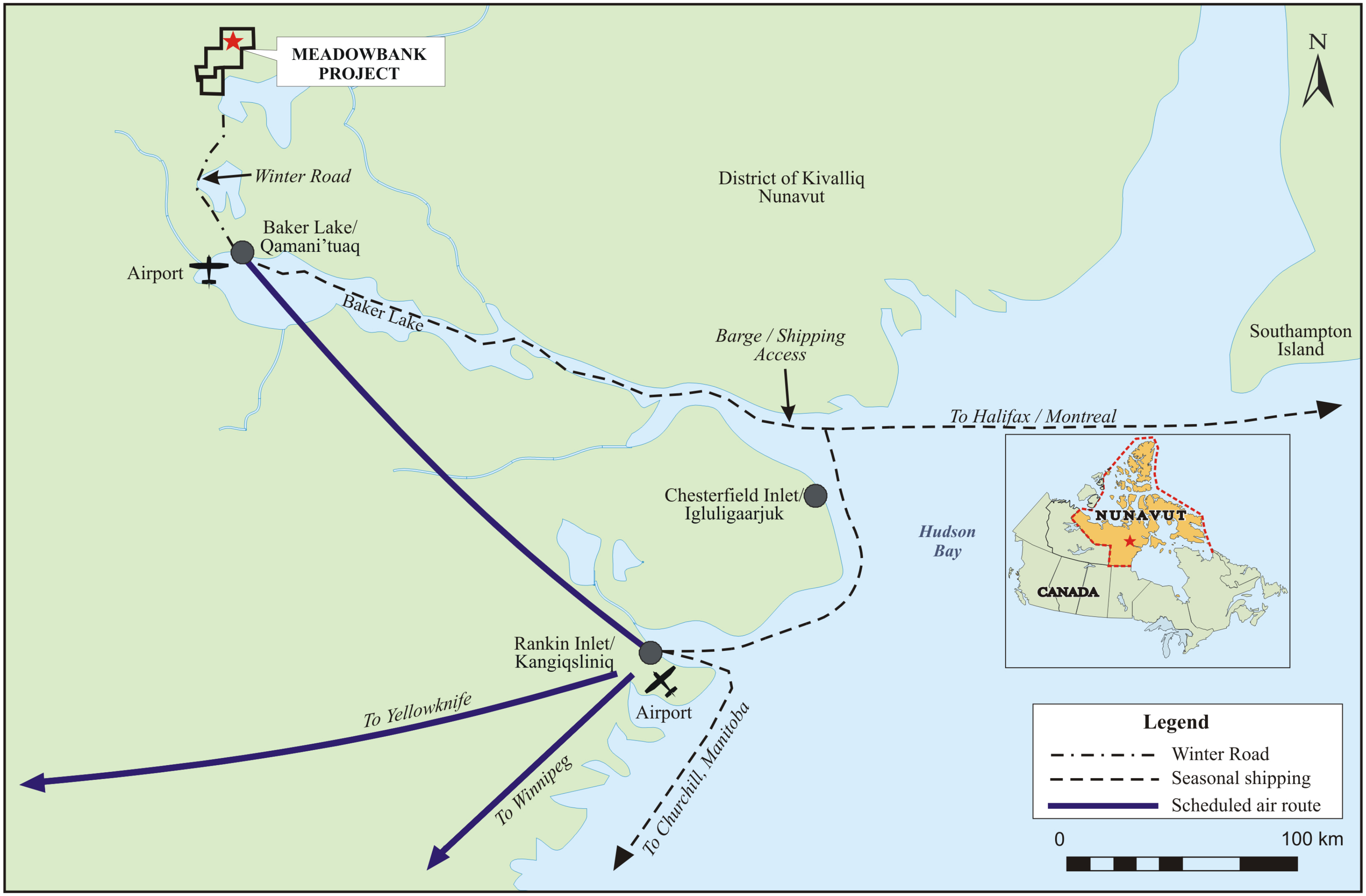
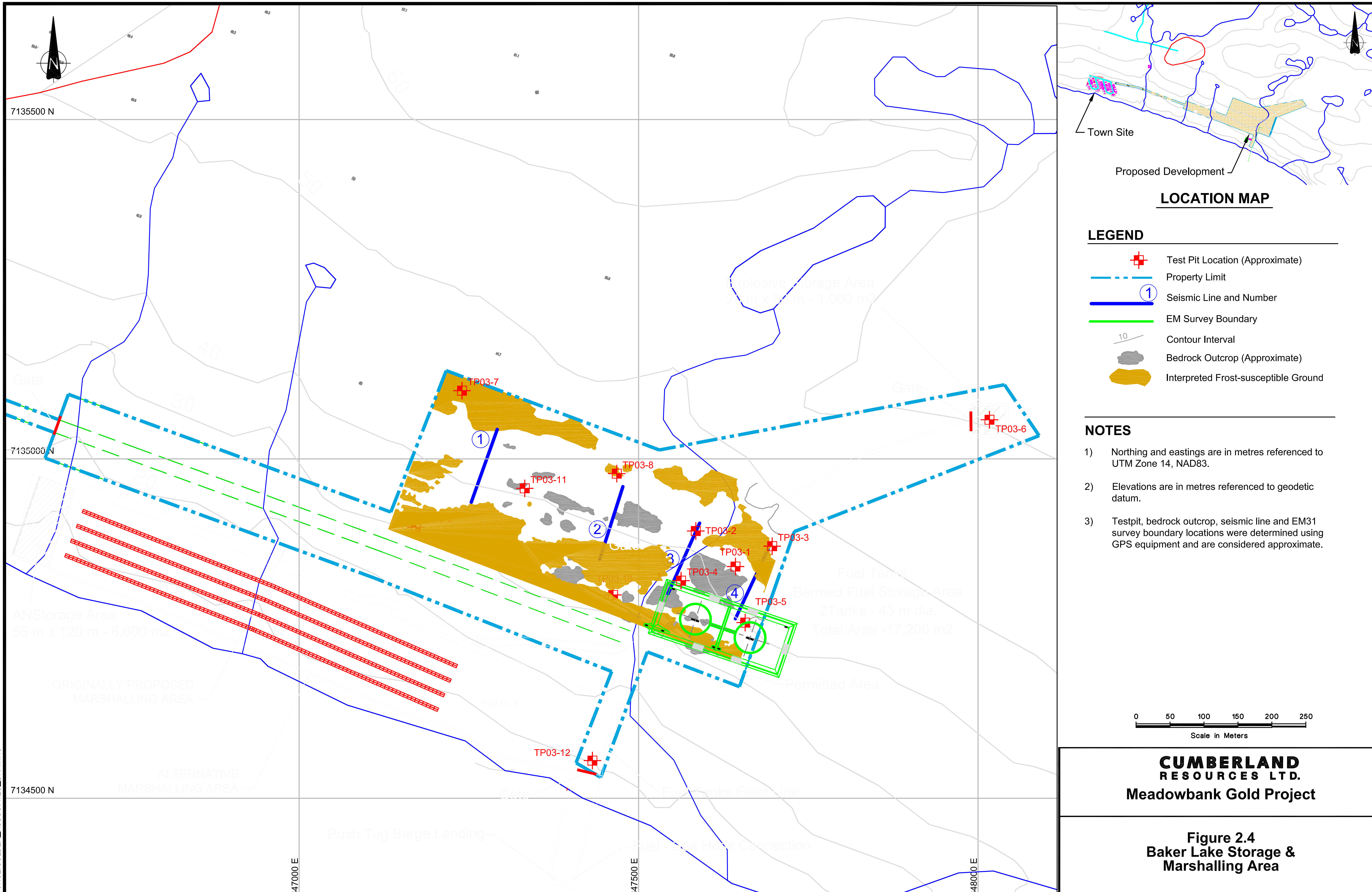
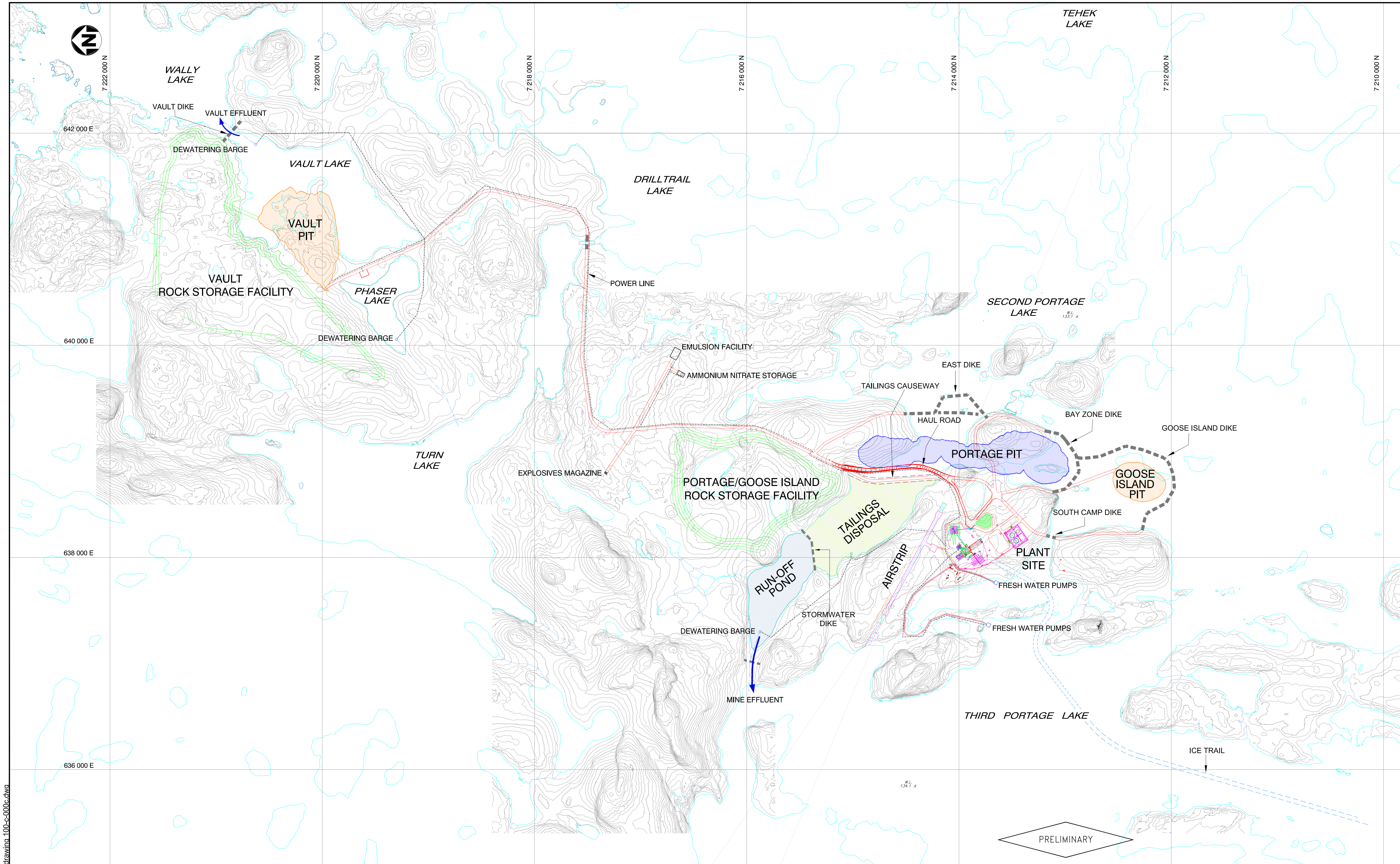


Figure 2-3: Site Access & Transportation Alternatives





7135500 N
7135000 N
7134500 N
647000 E
647500 E
648000 E
TP03-7
TP03-8
TP03-11
TP03-2
TP03-3
TP03-1
TP03-4
TP03-5
TP03-6
TP03-12
1
2
3
4
SOURCE:GOLDER_ASSOCIATES_DRAWING
Town Site
Proposed Development
LOCATION MAP
LEGEND
Test Pit Location (Approximate)
Property Limit
Seismic Line and Number
EM Survey Boundary
Contour Interval
Bedrock Outcrop (Approximate)
Interpreted Frost-susceptible Ground
NOTES
1) Northing and eastings are in metres referenced to UTM Zone 14, NAD83.
2) Elevations are in metres referenced to geodetic datum.
3) Testpit, bedrock outcrop, seismic line and EM31 survey boundary locations were determined using GPS equipment and are considered approximate.
0 50 100 150 200 250
Scale in Meters
CUMBERLAND RESOURCES LTD.
Meadowbank Gold Project
Figure 2.4
Baker Lake Storage & Marshalling Area



SOURCE: AMEC drawing 100-c-000c.dwg

Figure 2.5
Proposed Mine Site Layout

CUMBERLAND RESOURCES LTD.
Meadowbank Gold Project

Environmental baseline studies have been conducted in the project area, the results of which have been integrated into the current project design. Valued ecosystem components (VECs) and valued social and economic components (VSECs) have been identified in consultation with regulatory authorities and members of the local community. VECs include: air quality, noise, water quality, surface water quantity, permafrost, fish populations, fish habitat, ungulates, predatory mammals, small mammals, raptors, waterbirds, and other breeding birds. VSECs include: employment, training and business opportunities; traditional ways of life; individual and community wellness; infrastructure and social services; and sites of heritage significance.

Cumberland will implement an Environmental Management System (EMS) consisting of three key elements: an integrated environmental management plan, a formal environmental awareness program, and an ongoing environmental monitoring plan. Upon conclusion of activities, Cumberland will fully decommission the mine by removing the mill and ancillary buildings, recontouring disturbed areas, and reclaiming vegetation.

3.0 EIS OVERVIEW

To prepare the draft EIS for the Meadowbank Gold project, Cumberland:

1. Determined the VECs and VSECs based on discussions with stakeholders, public meetings, traditional knowledge, and the experience of other mines in the north (see Column 1 in Figure 3-1).

2. Conducted baseline studies for each VEC and VSEC and compared / contrasted the results with the results of traditional knowledge studies (see Column 1 in Figure 3-1 for a list of baseline studies).

3. Used the baseline and traditional knowledge studies to determine the key potential project interactions and impacts for each VEC and VSEC (see Column 2 in Figure 3-1 for a list of Environmental Impact Assessment (EIA) reports. The impacts are also summarized in the impact matrices provided in Appendix B of this document).

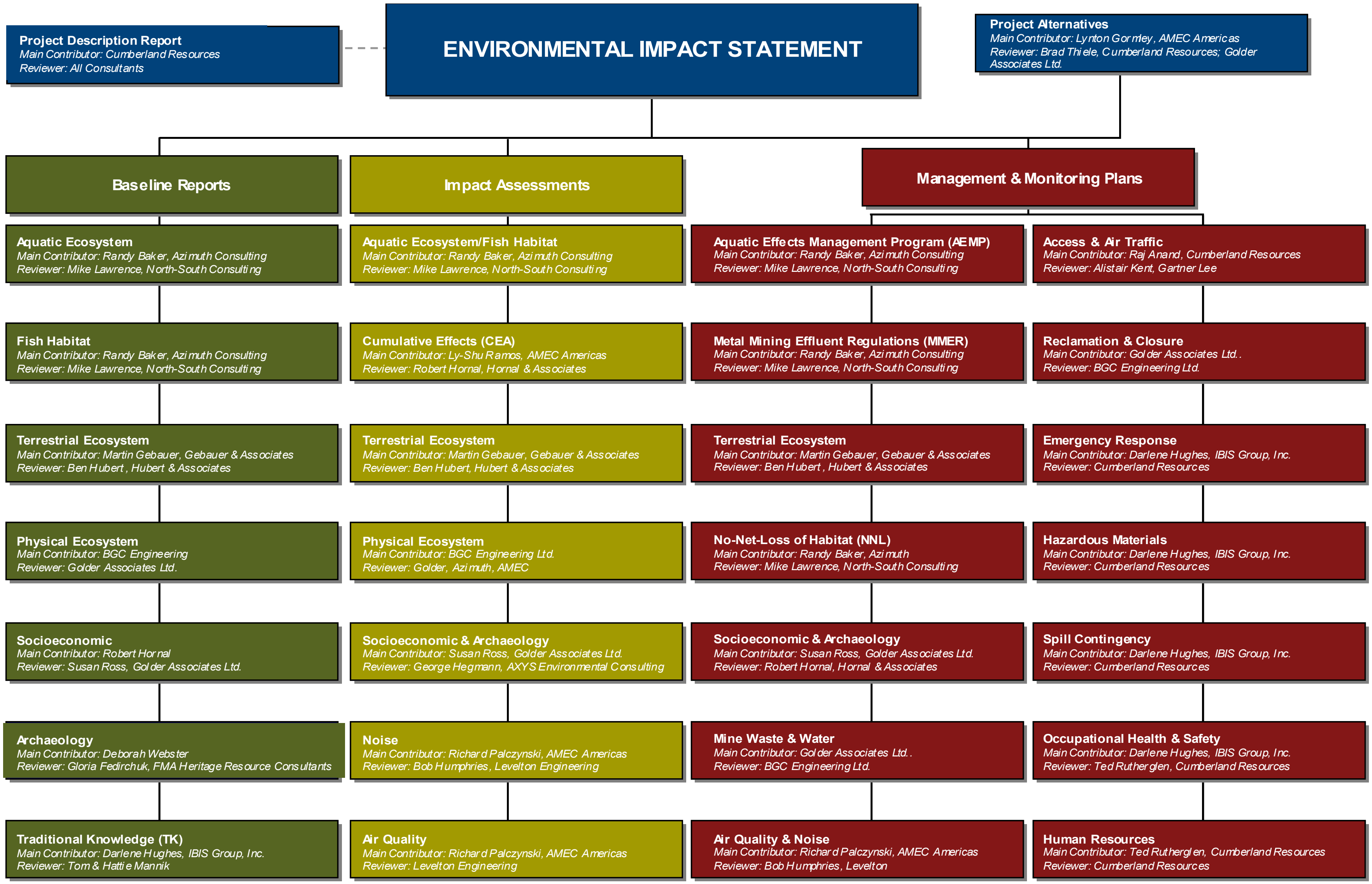
4. Developed preliminary mitigation strategies for key potential interactions and propose contingency plans to mitigate unforeseen impacts by applying the precautionary principle (see Column 3 in Figure 3-1 for a list of management plans).

5. Developed long-term monitoring programs to identify residual effects and areas in which mitigation measures are non-compliant and require further refinement. The mitigation and monitoring procedures will be integrated into all stages of project development and will assist in identifying how natural changes in the environment can be distinguished from project-related impacts (monitoring plans are also included in Column 3).

6. Summarized above reports into a 150 page EIS report.

Reports generated for each step are listed in Figure 3-1. To ensure the accuracy of the submitted reports, Cumberland implemented a vigorous quality assurance/quality control (QA/QC) process. Experts were hired to collect data over several years and prepare the appropriate reports. All reports were then reviewed by third-party specialists. Members of the local community were hired to assist in all aspects of data collection and review (see Appendix A and Table 4-3 for a list of participants.) These reports, along with the summary Environmental Impact Statement (EIS), form the basis of Cumberland's Draft Environmental Impact Statement.

Figure 3-1: EIS Support Documentation Organization Chart



As per Sections 3.1 to 3.5 of the Terms of Reference, Cumberland has observed the full intent of the Nunavut Impact Review Board (NIRB) guidelines issued February 2004. This document is double-spaced and conforms to the 150 page text limit **(NOTE: OVER 70 PAGES OF FIGURES, CHARTS, DIAGRAMS, AND PHOTOGRAPHS HAVE BEEN INCLUDED AS NECESSARY TO ASSIST THE READER AND CLARIFY MATERIAL PRESENTED IN THE TEXT.**

To facilitate the review of this document by regulatory authorities and other stakeholders, this DEIS report **responds directly** to the outline of the Terms of Reference provided by NIRB (February 2004) by maintaining the headings and numbering system of the Terms of Reference. Although this approach has some organizational constraints, it allows the conformity and deficiency reviews to be conducted in an efficient and effective manner, and minimizes confusion regarding the location in the document of critical project components.

As per Sections 3.6 and 3.7 of the Terms of Reference, an Executive Summary and Popular Summary have been prepared. The Executive Summary describes the key project elements and key findings of the EIS and provides a clear rationale for Cumberland's assessment of the predicted impacts. The Popular Summary has been written in non-technical language, includes a glossary, and has been translated. Both summaries are available as separate documents.

4.0 SUBSTANTIVE DIRECTIVES

4.1 The Proponent

Cumberland Resources Ltd. (Cumberland), a public, Canadian exploration and development company, is the sole owner of the Meadowbank project and the proponent for the environmental review process.

4.1.1 Cumberland & Regulatory Compliance

Cumberland has complied with all governmental policies and regulations pertaining to environmental and socioeconomic issues in developing the Meadowbank project and has an exemplary local employment and safety record over nine years of exploration in Canada's Arctic.

Cumberland has been very forthcoming with all government authorities during all aspects of project development, and has a good rapport with the local Inuit people based on mutual respect and communication. Cumberland intends to build a mine with integrity—one that is safe, environmentally responsible, and beneficial to all parties involved. To this end, Cumberland intends to balance good stewardship in the protection of human health and the natural environment with the need for economic growth.

4.1.2 Cumberland's Environmental Policy

Cumberland Resources Ltd. is committed to achieving a high standard of environmental care in conducting its mineral exploration activities. Cumberland's Environmental Policy includes:

- Compliance with all applicable legislation including laws, regulations, and standards. Where laws do not exist, appropriate standards will be applied to minimize environmental impacts resulting from exploration activities.
- Open communication with government, the community, and employees on environmental issues.
- Development and adherence to management systems that adequately identify, monitor, and control environmental risks associated with Cumberland's exploration activities.
- Assurance that the employees are aware of their responsibilities and comply with Cumberland's Environmental Policy and field guide.

4.1.3 Contractors to the Meadowbank Gold Project

A pre-hire assessment will be made of all contractors and subcontractors based on their environmental and safety record. Preference will be given to "best-in-class" companies based on their past performance in these areas.

Major contractors to the project will be required to have their own environmental policies that meet federal and territorial legislative standards. This will be verified by Cumberland prior to final engagement of the contractor.

4.2 SUSTAINABLE DEVELOPMENT & PRECAUTIONARY PRINCIPLE

According to Environment Canada's Sustainable Development Strategy, *sustainable development* "is not an end point, but rather an approach to decision-making. It recognizes that social, economic and environmental issues are interconnected, and that decisions must incorporate each of these aspects if they are to be good in the long term."

Achieving sustainable development requires continued and full consideration of the economic, environmental, and social impacts on the sustainability of both the project and the Baker Lake community. To promote the goal of sustainable development, support is needed for local people to pursue sustainable livelihoods both in the traditional and wage economy. To this end, Cumberland:

- has negotiated a benefit agreement with the KIA to accompany the exploration land lease; this agreement focuses on jobs, training, local hiring programs, contracting and community liaison
- has successfully worked with businesses in Baker Lake and elsewhere in Kivalliq Region over the exploration phase of the project; with continuing preferential contracting, local business participation in the project is expected to grow
- coordinates and supports community capacity building through local training initiatives including transportation of dangerous goods and first aid
- has made financial contributions to the local heritage center and Elders organization in Baker Lake
- has, over a nine-year term, directed approximately 25% of its exploration expenditures and maintained a 25% local employment rate through local communities in Nunavut.

Other strategies that encourage sustainable and responsible mining developments include community participation and information disclosure. Cumberland has maintained an average 25% local workforce during its exploration programs and has demonstrated its commitment to community consultation by establishing a community liaison office, hiring a local liaison officer, and holding community forums and public meetings on a regular basis. Furthermore, it has informed the communities of production designs and plans for future mining and has voluntarily distributed the results of traditional knowledge studies.

Cumberland's efforts to gather and document traditional knowledge are a testament to its commitment to undertake the full consideration of economic viability, social implications, and cultural and environmental values in decision-making and policy and program development. Cumberland respects the traditional values of the Inuit and recognizes that decision-making based on the best available scientific, traditional, and local knowledge is not only essential on a pragmatic level, but is the foundation for the promotion of a healthy community interaction.

The safe use of minerals and metals, life-cycle assessments, product stewardship, mitigation of environmental impacts of development, mine decommissioning, and site reclamation are among other commitments Cumberland has made to sustainable resource development.

In order to achieve sustainable development, policies must be based on the *precautionary principle*. Environmental measures must anticipate, prevent, and mitigate the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The Meadowbank environmental impact, socioeconomic effects, and heritage resources impact assessments have addressed all known potential effects of the project on the environment, economy, culture, and heritage of the region. Comprehensive management and monitoring programs are planned to mitigate impacts and allow early detection of unpredicted changes.

4.3 BASELINE DATA COLLECTION & METHODOLOGY

This EIS applies an ecosystem-based approach by describing the ecological function of each ecosystem component, indicating the ecological pathways of the impacts that are predicted, and designing mitigation and monitoring plans to deal with those impacts (see Figures 4-1 and 4-2). Baseline data collection commenced in 1996 and continued through to 2004. These data are summarized in a series of baseline reports that are included as supporting documents in this Environmental Assessment documentation series (see Figure 3-1). The content of these reports is summarized in the subsections below.

Traditional knowledge enhanced Cumberland's understanding of the environment through public interaction and interviews conducted by a local Inuit heritage consultant (Hattie Mannik). Workshops were held with the community and with the Hunter's and Trapper's Organization (HTO) to help support and clarify the baseline data collected, specifically with regard to caribou migration patterns and fish. In addition, well-known and respected Inuit were hired as surveyors and in other capacities to help in the collection of scientific and traditional baseline data.

4.3.1 Physical Environment

Baseline physical environmental data were collected for hydrology, hydrogeology, permafrost, geochemistry, sediment, and water quality. Methods for the collection of data for these studies are described below.

Hydrology – Hydrometric data were recorded from the onsite meteorological weather station (operational since 1997), as well as through monitoring of lake levels, lake outlet discharges and snow surveys. Climate data from Baker Lake, from 1947 to present, were also used to put the site in context with the regional environment.

Permafrost – Progressive geotechnical drilling investigations were conducted between 1996 and 2003. Eleven boreholes were drilled within the proposed plant site and six oriented boreholes were drilled in the Portage pit and tailings facility areas. Laboratory testing was carried out on a selection of the samples recovered. Thermistor cables were installed in several holes at the dike abutments, the

Figure 4-1: Generalized Linkage Diagram (VECs)

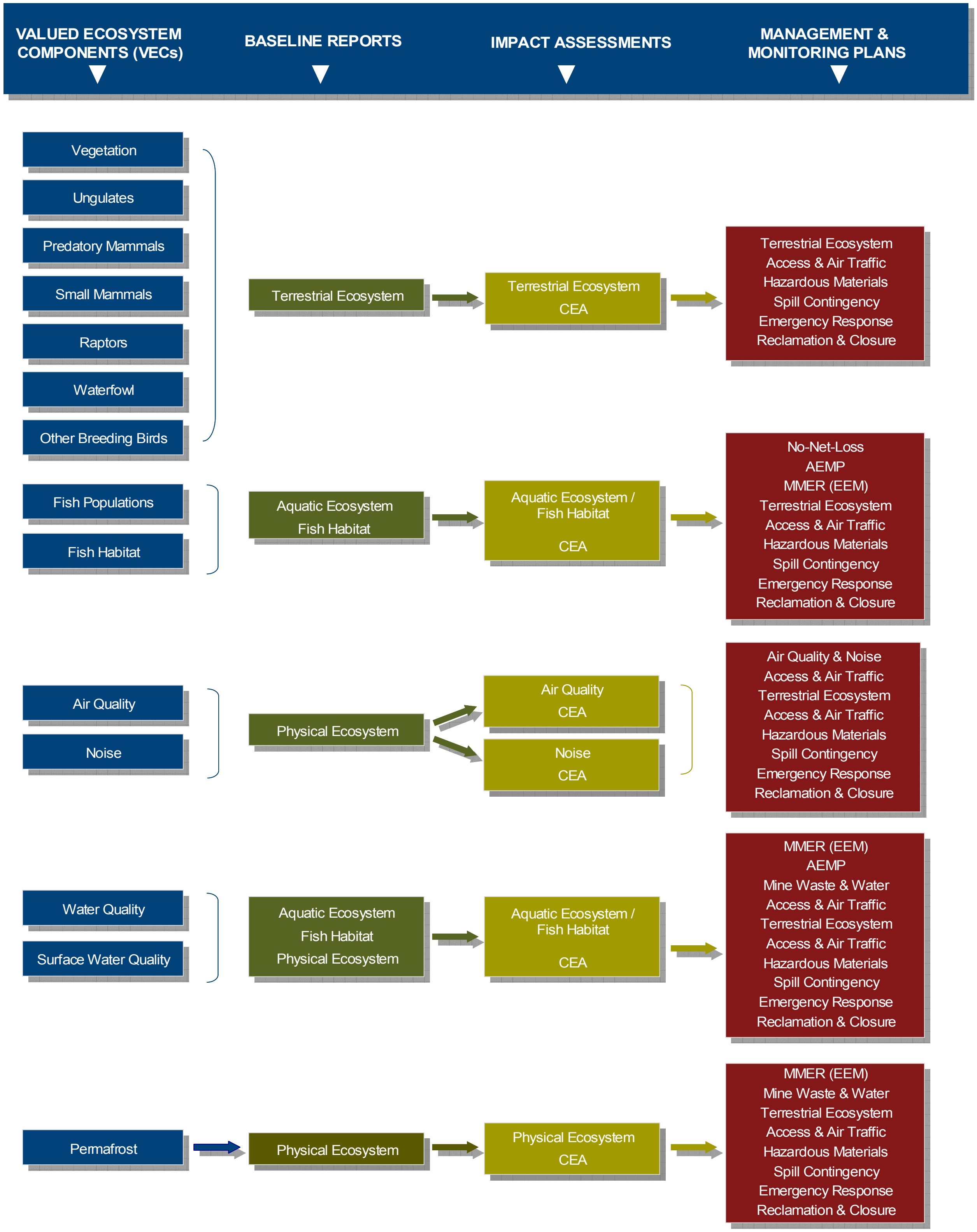
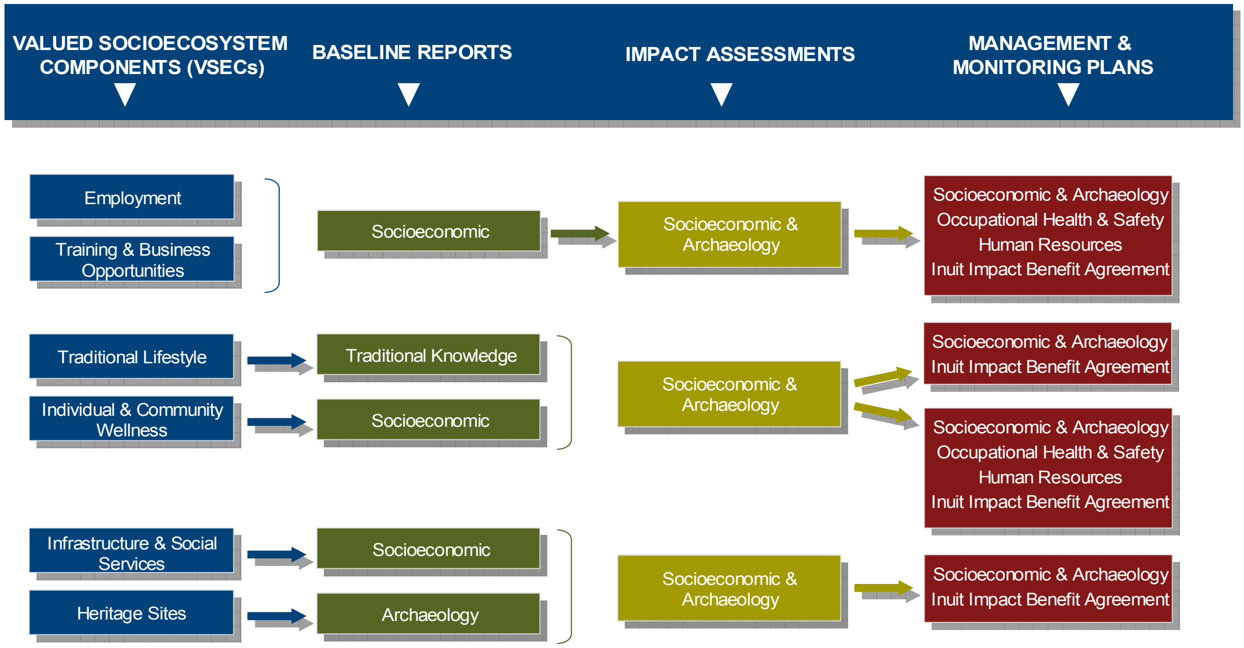


Figure 4-2: Generalized Linkage Diagram (VSECs)



plant site, the Goose Island deposit, and across the east-west trending linear feature near the northwest end of Second Portage Lake. Hydraulic conductivity testing was carried out in several boreholes. An electromagnetic (EM) survey was completed over the proposed plant site, airstrip, and fuel tank farm to investigate ground ice.

Groundwater – Groundwater baseline data was collected in 2003 from four monitoring wells located within the three main rock types in the area of the Goose Island and Portage deposits (see Section 4.11.1 and Figure 4-29) and from the talik underlying the proposed tailings disposal area at Second Portage Lake. Wells were not installed in Vault as it lies within continuous permafrost.

Water Quality – The methods used to collect water between 1996 and 2003 were consistent among years, either by pumping water from depth using weighted C-flex tubing and a diaghram pump, or from the surface by hand. Ultraclean techniques were employed to minimize contamination and water samples were always collected before other environmental media to limit contamination of the water column. Before samples were taken, total depth (m) and a Global Positioning System (GPS) position were recorded. Vertical temperature and oxygen profiles were then recorded to determine the depth of sampling.

Sediment - Sediment was collected at all water sampling locations using a petite grab sampler. Water sample and sediment collection were accomplished using available, proven sample collection and handling methods and QA/QC procedures to ensure unbiased comparisons.

Geochemistry - A mine site materials geochemical program was developed to characterize rock at the mine site and define the nature and magnitude of impacts that may result from the interaction between mine materials and the environment during all phases of project development, including post-closure. This program involved characterizing:

- geochemical characteristics of bedrock in the area of the proposed open pits and planned mine infrastructure away from the ore deposits
- tailings material and overburden through static testing
- long-term weathering behaviour of selected pit rock and tailings samples with respect to acid rock drainage (ARD) potential and leachate chemistry through kinetic testing (guidelines presented by INAC (1992) for northern mine sites were applied in the classification of acid generation potential, with the neutralization potential ratio (NPR) as the principal indicator of ARD potential considered)
- aqueous chemistry of tailings decant and surface water ponded in mineralized exploration trenches.

The major rock types to be disturbed during construction and mining are grouped into three lithological units: iron formation rock (IF), intermediate volcanic (IV), and ultramafic rock (UM) rocks (see Table 4-1). A quartzite unit (QTZ) also occurs in localized areas of the upper portions of the west pit wall, but will generate a significantly lower quantity of waste rock (~1%). This unit was included in the static testing program but not in the kinetic testing program.

Processed ore samples from each of the three proposed pits were represented in the chemical characterization program (see Table 4-2).

Table 4-1: Pit Rock Lithology & Sample Distribution

Rock Type	Estimated Quantity of Pit Rock Generated (10^6 tonnes) Goose/Portage	Vault	Total	Lithological Distribution of Pit Rock (%)	Number of Samples Analyzed (Static Tests)	Sample Distribution (%)
IV	27	54	81	53.3	87	53
IF	34	-	34	22.4	31	19
UM	35	-	35	23.0	39	24
QTZ	2	-	2	1.3	7	4
Total	**98**	**54**	**152**	**100.0**	**164**	**100**

Table 4-2: Proportion of Tailings from Each Deposit & Sample Distribution

Deposit	Estimated Quantity of Ore Mined (10^6 tonnes)	Proportion of Tailings in Impoundment at Closure (%)	Number of Tailings Samples Analyzed (Static Testing)
Goose Island	1.7	8	5
Portage	11.5	53	5
Vault	8.5	39	5
Total	**21.7**	**100**	**15**

4.3.1.1 Static Testing

Static testing was conducted between 1996 and 2003 on 15 rock samples from mine site infrastructure, 164 drill core samples representing pit rock (including low grade ore and older, weathered samples), and 15 tailing solids of ores from each deposit. Other samples collected for water chemistry analysis included 11 tailings decant water samples and four trench water samples.

Mine infrastructure was characterized by 10 surface rock (grab) samples collected along the proposed airstrip alignment, three drill core samples, one surface grab sample collected from the plant site area, and one drill core sample collected from the tank farm area.

Pit rock samples were obtained from exploration drill core specifically for ARD and metal leaching testing to determine the spatial and compositional variability of each rock unit to be disturbed. Analysis of a relatively old drill core that had been exposed to climatic conditions on site for 11 to 12 years was conducted to document the effects of weathering on the chemical characteristics of pit rock.

Tailing solids and decant water samples were obtained from the metallurgical program, which focused on the processing characteristics of representative ore samples from each deposit.

4.3.1.2 Kinetic Testing

Kinetic testing was completed on representative samples of each of the three principal lithologies that will be disturbed during mining and on all flotation-circuit tailings generated from each deposit.

The pit rock sample selection focused on representing the average and higher concentration ranges of constituents having environmental interest. Lithological representation was addressed by considering the volume of waste to be generated from each lithology, the variance of constituents of interest for each lithology, and the potential impact from these constituents on water quality. The 12 pit rock samples selected for kinetic testing include six IV, four IF, and two UM rock samples.

4.3.1.3 Metal Leaching Potential

Metal concentrations in leachate generated by static and kinetic tests were compared to the Canadian Council of Ministers of the Environment's (CCME) Canadian Environmental Quality Guidelines (CEQGs) (updated 2002) for the protection of freshwater aquatic life, and to the Canadian Metal Mining Effluent Regulations (MMER, 2002). Short-term (static) leaching tests are considered initial screening tools in the identification of potential constituents of concern and do not necessarily infer non-compliance of mine drainage chemistry.

4.3.1.4 Water Quality Predictions

Water quality was calculated for each mine component by combining predicted water flow volumes with laboratory-derived chemical loading rates; the latter was obtained by leaching representative samples of mine site materials. The laboratory-derived chemical loading (leaching) rates were factored to account for the differences expected between site and laboratory conditions of particular importance, the lower ambient temperatures, larger size of rock fragments (tailings excepted), and expected water flow through the mine components.

4.3.2 Biological Environment

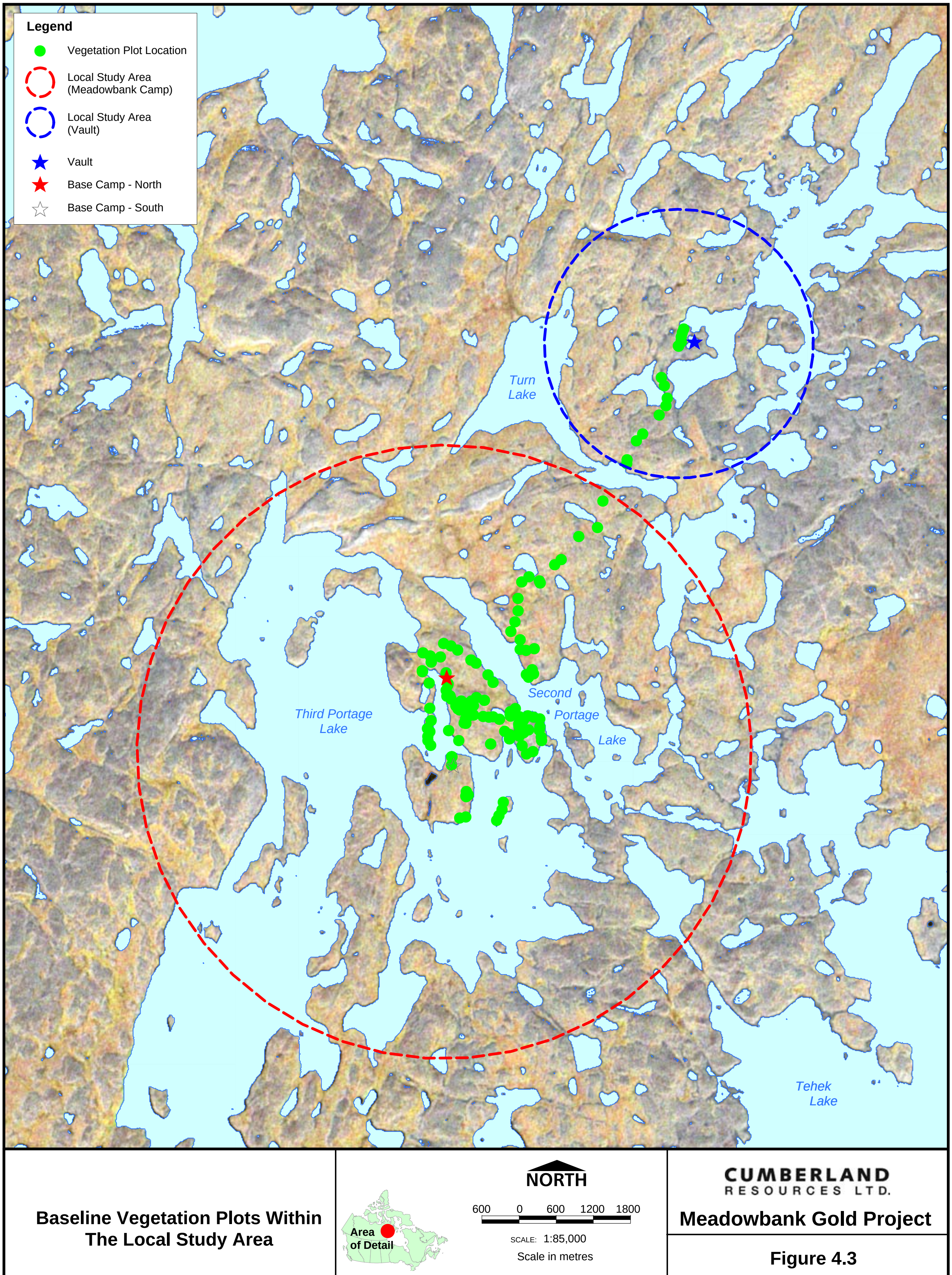
4.3.2.1 Vegetation

Between August 1999 and 2002, 156 vegetation plots, 5 x 5 m in size, were evaluated (see Figure 4-3 for the location of plots). Species and the percent cover by species were recorded at each plot. Additionally, an aerial reconnaissance survey was done in 1999 to look for community types not represented within the ground survey area.

In 2002, six phenology plots were established in the following communities: Sedge, Heath Tundra, Birch Seep, Lichen Rock, Snowbank, and Avens. Data recorded since 2002 include, snow-free date, first greening of sedges/cottongrasses, first leaf activity in dicots, floral activity, fruit formation, and seed release and dispersal.

Plant communities identified in the Local Study Area (LSA) (see Figure 4-3) were the basis of the ecological land classification (ELC) units, and the entire LSA was mapped on a 2002 series of 1:10,000 colour air photos. The ELC units included: Water, Sedge, Moss, Birch Seep, Riparian Shrub – Birch Association, Heath Tundra, Snowbank, Avens, Lichen-Rock (Boulder and Bedrock associations), Ridge Crest (Sand and Cobble communities), and Disturbed Sites.

For the Regional Study Area (RSA), ELC units were mapped by interpreting Landsat 7 satellite imagery (see Figure 4-4 for RSA boundaries). Of the four ELC satellite scenes from various dates that were mapped within the RSA, two were used in the classification. The scenes cover an area approximately 185 x 170 km in size, and have a pixel resolution of 30 m. Scene numbers 36-14 and 36-15 were taken on September 2000, and encompass both the RSA and the winter access road corridor. Landsat 7 imagery has eight data bands that capture different ranges of the electromagnetic spectrum. In addition, each image contains three pixel resolutions. Each band was used to detect different features in the imagery (i.e., spectral signatures), which were used to classify different ecosystem types. The RSA spectral classes were grouped into the following classes: Deep Water, Shallow Water, Sedge, Birch Seep, Riparian Shrub, Heath Tundra, Heath Tundra / Lichen-Rock



Baseline Vegetation Plots Within The Local Study Area

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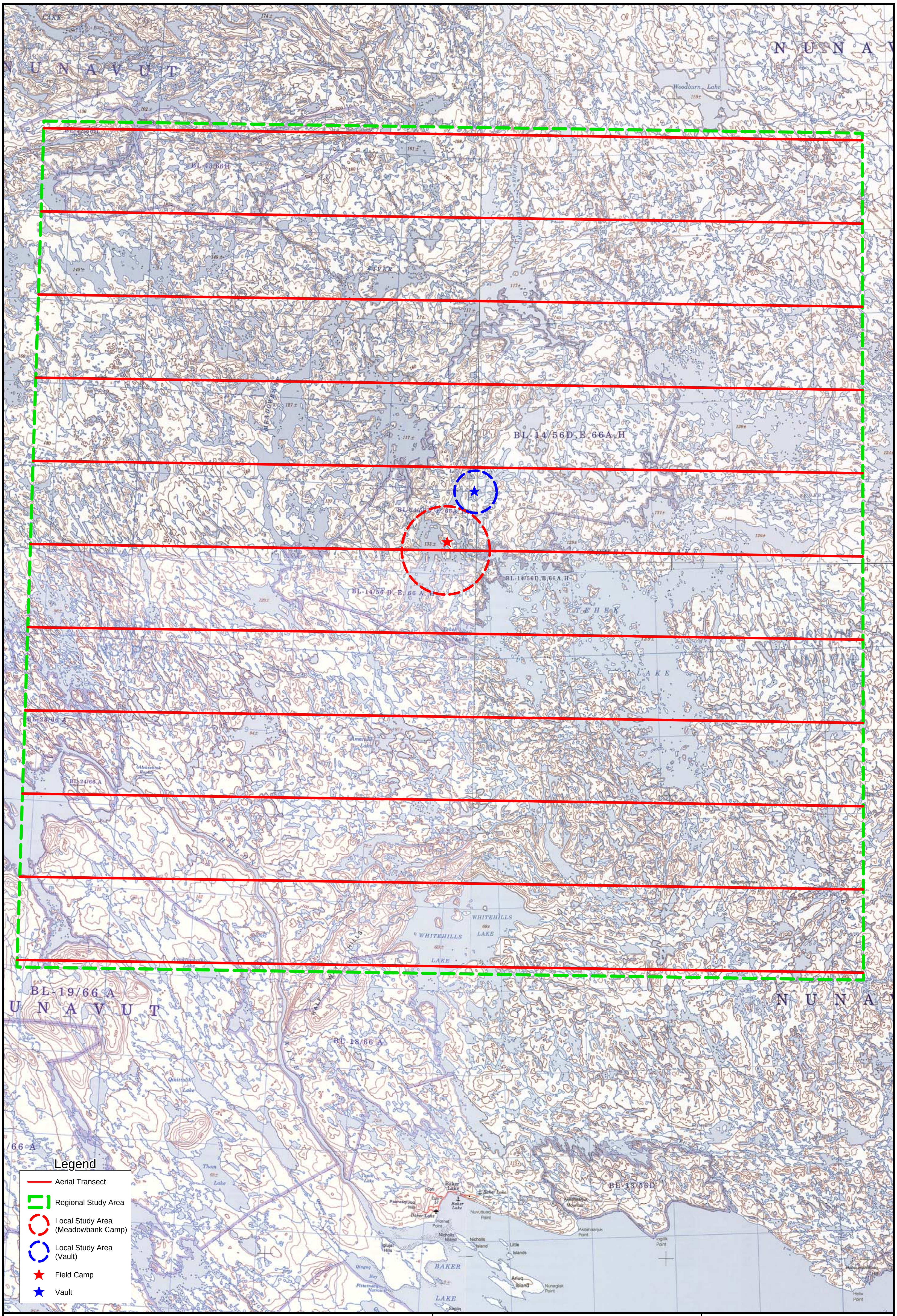
Figure 4.3

Source: KAVIK-AXYS Inc.



Aerial Survey Transects In The RSA, 1999, 2002 & 2003

NORTH

1:430,000

4 0 4 8 12

Scale in kilometres

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Figure 4.4

Association, Lichen-Rock – Boulder Association, Lichen-Rock – Bedrock Association, Esker, Sand/Gravel, Disturbed Sites, and Unclassified.

The ELC units mapped for the LSA (based on ground-truthing) and those for the RSA (based on an interpretation of satellite imagery) were slightly different. Accuracy of the ELC analysis was verified by: (a) interpretation of vegetation plot data; and, (b) data collected at 157 sites in the Tehek Lake area by Department of Sustainable Development. A detailed description of methodology is provided in the Baseline Terrestrial Ecosystem Report.

4.3.2.2 Wildlife

Baseline wildlife surveys were initiated in 1999 with the intent to document the seasonal numbers and distribution patterns of wildlife in the Meadowbank area. Aerial wildlife surveys in the RSA were conducted by helicopter or fixed-wing aircraft along 11,000 km of predetermined transects (see Figure 4-4) designed to maximize coverage of the LSA. On eight occasions between 1999 and 2004, the GPS locations of all wildlife sightings or observations of clearly identifiable wildlife signs (e.g., dens, nests, craters) were recorded. At a minimum, the number of individuals was determined and, if possible, information on sex and age class was recorded. In June 2003 and July 2004, an aerial survey was conducted of lakes and wetlands within the LSA to identify the occurrence and distribution of waterbirds. The flight path was selected to maximize the number of wetlands habitats (e.g., ponds, lake margins) visited.

Transect ground surveys were also conducted between 1999 and 2004. Transects connecting high elevation vantage points (i.e., observation stations) were surveyed. Observation stations and transects were located to maximize coverage of the LSA. Wildlife and wildlife sign were recorded within a 5 m radius circular plot centered on each observation station. A transect was then walked (or driven by snowmobile) to the next observation station and all wildlife or wildlife sign within a 2 m wide belt centered on this transect was recorded. Eleven stations were established at high points within the LSA. These stations were surveyed over eight periods in 2003 and 2004 by two field personnel based in Baker Lake. A minimum of 10 minutes was spent at each station and the surrounding area was scanned with binoculars and wildlife sign was searched for within a 10 m radius of each observation point.

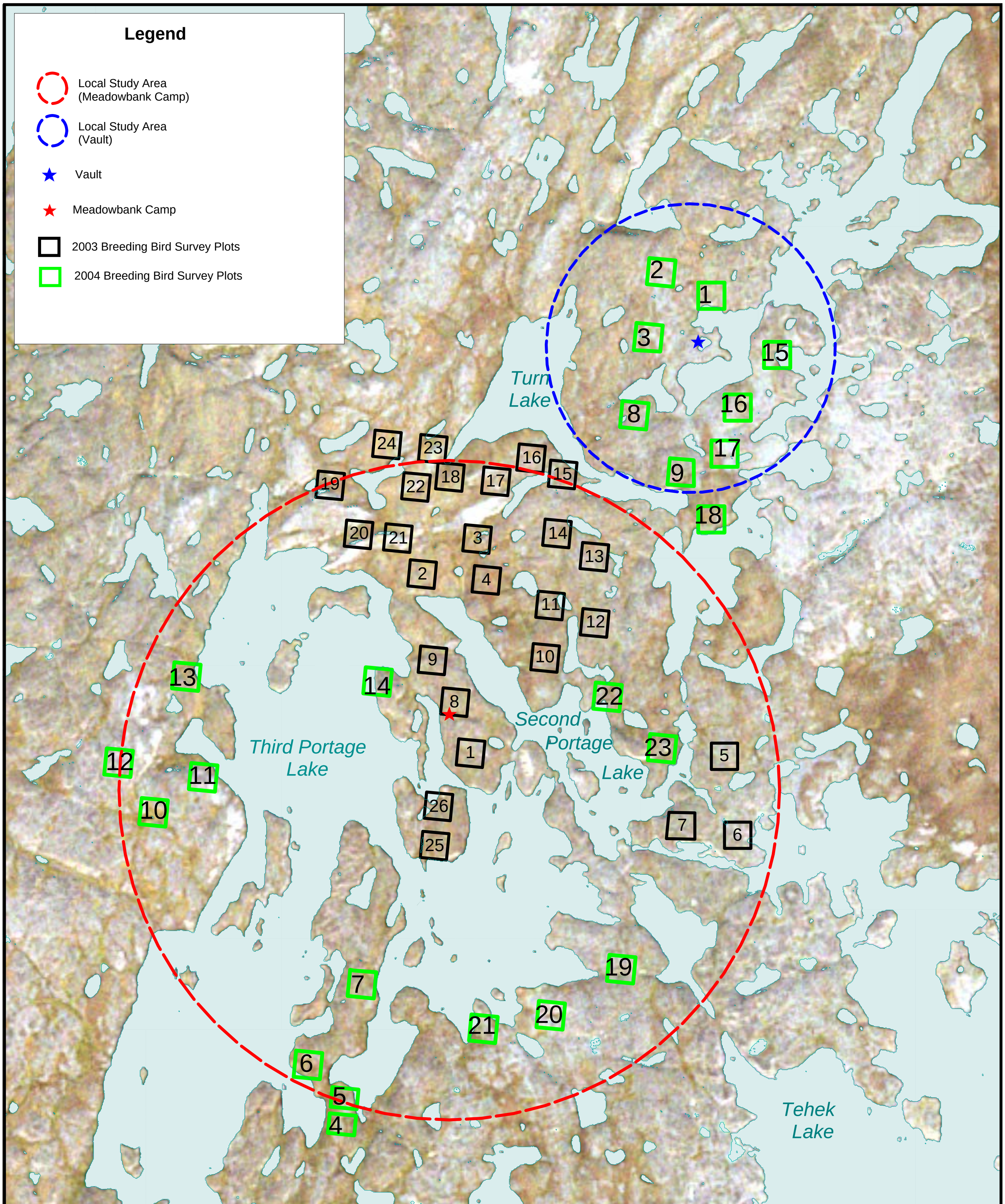
Breeding bird surveys were conducted according to PRISM (Program for Regional and International Shorebird Monitoring) survey protocols established by the Canadian Wildlife Service (Bart et al, 2003). The general methodology involved a “rapid survey” of 400 x 400 m plots with two observers, spaced at 25 m intervals, walking back and forth across each plot and recording all birds and nests observed. Orientation on the plot was accomplished with handheld GPS units. Twenty-six plots were surveyed within the LSA in 2003, and 23 were surveyed in 2004 (see Figure 4-5). Results from the latter are not included in this submission. A checklist bird survey protocol has been developed by Canadian Wildlife Service (CWS). The survey simply involves a day’s end estimation of the total number of individuals and species recorded within a 10 km x 10 km area. A checklist survey form was completed for every day that wildlife (e.g., breeding birds) surveys were conducted within the Meadowbank LSA. All forms were submitted to the CWS.

Incidental wildlife observations were recorded by Meadowbank Camp staff on a wildlife log data sheet. Observations were made between 1996 to 1999, and 2002 to 2004. The haulage route corridor was surveyed from the air in 2003 and 2004. In addition, the corridor was crossed by five transects that were part of the RSA aerial surveys. Wildlife was discussed during the Traditional Knowledge Study and in some detail during the HTO and impact workshops.

4.3.2.3 Fish & Aquatic Environment

The Meadowbank project area contains a large number of lakes of various sizes. Early baseline studies were limited in spatial extent and sampling intensity, and were focused on core areas of the potential mine. Later studies covered a broader range of parameters and included all lakes potentially vulnerable to the effects of the proposed development, as well as several reference lakes.

Key aquatic features of study area and reference lakes examined during most years between 1996 and 2003, included limnology, hydrology, water and sediment chemistry and all levels of the aquatic food web, including phytoplankton, periphyton, zooplankton, benthic invertebrates, fish, and fish



Breeding Bird Survey Plots
In The LSA,
June 2003 & June 2004

Area of Detail

NORTH

600 0 600 1200 1800

Scale in metres

SCALE: 1:85,000

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Figure 4.5

habitat. Central to this foundation was a thorough characterization of seasonal and inter-annual physical, chemical, and ecological features, spatial variability within and among project lakes, and comparisons with key ecological features from internal and external reference areas. Regional lakes were also evaluated to provide a context against which future data can be compared to baseline.

Empirical sampling of environmental media was conducted using accepted, consistent, quantitative methods to ensure that unbiased comparisons in abundance, species composition, and density of organisms could be made within and among lakes and over time. Care was taken to ensure ongoing consistency with regard to sampling equipment, depth, and other parameters. Quality assurance and control measures were implemented at all stages of sampling and analysis. Fish was discussed during the interviews for the Traditional Knowledge Study, and in some detail during the HTO and impact workshops.

4.3.3 Socioeconomic Environment

Community and regional level data collection methodology focused on secondary data available from Statistics Canada, and the Government of Nunavut; quantitative and qualitative data obtained from interviews with key informant interviews in the community of Baker Lake; and qualitative information obtained through key informant interviews with Inuit Elders, literature review, and observation and experience in the region on the part of the socioeconomic consultants. The socioeconomic baseline was also informed by public consultations, traditional knowledge, and archaeology investigations.

At the territorial level, the secondary data sources are more consistent, making it possible to report on data, past performance, and strategic future directions for Nunavut as a whole and include some analysis of socioeconomic trends over the recent past.

4.4 TRADITIONAL KNOWLEDGE & ARCHAEOLOGY

4.4.1 Traditional Knowledge

Traditional knowledge is a complex and sophisticated system of knowledge drawing on centuries of wisdom and experience. It is an experience-based relationship with family, animals, places, spirits, and land that includes a set of empirical observations about the local environment and a system of self-management that governs resource use. To learn about traditional knowledge, Cumberland:

- conducted two sets of interviews (Phase 1 and Phase 2)
- held numerous public gatherings over a period of six years with local residents
- reviewed other Arctic studies
- examined other Arctic mining projects, such as Snap Lake, Doris North, Jericho, Diavik, Lupin, Ekati, and Polaris
- studied many government regulations in several countries relating to traditional knowledge
- held an impact workshop with the community.

The interview methodology is described briefly below. Cumberland's record of public consultation is described in Section 4.5. For more information on these or any other sources listed above, see Cumberland's Baseline Traditional Knowledge Report.

Cumberland conducted two sets of interviews with the help of Hattie Mannik, a Heritage Consultant and author of *Inuit Nunavummiut*. Hattie selected the interviewees. Phase 1 of the interviews focused on gathering information about traditional lifestyle and land use within and around the project area (see Figure 4-6). Phase 2 focused more on project development (see Figure 4-7). Women were included in the interview process during both phases.

Cumberland used the information from these interviews in all aspects of project design, as appropriate. Traditional knowledge helped Cumberland understand fish populations and caribou migration patterns in the area, and contributed to project decision-making. For example, traditional knowledge was used in deciding where to build the Vault open pit access road and whether or not to fence any roads in and around the mine site. There were no conflicts between traditional knowledge and scientific data. In fact, the relationship was complimentary. For more information on how traditional knowledge shaped project design, see Cumberland's Baseline Traditional Knowledge Report and Project Alternatives Report.

Figure 4-6: Traditional Knowledge Phase 1 Interview Questions

1. Did you ever live in the area around Meadowbank or this area where there is a proposed winter road?
2. If so, please indicate on the map where you lived and why you lived there.
3. Did you ever live in the area between Baker Lake and Hudson Bay?
4. If so, please indicate on the map where you lived and why you lived there.
5. Who else camped with you?
6. Tell me about other families who also camped around that area.
7. Did your ancestors live in that area?
8. What time of year did you live in this area?
9. Where else did you live and why?
10. Tell me about your main food sources.
11. What was the route for migrating caribou?
12. Where did you cache meat for the winter?
13. Show me on the map where you cached meat.
14. Where did you fish?
15. Show me on the map where you fished.
16. Can you tell me about the archaeological sites between Baker Lake and Meadowbank? Between Baker Lake and Hudson Bay?
17. What can you tell me about graves in the area?
18. What can you tell me about sites of spiritual significance or special sites in the area?
19. Is there anything I missed that you would like to add?
20. For what reason or reasons did your family move to the settlement of Baker Lake?
21. I have no more questions. Thank you for your time.

Figure 4-7: Traditional Knowledge Phase 2 Interview Questions

1. In what ways do you feel this mine will benefit your community?
2. (a) What negative effects do you think this mine will have on your community? (b) Can you suggest ways that Cumberland can lessen these potential effects?
3. How will mine development affect young people in the community?
4. Cumberland has an office in Baker Lake. Is there a particular service this office should provide the community?
5. What can Cumberland do to help maintain the traditional lifestyle of its Inuit employees?
6. (a) Can you suggest ways to improve non-Inuit awareness of traditional knowledge and practices? (b) What do you think non-Inuit should know when they work and live in camps with Inuit men and women?
7. How do you feel about Inuit women working at the mine?
8. Are you worried about the effect mine development will have on the land and water?
9. Are you worried about the effect mine development will have on fish?
10. Can you suggest ways to ensure protection of wildlife at the project site?
11. What kinds of input and participation would you like to have in planning and monitoring the project?
12. Are there any aspects of the project that you need further explanation about or have concerns about?
13. Any other comments/concerns?

4.4.2 Archaeology

Two archaeological surveys were conducted at the proposed Meadowbank mine development property, the first in August 1999 and the second in July 2003. The surveys focused on areas of proposed project development such as the mine site and vicinity (Area A), the haulage route (Area B), and selected sites outside the development area (Area C). The project marshalling area east of the Hamlet of Baker Lake was also surveyed.

The purpose of the 1999 work was to carry out an initial inventory of archaeological sites within the project area and to assess the potential impact of the various project components on the archaeological resources. The 2003 work followed up on certain sites identified during the previous program and continued with the inventory. The sites were visited or observed by helicopter, foot, vehicle, and boat. At each site, features were identified, photographed, recorded on VHS video, and recorded in field notes. Typical information included dimensions, associated artifacts or faunal remains, site condition, impacts, and vulnerability. A hand-held GPS unit was used to record geographic coordinates, which were plotted on maps. The results of the 1999 and 2003 work was presented to the Baker Lake Hamlet Council, board members of the Inuit Heritage Centre, and the Qilautimiut (Elders) Society.

4.5 PUBLIC CONSULTATION

In conjunction with the study of traditional knowledge, public consultation with the local Inuit has enabled current and historical patterns of land and resource use, VECs, and VSECS to be identified. Cumberland has made a considerable and sustained effort to involve local residents, community organizations and leaders, government regulators, and local experts in all phases of the project since 1995 when project exploration began. This has included site visits, public meetings, impact workshops, technical meetings, school lectures, science fairs, written correspondence, onsite liaison officers, telephone conversations, and local hiring (see Table 4-3). Question and answer sessions afforded participants the opportunity to raise issues based on their knowledge of the area or to offer their opinion on various matters. Maps, slides, posters, handouts, and computer-assisted presentations were used to help explain, in layperson’s terms, the proposed development and any

Table 4-3: Community Meetings & Involvement

Year	Description
2004	A community Liaison Office was opened in Baker Lake in early 2004. Michael Haqpi, a Baker Lake resident, was hired as Community Liaison Officer. Mr. Haqpi's role is to disseminate information on the Meadowbank project to the local community and respond to any questions or concerns Baker Lake residents may have about the project. The office also contains a Resource Centre, which provides information on mineral exploration, mining, and mining-related activities. A quarterly newsletter provides updates on activities at the Meadowbank site and general information on exploration, mining, and mine processes. The Baker Lake office also provides information on possible employment opportunities at site, both present and future, and collects résumés from individuals who may be interested in obtaining employment. On March 25th, a presentation was given to the Hamlet Council by Gordon Davidson (Project Manager, Exploration). At that time the council was updated on exploration plans for the 2004 field season and was informed of the delay for the completion of the feasibility study. The feasibility study was delayed due to the escalating costs for raw materials (steel, fuel, etc.) required for development. The delay in completion of the study will allow development alternatives to be examined that might reduce the capital costs required to bring the project to production. The feasibility study is now scheduled for completion in fourth quarter of 2004. A tour of the Meadowbank site was completed on June 7th with several representatives from Baker Lake. The tour group consisted of: David Simailak (MLA), Robert Seeteetnak (Hamlet Council), Samson Arnawyok (Hamlet Council), and Rod Rudia (RCMP). On September 16th, a representative of Cumberland Resources (Jeff Kellner, Manager of Camp Operations) attended the Kivalliq Science Camp in Baker Lake and engaged students in a discussion about mineral exploration and mining activities. Information on possible employment opportunities was also provided. To date, between 3 to 10 Inuk have been working at camp during 2004, and a total of 15 local employees were hired by Cumberland Resources in 2004. Duties ranged from cook's helper to geological, survey, and environmental technicians to heavy equipment operators and construction labourers. Tercon's Senior Equipment Operator/Trainer, Ms Noella Champagne, conducted training sessions at the Training Center in Baker Lake that were open to all persons interested in possible employment at the mine. Training focused on job safety and familiarization with a mine operating environment and the equipment. Emphasis was on the equipment that was being transported at that time, namely: 50 tonne trucks, mobile crushing plant, excavator, 966 loader, and service equipment. Several meetings with Arctic College personnel to further establish the scope and objective of planned training programs for local residents.
2003	An impact workshop was held with community organizations at the Nunammiut Hotel from March 24th to 26th. A dozen coloured plans and drawings showing mine layout and environmental study areas were displayed on the walls. Students, Elders, and members of the HTO and KIA were amongst the attendees who expressed concerns, voiced opinions and asked questions regarding potential impacts of the development project on air and water quality, fish and wildlife, local youth (in terms of the possible presence of drugs and/or alcohol at the camp), and on employment and job training. Hand-outs in both English and Inuktitut were distributed. In the course of a community visit to Baker Lake between September 30 and October 2, 2003. Nineteen community members were interviewed, including the mayor and deputy mayor, mental health nurse, RCMP constable, high school principal, social worker, the economic development officer, a representative from Arctic College, and one from Baker Lake Housing Authority, in addition to several concerned citizens. Issues centered on training, employment, and concerns regarding the possible negative effects of additional money flowing into the community as a result of the mine. Support for the Meadowbank project was overwhelming (95%), providing it delivers jobs for the community. Some concern regarding lack of information, particularly employment opportunities, was expressed.

Year	Description
	A series of meetings were held on Apr 24th and 25th in Baker Lake. On April 25th a well-attended public meeting was held at the Recreation Center with over 150 people in attendance. A translator provided by Cumberland ensured that everything was translated into Inuktitut. Two separate meetings were held the following day with the elders of the community as well as students at the High School respectively. In June 2003, representatives from HTO, CLARC and various regulators from territorial and federal governments were flown into camp and were given tours of the site. The number of local employees varied throughout the season, but generally 8 to 15 Inuk were working in the camp at any given time. There were a total of 36 local employees that were hired by Cumberland in 2003. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians to heavy equipment operators and construction labourers and tradesmen. Travis Mannik and Roy Avaala of Baker Lake assisted in the 2003 fieldwork. Lucy Evo of the Inuit Heritage Center and Hattie Mannik translated summaries of the original 1999 and 2003 field reports into Inuktitut. Peter's Expediting Ltd. provided logistic support for the archaeological investigations undertaken by Webster Heritage Consulting at the Meadowbank property and surrounding area in 1999 and 2003. A year-end summary report was submitted to the Hamlet of Baker Lake; CLARC; HTO (Baker Lake); KIA (Rankin Inlet);KIA (Baker Lake); NWB (Gjoa Haven); NIRB (Cambridge Bay) and NTI (Cambridge Bay). The results of the 2003 work were presented to the Baker Lake Hamlet Council, board members of the Inuit Heritage Centre, and the Qilautimiut (Elders) Society on 6 and 7 November 2003. Several meetings with Arctic College personnel establishing scope and objective of planned training programs to prepare northerners for potential mine construction and operations work. Meetings identified basic skill sets that would enhance job applicants' opportunities with the mine. The basic skills included progress in the public education system, industrial safety awareness, an appreciation of work schedules, and introduction to specialized trades training as well as equipment operating.
2002	Favourable economic conditions made 2002 a busy year: an active program of exploration, drilling, and environmental baseline monitoring was pursued, and several site visits and meetings were held. On May 2nd, a meeting was held with 23 Elders of Baker Lake at the Elders Centre, during which Cumberland presented a translated slide show of its 2001 activities and 2002 plans, and reviewed the past five years of environmental studies and plans for the 2002 Environmental Program. The following day, Cumberland made two similar presentations at the Nunammiut Lodge, attended by representatives from the HTO, CLARC, KIA (Baker Lake), and the general public including prospectors. The presentation included a detailed description of the proposed new camp, the primary airstrip construction, and locations. There was a 30- to 45-minute question period following both meetings. Site visits to camp by David Aksawnee (HTO Chairman), Phillip Putumiraqtuq (HTO Secretary/Treasurer), Josiah Nuilalik (Elder), Norman Attungala (Elder), Joe Niego (Wildlife Officer/Mayor) and Jacob Ikinilik (Elder) were organized. A meeting was held with the Baker Lake HTO on September 19th to discuss findings of the wildlife and fisheries studies, and to collect local knowledge from the HTO members. The meeting was well attended by both HTO members and Cumberland officials. The hunters and trappers expressed concern regarding the impact of noise on wildlife, notably caribou. The number of local employees varied throughout the season, but generally 5 to 10 Inuk were working in camp at any given time. There were a total of 30 local employees that were hired by Cumberland Resources in 2002. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians to heavy equipment operators and construction labourers and tradesmen. A year-end summary report was submitted to the Hamlet of Baker Lake; CLARC; HTO (Baker Lake); KIA (Rankin Inlet); KIA (Baker Lake); NWB (Gjoa

Year	Description
	Haven); NIRB (Cambridge Bay); and NTI (Cambridge Bay).
2001	A public meeting was held on April 20th for members of the general public and HTO, the Elders, Hamlet Councillors, Mayor, and Glen McLean, MLA for Baker Lake. The number of local employees varied throughout the season, but generally 2 to 5 Inuk were working in camp at any given time. There were a total of 8 local employees that were hired by Cumberland in 2001. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians to heavy equipment operators and construction labourers. A year-end summary report was submitted to the Hamlet of Baker Lake; CLARC (Baker Lake); HTO (Baker Lake); KIA (Rankin Inlet); KIA (Baker Lake); NWB (Gjoa Haven); NIRB (Cambridge Bay); and NTI (Cambridge Bay).
2000	After the prefeasibility study report showed that more resources or a better gold price were required to economically develop the mine, only a minimal amount of exploration work was conducted in 2000. The number of local employees varied throughout the season, but generally 2 to 5 Inuk were working in camp at any given time. There were a total of 8 local employees that were hired by Cumberland in 2000. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians to heavy equipment operators and labourers. A year-end summary report was submitted to the Hamlet of Baker Lake; CLARC (Baker Lake); HTO (Baker Lake); KIA (Rankin Inlet); KIA (Baker Lake); NWB (Gjoa Haven); NIRB (Cambridge Bay); and NTI (Cambridge Bay).
1999	Two meetings were held in Baker Lake. The first was convened in the Hamlet Chamber on April 12th. Participants included the mayor, William Noah; various council members; HTO representatives; the director of the KIA, Edwin Evo; and members of the general public. Affairs focused on overview activities for 1998 and 1999, a review of local expenditures, as well as projected construction, transportation, processing, and employment issues related to the mine. The second was held in the Igloo Hotel and included Nunavut's MLAs. A field trip to the mine site followed and was attended by Premier Paul Okalik and Ministers Jack Anawak, Peter Kilabuk, and Kelvin Ng. The objectives of the meetings were to present the current status of the mine site and encourage public interaction. Discussions centered on concern for local employment and the protection of caribou and fish. There was general agreement among the local Inuit to proceed with mine development providing there are environmental and social protection measures in place and providing there will be significant economic gain by the community. The number of local employees varied throughout the season, but generally 2 to 5 Inuk were working in camp at any given time. There were a total of 8 local employees that were hired by Cumberland in 2001. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians to heavy equipment operators and construction labourers. A year-end summary report was submitted to the following: Hamlet of Baker Lake; CLARC (Baker Lake); HTO (Baker Lake); KIA (Rankin Inlet); KIA (Baker Lake); NWB (Gjoa Haven); NIRB (Cambridge Bay); and NTI (Cambridge Bay). Travis Mannik of Baker Lake and Jeff Tabvahtah of Nunavut Environmental Ltd. in Arviat provided field assistance in 1999, and Jose Attutuvaa volunteered his time in the evenings. Prior to starting the 1999 fieldwork, discussions about the project were held with Counsellor David Webster on behalf of the Baker Lake Hamlet Council; Mr. Webster is also the manager/curator of the local museum. An archaeological permit was not issued for the work in 1999, but a letter of authorization was received from Leah Oak, the Director of Culture, Language,

Year	Description
	Elders and Youth of the Government of Nunavut, dated 14 July 1999. The survey program was conducted from 21 July to 1 August 1999. Hattie Mannik, a traditional knowledge specialist, assisted Deborah Kigjugalik Webster (of Webster Heritage Consulting) with the interview of Elder Silas Kalluk of Baker Lake at the time of the 1999 survey. Lucy Evo of the Inuit Heritage Center and Hattie Mannik translated summaries of the original 1999 and 2003 field reports into Inuktitut. Peter's Expediting Ltd. provided logistic support for the archaeological investigations undertaken by Webster Heritage Consulting at the Meadowbank property and surrounding area in 1999 and 2003.
1998	Two meetings were held at both the HTO/KIA office and at Hamlet Chambers on May 1st to provide project development and environmental studies updates and to identify the primary concerns of the Inuit residing near the Meadowbank property. Mine development, wildlife protection, employment and job training, and the financial needs of the local community were the primary topics of discussion. A mock-up of the proposed airstrip was presented. All of these meetings were well attended. Attendees included: Cumberland officials; Nunavut Environmental Ltd.; Mayor, David Tagoona; KIA director Edwin Evo; and the HTO representative, Harold Etegoyuk A year-end summary report was submitted to the following: Hamlet of Baker Lake; CLARC (Baker Lake); HTO (Baker Lake); KIA (Rankin Inlet); KIA (Baker Lake) NWB (Gjoa Haven); NIRB (Cambridge Bay); and NTI (Cambridge Bay). A traditional study consisting of interviews with eight local Inuit Elders (men and women) was undertaken in October to determine traditional use and traditional ecological areas within and around the Meadowbank project development boundary. The number of local employees varied throughout the season, but generally 3 to 6 Inuk were working in camp at any given time. There were a total of 15 local employees that were hired by Cumberland in 1998. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians and labourers.
1997	On March 24th, the Igloo Hotel in Baker Lake was the site of a public meeting with 22 members of the community. Information on the current and projected activities of Cumberland in the Meadowbank project was presented through a slide show and posters displayed in a hallway. Questions by local residents concerned dates of operation of the mine and employment opportunities for the Baker Lake community. From 19 April 1997 to 25 March 1998, approximately 40 Nunavummiut signed the guest book at Meadowbank Camp. On August 11th and 12th, Jacob Ikinilik, Elder and member of the HTO, toured the project site. Having lived in the area with his family before leaving in 1962, Mr. Ikinilik was able to provide information regarding traditional use and potential archaeological sites. He identified two grave sites and stated, at the landing strip, that his people rarely hunted in the area. He indicated he was pleased regarding the number of local people employed at the exploration camp. The number of local employees varied throughout the season, but generally 4 to 6 Inuk were working in camp at any given time. There were a total of 7 local employees that were hired by Cumberland in 1997. Duties ranged from cook's helpers to geological and survey technicians to environmental technicians and labourers.
1996	Cumberland met with 14 members of the Baker Lake Prospectors Association (BLPA) on April 1st. During discussions concerning employment, the members of the BLPA inquired whether jobs would be available at the drill sites or in equipment supply. Cumberland's representative replied that employment opportunities did exist at the sites and that two Baker Lake residents were currently working on site. He added that he would encourage contractors to hire locally. Furthermore, he offered support for the BLPA's activities in the form of hand lenses, geology maps, hammers and picks, as well as assistance with the identification of samples resulting from exploration by the prospectors. The meeting closed after discussions regarding individual prospectors' properties and

Year	Description
	the cost of a preliminary drill program. On April 2nd, Cumberland held two meetings with the community. The first was with 19 students at Arctic College to discuss employment opportunities in mining and geology and training opportunities in environmental science. Information was also presented concerning a proposed environmental program and Cumberland's activities at the Meadowbank project. The second meeting was held at the community center in Baker Lake with 20 adult members of the community and 30 children from the local public school. A slide presentation on the activities of Cumberland in Meadowbank was followed by a discussion of the phases of mining exploration, the risks involved, the likelihood of finding deposits, and the roles and characteristics of junior and major mining companies. Community members asked questions regarding prospecting, mineral exploration, and costs related to permitting, licensing, and drilling. A total of 4 local employees were hired by Cumberland Resources in 1996. Duties ranged from cook's helpers to geological and survey technicians and labourers.
1995	Cumberland first made contact to obtain licenses and permits for exploration work. A total of 3 local employees were hired as geological technicians and labourers by Cumberland in 1995.

technical issues. Cumberland has established a liaison office in Baker Lake and will continue to hold public meetings throughout all phases of project development and operation.

Based on Cumberland's interaction with the public to date, there is much community support for the project on the understanding that it will provide badly needed employment and training and that environmental impacts will be managed to protect traditional resources. Most of the concerns expressed by the public were of a socioeconomic nature. For example:

- youth employment
- whether there will be an increase in gambling and use of drugs and alcohol as a result of an increase in income
- how the procurement of goods and services in Baker Lake could bring more services to the community at large and generate additional employment
- whether the rotation of employees will put stress on families and social services
- whether out-of-area workers will use local health services, which are ill equipped to deal with any increased demand
- how formal wage employment will affect traditional skills, values and language
- how any newly discovered sites of archaeological or cultural significance will be handled
- what infrastructure will be left to Baker Lake at the time of closure (e.g., the airstrip and buildings could be used to develop more tourism in the region).

These concerns have been addressed in management plans and monitoring programs that have been completed as part of this EIS (see Figure 3-1).

4.6 REGIONAL CONTEXT

The issues of concern considered in this EIS within a regional context were obtained from concerns and values described by the Nunavut Planning Commission (NPC) in the Keewatin Regional Land Use Plan approved by INAC and the Department of Sustainable Development (DSD) in 2000; those expressed to Cumberland during community consultation sessions; and from similar studies completed for other mining ventures located in the central mainland tundra over the past 10 years (e.g., Ekati, Diavik, Snap Lake, and Jericho mines). The issues include but are not limited to the following:

- sustainable development
- support for regional economic development
- encouragement of multiple land uses
- keeping communities informed about, and involved in, land use activities
- climate change
- cumulative effects on permafrost and ground thermal regime
- global air quality and its interaction with regional development and regional environmental quality
- water quality degradation from transboundary contaminant sources and its cumulative impact on fish, and birds
- regional water quality monitoring for early detection of potential degradation
- domestic and hazardous waste management
- minimization of negative effect of development activities on wildlife
- protection of wildlife habitat
- inclusion of mine closure and restoration plans in proposals for mining development
- providing benefits to local residents as well as Canada as a whole from non-renewable resource development
- utilization of traditional knowledge
- protection and management of heritage resources
- protection and promotion of the Inuit people and Inuit-owned land during life of project.

4.7 REGULATORY REGIME

The Meadowbank project is subject to the environmental review and related licensing and permitting processes established by Part 5 of the Nunavut Land Claims Agreement (“NLCA”) (INAC and TFN, 1993). In addition to a mining lease and land leases required for Inuit-owned lands from the Kivalliq Inuit Association (KIA), the mine will require several other permits and licenses. A complete list is shown on Table 4-4.

4.8 LAND TENURE

The Meadowbank project covers an area of 30,521 ha: ten grandfathered crown mining leases encompassing 7,395 ha, and three exploration concessions administered by NTI encompassing

Table 4-4: Required Approvals, Permits & Licenses

Legislation		Authorization
Federal Legislation (Canada)		
Canadian Environmental Protection Act, 1999 (CEPA)		Registration
Explosives Act		Licence for Magazine
		Explosives Transportation Permit
Federal Real Property & Federal Immovables Act		Licence of Occupation
Fisheries Act	(s. 35)	Authorization
	(s. 32)	Authorization
	(s. 30)	Approval
	Fishery (General) Regulations	Licence
Migratory Birds Convention Act: Migratory Bird Regulations		Permit
Navigable Waters Protection Act		Approval for Constructing Works in a Navigable Water
Nunavut Act: Nunavut Territorial Archaeological Sites Regulations		Archaeologist Permit
Nunavut Land & Claims Agreement (NLCA)		See below
Nunavut Waters & Nunavut Surface Rights Act (NWNSRA)		Water Licence
Territorial Lands Act	Canada Mining Regulations	Mining Lease
		Drilling Authority
	Territorial Land Regulations	Surface Lease
	Territorial Land Use Regulations	Land Use Permit
	Territorial Quarrying Regulations	Quarry Lease
		Quarry Permit
Territorial Legislation (Nunavut)		
Transportation of Dangerous Goods Act		Approval – Emergency Response Assistance Plan
Environment Protection Act: Spill Contingency Planning & Reporting Regulations		Spill Contingency Plan
Explosives Use Act		Permit
Pesticide Act		Permit
Mine Health & Safety Act (Note 1)		Permit
Scientist Act		Scientific Research Licence
Wildlife Act		Wildlife Research Permit
Inuit Owned Lands		
Nunavut Land Claim Agreement Nunavut Tunngavik Incorporated (NTI) Rules & Procedures for the Administration of Inuit Owned Lands under the NLCA		Exploration Licence
		Surface Land Lease
		Land Use Licence Right-of-Way Agreement
		Water Compensation Agreement
		Consent to Access
		Inuit Impact Benefit Agreement

Notes 1: This Act, is administered by the Workers' Compensation Board (WCB), has a number of regulations that govern working environment and construction and operational activities on mine site, for which permits are required in relation to industrial hygiene, fire protection, and explosives.

23,126 ha. The crown leases cover the southern portion of the property near Third Portage Lake and contain the Portage and Goose Island deposits; the Vault deposit is contained by the southernmost NTI exploration concession (BL14-99-01). Tables 4-5 and 4-6 provide detailed information on the land tenure at Meadowbank. A map showing the land tenure is provided in Figure 4-8 (overleaf).

Table 4-5: Grandfathered Crown Leases

Claim Name	Lease #	Effective Date	Expiry Date	Acreage	Hectares
Dick	3669	Dec.13/1995	Dec. 13/2016	1,800.00	728.44
Carey	3670	Dec.13/1995	Dec. 13/2016	2,545.00	1,029.93
OY 2	3782	Apr.27/1998	Apr. 27/2019	2,547.00	1,030.74
OY 3	3783	Apr.27/1998	Apr. 27/2019	2,582.00	1044.90
OY 4	3784	Apr.27/1998	Apr. 27/2019	1,954.00	790.76
YO 1	3777	Apr.27/1998	Apr. 27/2019	1,460.00	590.84
YO 2	3778	Apr.27/1998	Apr. 27/2019	2,020.00	817.47
YO 3	3779	Apr.27/1998	Apr. 27/2019	1,652.00	668.54
YO 4	3780	Apr.27/1998	Apr. 27/2019	1,105.00	447.18
YO 5	3781	Apr.27/1998	Apr. 27/2019	607.76	245.95
			Total Area:	**18,272.76**	**7,394.75**

Table 4-6: NTI Exploration Concessions

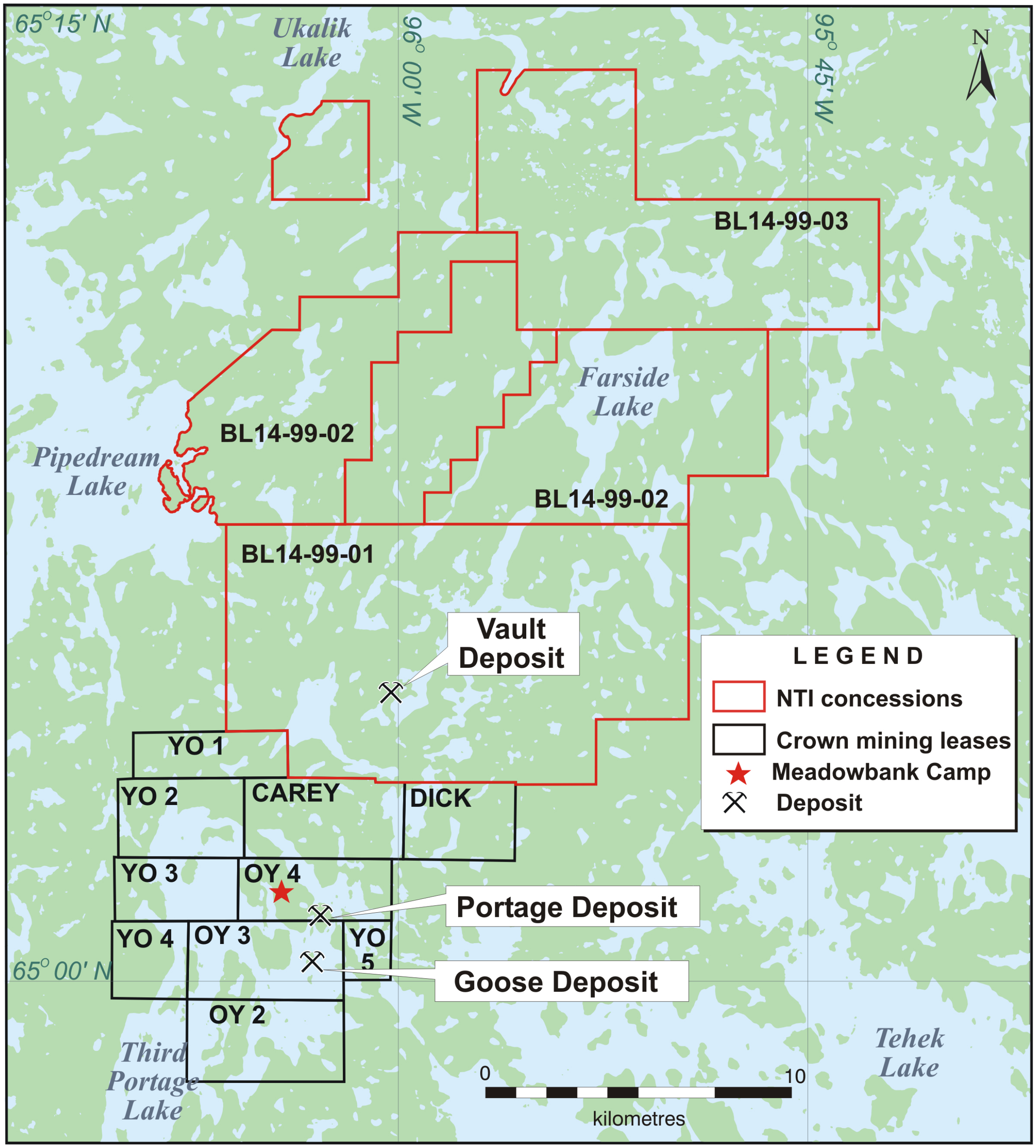
Claim Name	Effective Date	Expiry Date	Hectares
BL14-99-01	31 December 1999	31 December 2019	9,234
BL14-99-02	31 December 1999	31 December 2019	8,502
BL14-99-03	31 December 1999	31 December 2019	5,390
		Total Hectares:	**23,126**

4.9 PROJECT JUSTIFICATION

4.9.1 Project Purpose & Rationale

The purpose of this project is to mine and extract gold from several ore deposits in the Meadowbank area to provide an additional gold source for international buyers and dealers. This purpose is consistent with Canada's overall strategy of encouraging private corporations to generate national export commodities and tax revenues from natural resource development. The national objective is to encourage sustainable resource development for the benefits of increased employment, contracting

Figure 4-8: Land Tenure Map



opportunities, and expanded services at the local, regional, and national levels without causing significant adverse effects on the environment.

There is a sustained worldwide demand for gold that will not be materially affected by the proposed production rate at the Meadowbank Gold project. Gold is a commodity, with a price set by global supply and demand forces; the project will be able to sell all of its production into the world market at prevailing prices.

4.9.2 Project Need

Cumberland believes in the economic viability and potential of the Meadowbank Gold project, and that project development will bring much needed training and employment opportunities as well as increased investment in services to the people of Baker Lake, the Kivalliq region and Nunavut as a whole. Prefeasibility Studies, completed in May 2000, identified a significant portion of the Meadowbank resources to have suitable confidence and economic constraints to satisfy the conditions for a mineral reserve. Additions to project reserves as a result of subsequent drilling initiatives will be a concluding component of the Feasibility Study. At the time of writing, a final Feasibility Study of the Meadowbank project is nearing completion.

According to Statistics Canada, the unemployment rate in the Kivalliq Region in 2001 was 18.6%—a percentage that reflects the limited employment opportunities in the region. Nunavut also has the highest birth rate in the country, with an average of 26.1 per 1,000 between 1998 and 2003 compared with the average Canadian rate of 10.9 per 1,000 persons (Statistics Canada, 2003b). The Meadowbank project would create over 1,000 person-years of employment in Nunavut during the construction phase: 80% in the mining and construction sectors, others would be in the following sectors in order of magnitude: (i) finance, insurance, real estate and renting and leasing; (ii) professional, scientific and technical services; (iii) government sector; (iv) wholesale trade; and (v) transportation and warehousing.

To estimate the economic impacts of the project on Nunavut and Canada as a whole, Cumberland requested and funded an input-output simulation, which was run by Statistics Canada. Summary results for Nunavut and for Canada are presented in Table 4-7. As is evident, such project expenditures would be a significant boost to the local, regional, and territorial economies.

Table 4-7: Input-Output Interprovincial Model Summary Results

	Construction		Operations	
	$303 M/18 months		$92 M/year	
Parameter	**Nunavut**	**Canada**	**Nunavut**	**Canada**
Impact on GDP (market prices, $000)	120,333	233,813	35,451	63,780
Total Labour Income ($000)	76,651	149,584	27,010	43,745
Total Employment (person years)	1,008	2,584	303	700
Total Employ	50	70	40	50
Indirect Taxes on Production & Products (minus subsidies, $000)	2,088	5,688	1,168	2,331
Total Output ($000)	349,377	585,208	102,745	167,635
Output Multiplier	1.15	1.93	1.12	1.82

Source: Statistics Canada (2004).

4.10 PROJECT DESCRIPTION

4.10.1 Project Components & Activities

Five significant gold deposits—North Portage, Third Portage, Goose Island, and the Vault—have been identified on the property. These deposits are defined by 570 diamond drill holes in 84,560 m of drilling. As of the first quarter of 2004, the project hosted a combined measured and indicated resource of 21.7 Mt grading 4.30 grams gold per tonne and additional inferred resources of 5.7 Mt grading 4.30 g/t A brief description of project components is provided in the sections below. A project development sequence is provided in Figures 4-9 to 4-16.

4.10.1.1 Geology/Mineralogy of the Ore Deposit & Mining Methods

Geology/Mineralogy

The project is located within rocks of the Archean-aged Woodburn Lake Group of the Western Churchill Province. The Woodburn Lake Group comprises a deformed sequence of Archean supracrustal rocks unconformably overlain by rocks of the Paleoproterozoic Baker Lake Basin.

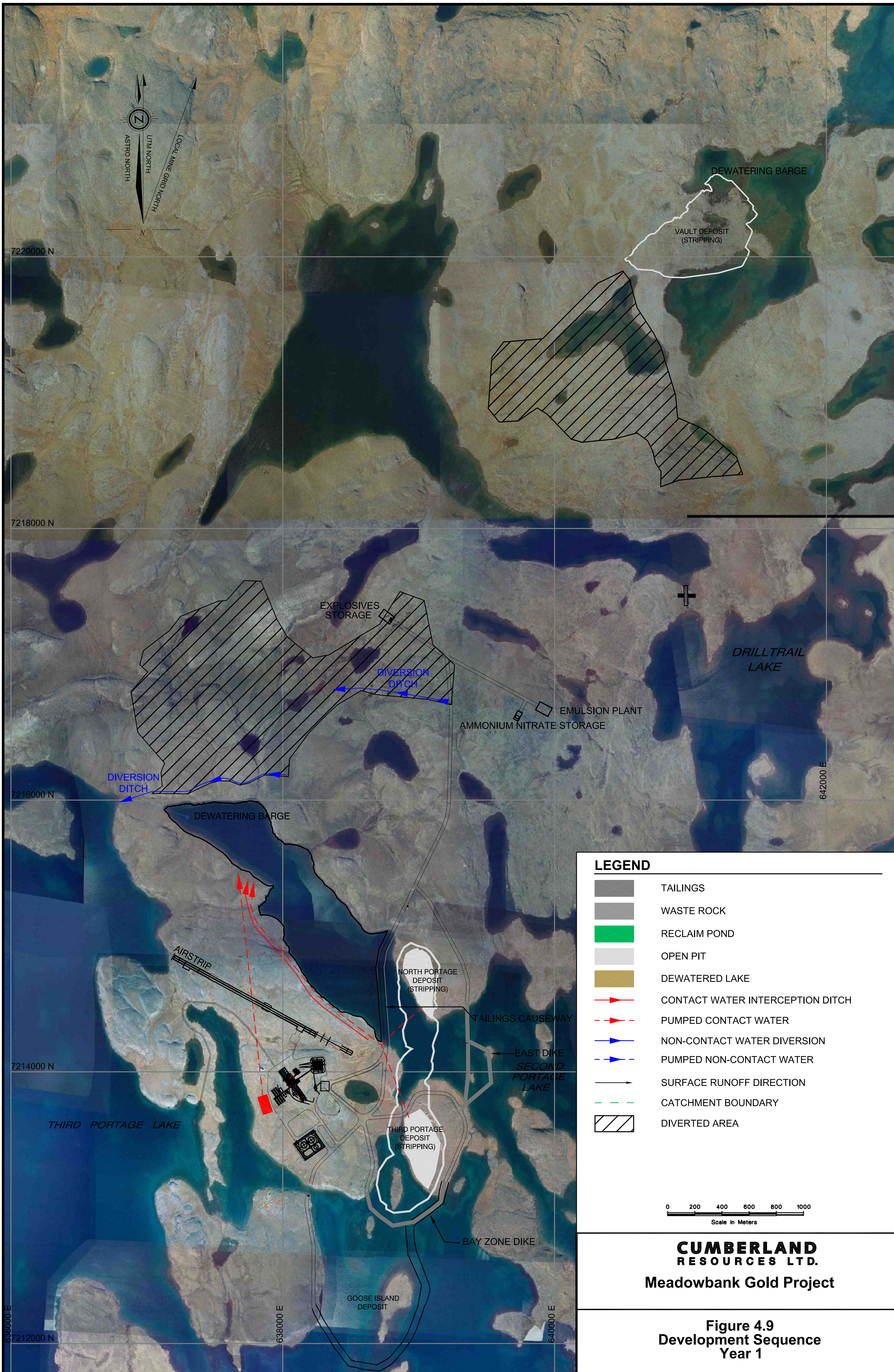


Figure 4.9
Development Sequence
Year 1

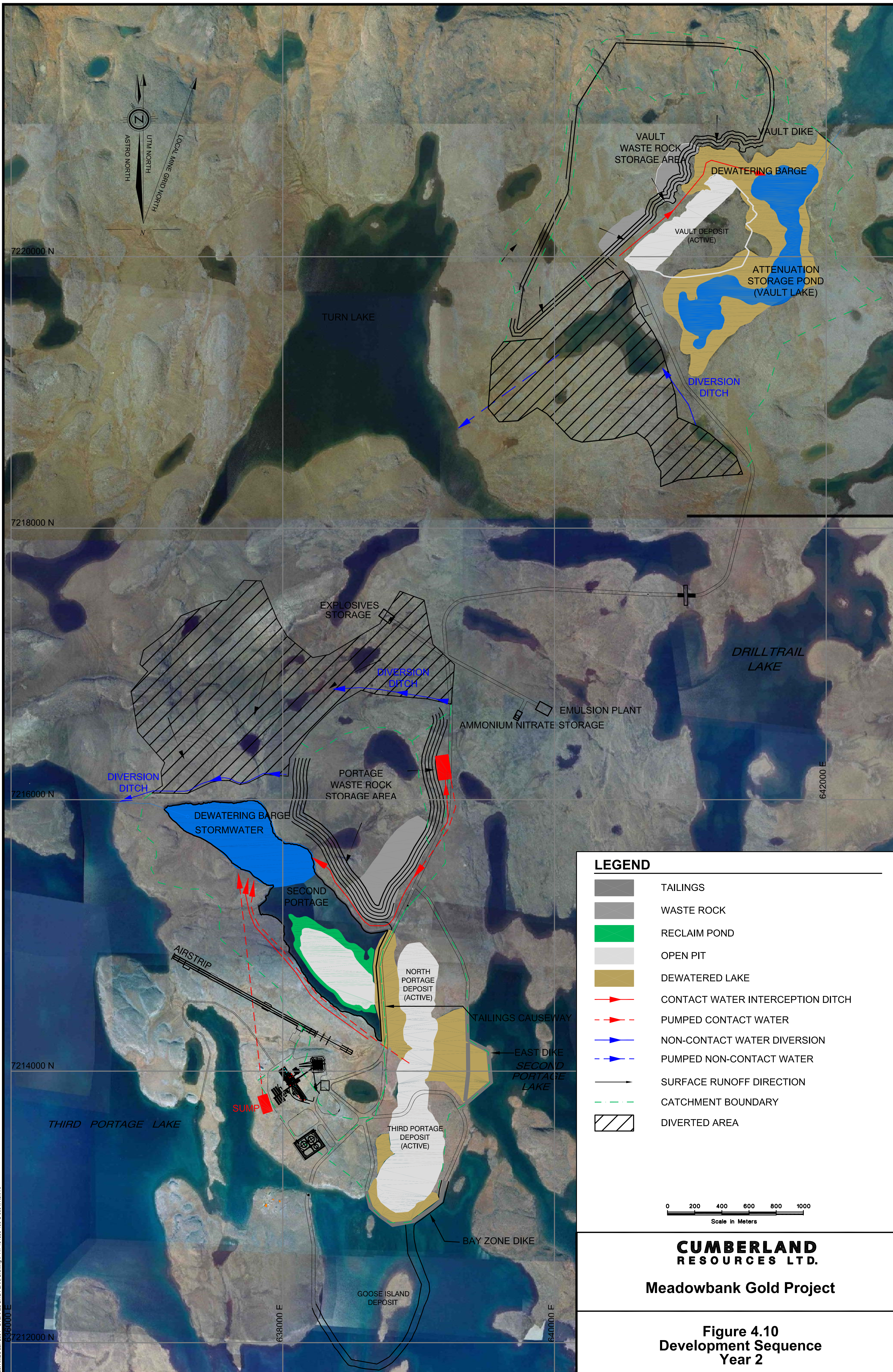


Figure 4.10
Development Sequence
Year 2

Source: AMEC Jan 2004 - OVERALL SITE PLAN, Drawing # A1-131395-100-C-0001, Rev. A.

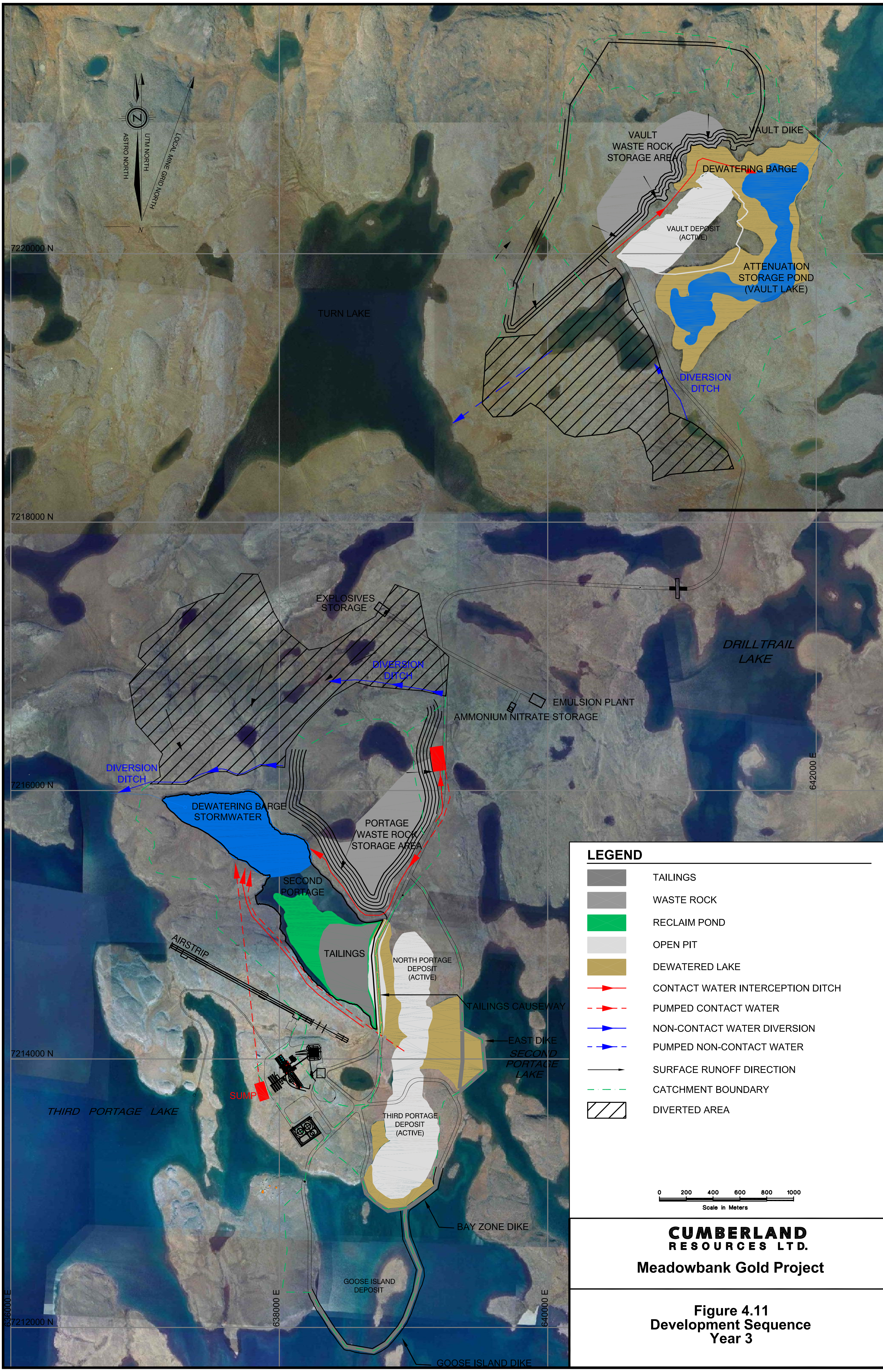


Figure 4.11
Development Sequence
Year 3

Source: AMEC Jan 2004 - OVERALL SITE PLAN, Drawing # A1-13395-100-C-0001, Rev. A.

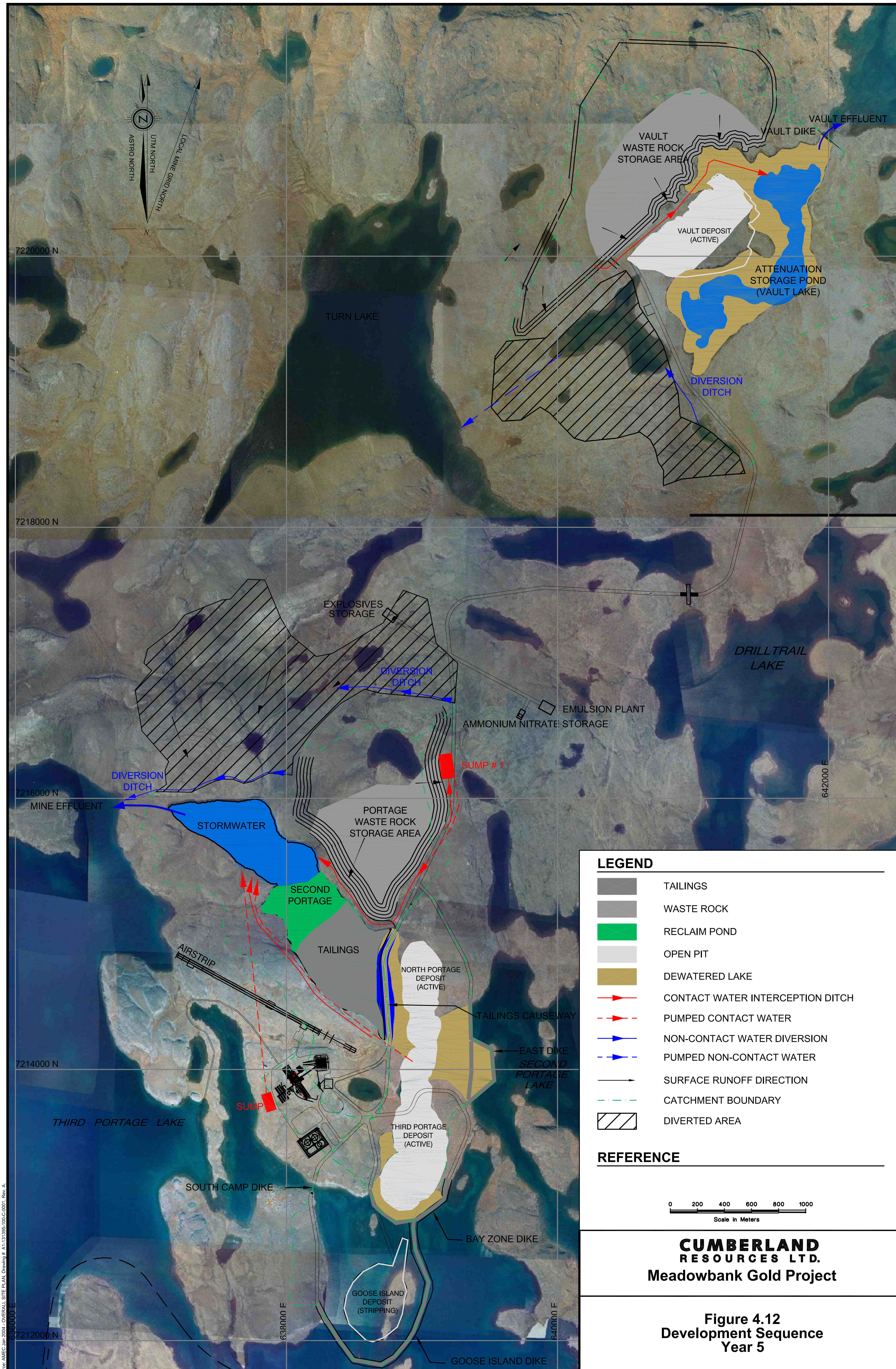


Figure 4.12
Development Sequence
Year 5

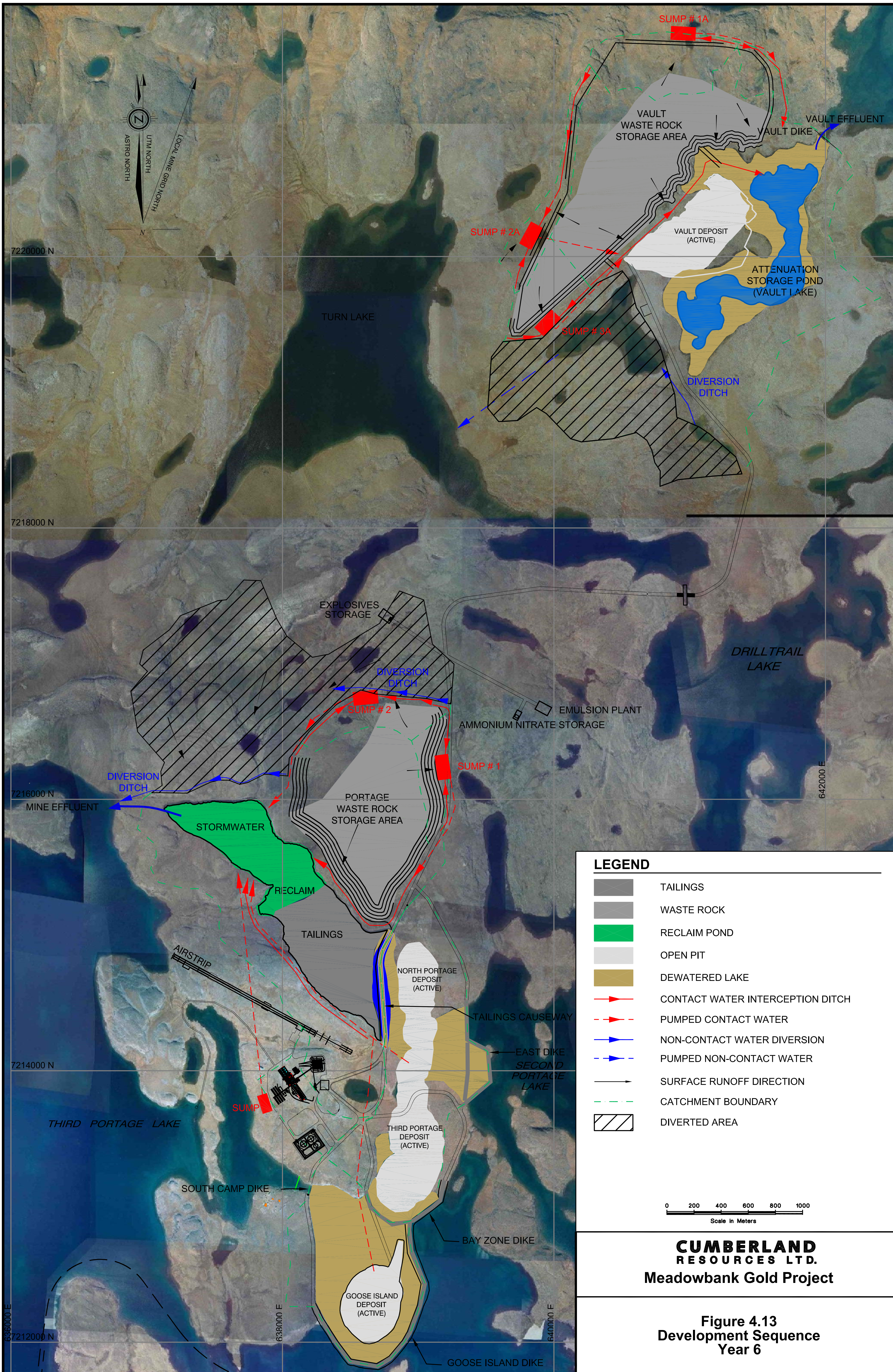


Figure 4.13
Development Sequence
Year 6

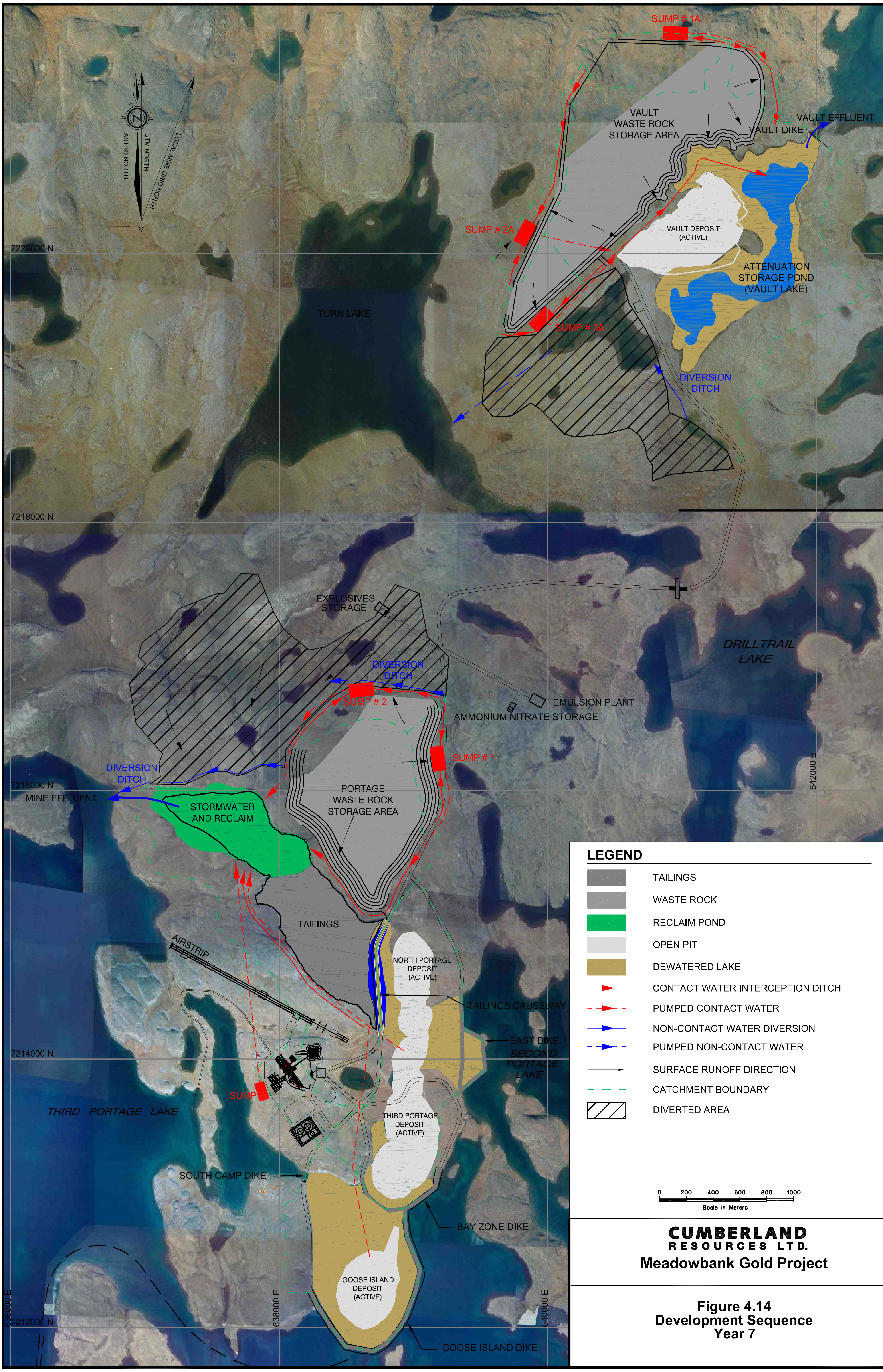


Figure 4.14
Development Sequence
Year 7

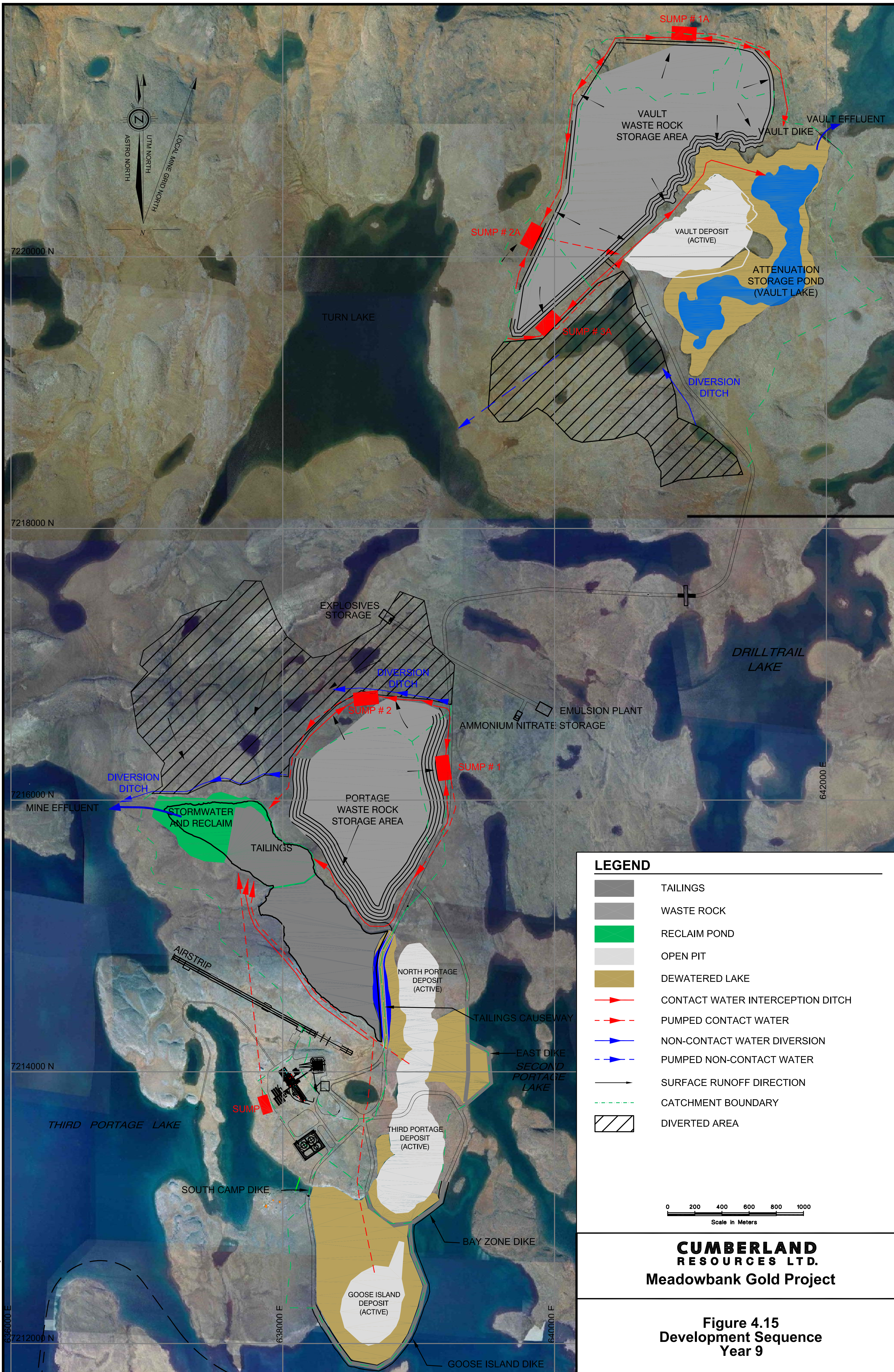


Figure 4.15
Development Sequence
Year 9

Source: AMEC Jan 2004 - OVERALL SITE PLAN, Drawing # A1-131395-100-C-0001, Rev. A.

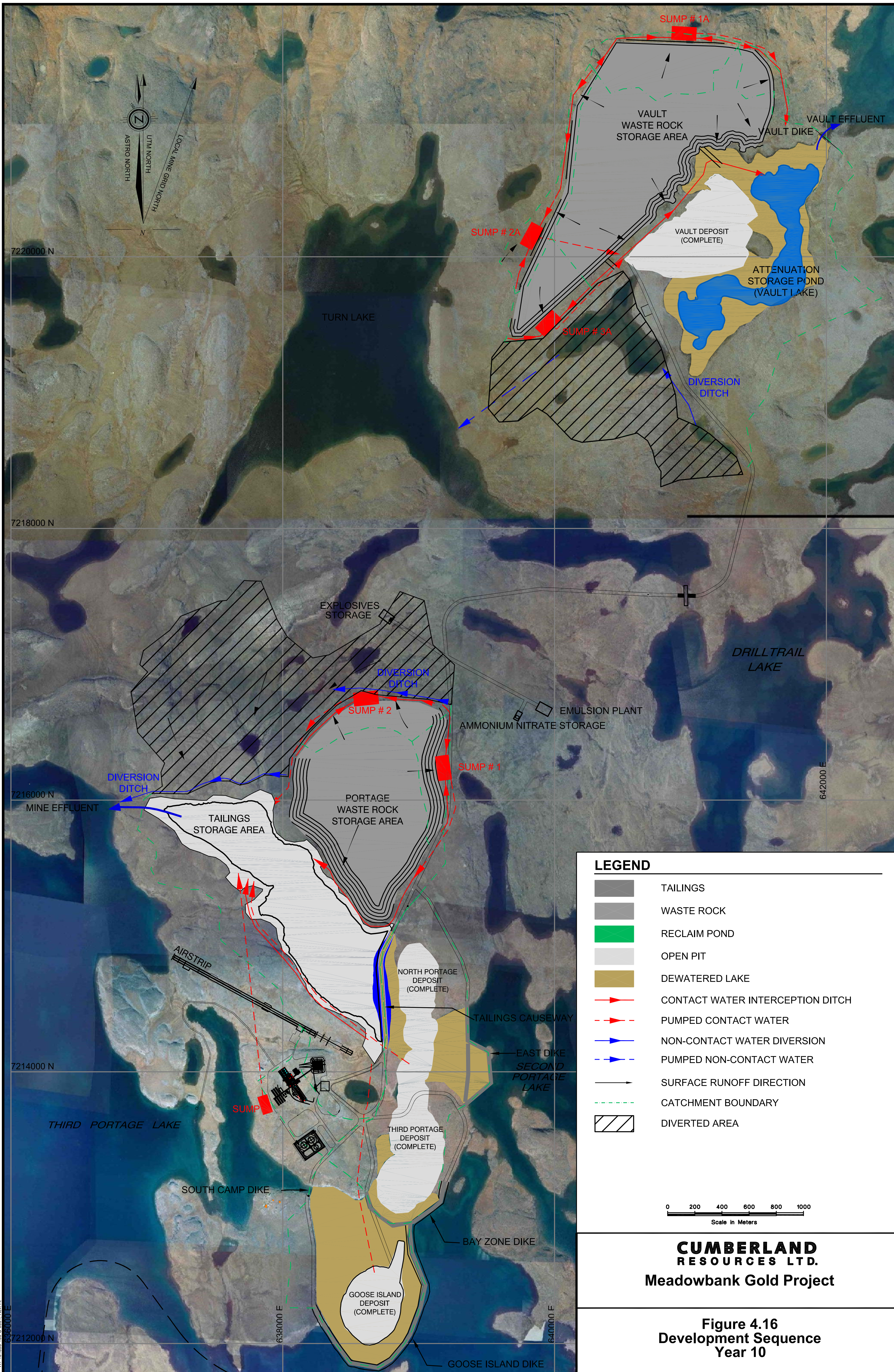


Figure 4.16
Development Sequence
Year 10

The project area is underlain by a sequence of metavolcanic (ultramafic, mafic and intermediate volcanic flows) and metasedimentary rocks. Geological units include volcaniclastic sediments, felsic to intermediate flows and tuffs, sediments (greywackes), and oxide facies iron formations. The North Portage, Third Portage, Bay zone, and Goose Island deposits are hosted within iron formation rocks. The Vault deposit is hosted within variably altered intermediate volcanic rock (see Figure 4-17).

Deposit mineralogy consists of pyrite and phyrrotite. Ores that are characteristically absent include arsenopyrite, sphalerite, and chalcopyrite.

Mining

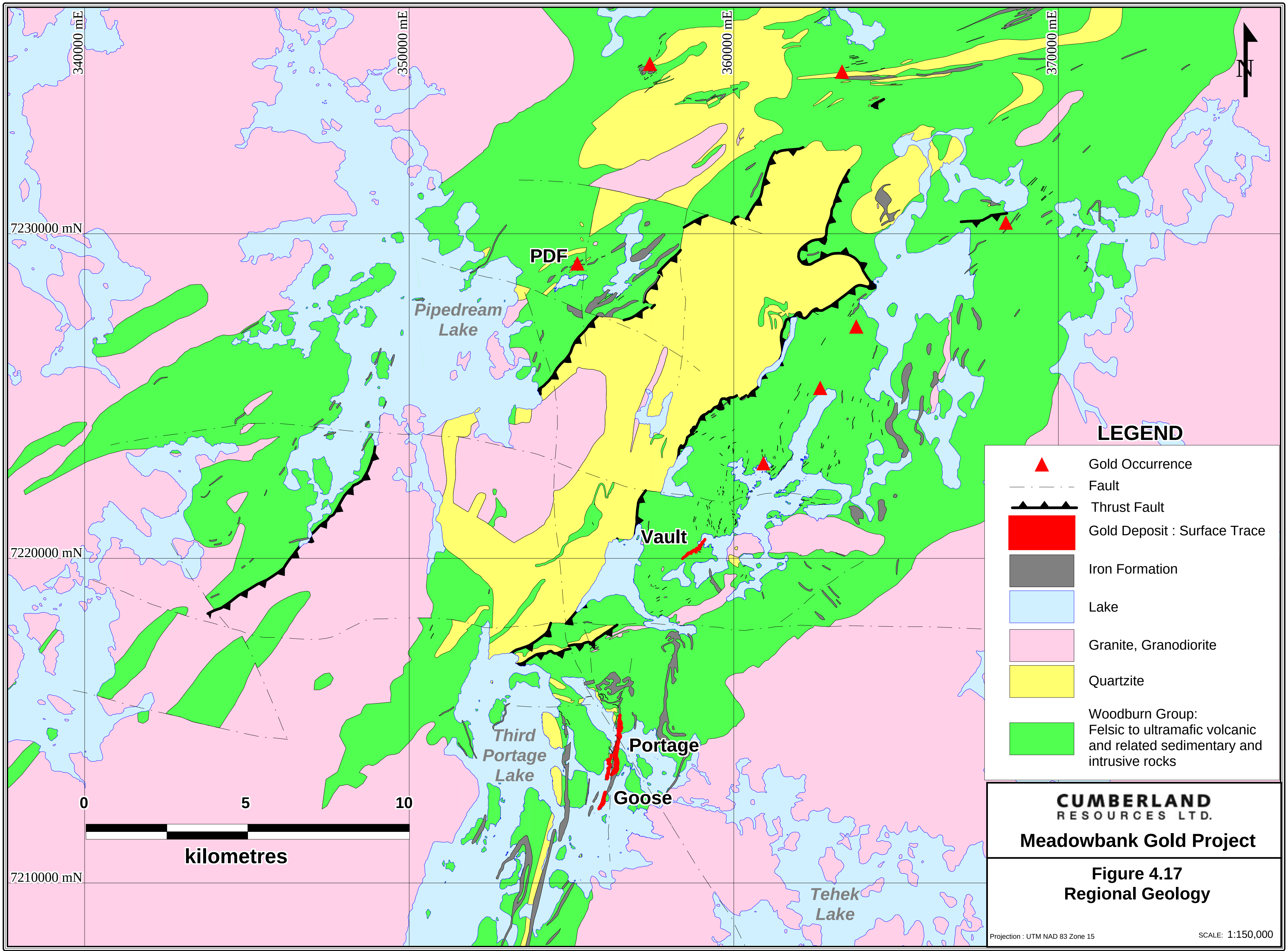
Production will be by surface or open pit mining, as grades do not currently support economical underground mining. Approximately 20 Mt of ore will be mined and processed over an 8- to 10-year mine life. The mine operation will generate approximately 160 Mt of mine waste rock comprising 12 Mm^3 of tailings, 80 Mm^3 of mine waste rock, and 3.7 Mm^3 of overburden soil and very limited organic materials.

Mining will occur in three separate areas. The Portage open pit is expected to be the largest, measuring 2,000 m in length, 200 to 400 m in width, and 175 m deep. The Goose Island open pit is less than 500 m in diameter and 120 m deep. The Vault open pit, located 5 km north of Portage and Goose Island, is designed to be approximately 500 m long, 300 m wide, and 85 m deep.

Due to the presence of permafrost and the long winters, it has been assumed the ground will remain frozen for a large portion of the year and that water problems for blasting may be encountered during spring runoff and periods of rainfall during the summer months. For explosives, Cumberland expects to use 50/50 emulsion/ammonium nitrate and fuel oil (ANFO); however, this could range from 70/30 to 30/70, depending on what water resistance is required.

Ore Recovery Plant, Extraction & Concentration

Exhaustive metallurgical studies were undertaken to develop the process flowsheet for the Meadowbank project. The preferred option (see Figure 4-18) leaches a mill throughput of over



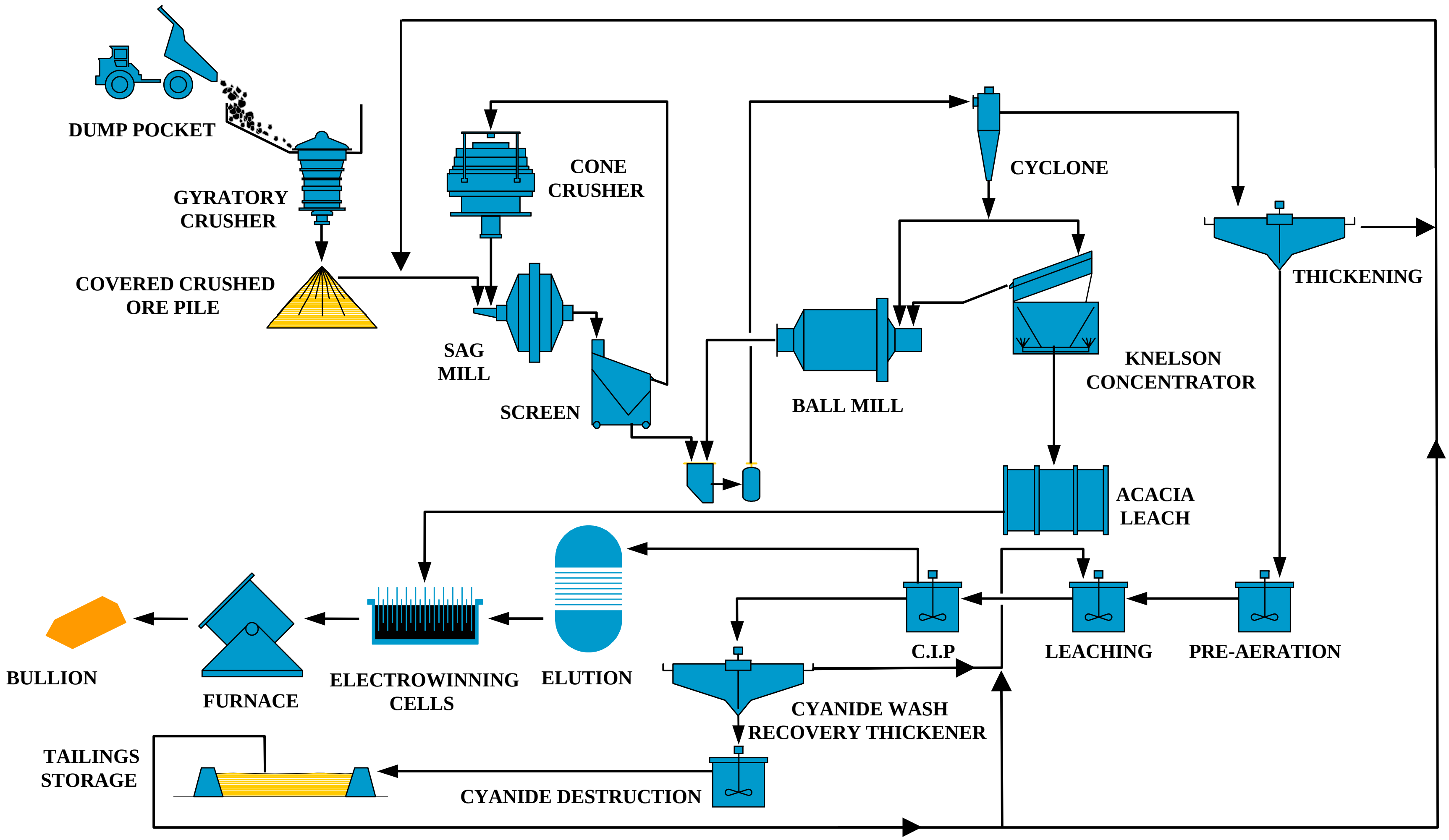
CUMBERLAND RESOURCES LTD.

Meadowbank Gold Project

Figure 4.17
Regional Geology

Projection : UTM NAD 83 Zone 15

SCALE: 1:150,000



CUMBERLAND RESOURCES LTD.

Meadowbank Gold Project

Figure 4.18
Process Flowsheet

5,500 t/d and includes standard crushing and grinding, gravity concentration, and carbon-in-pulp (CIP) cyanide leach technology, with cyanide destruction and refining to doré bars. A layout drawing of the main plant site, showing the location of the ore stockpile, is given in Figure 2-4.

Ore is delivered from the mine to a blending and surge pad at the crusher. Run-of-mine ore is crushed using a gyratory crusher and conveyed to an open coarse ore storage pile. The ore is reclaimed and ground in two stages through semi-autogenous grinding (SAG) and ball mill grinding. The SAG and ball mills discharge the ground product to cyclones for size classification. The ore is ground to approximately 80% passing 45 µm. Gravity separation of liberated gold particles is applied within the grinding circuit. A high-grade gravity concentrate suitable for treatment by intensive cyanidation in an Acacia reactor is produced.

The milled ore is pre-aerated prior to treatment in a CIP cyanidation circuit. The CIP circuit concurrently dissolves the gold and adsorbs it onto activated granular carbon.

The tailings from the CIP circuit are treated with a sodium metabisulphite process to detoxify the free cyanide in the tailings stream. To minimize the potential for ARD, the treated tailings are disposed of using a permanent freezing concept in the Second Portage Lake impoundment area.

The loaded carbon from the CIP circuit is stripped in a pressure Zadra-type elution circuit and returned to the CIP circuit. The loaded carbon from the CIP circuit is transferred to stripping, where the gold is dissolved from the carbon into a strip solution. Gold is recovered from the strip solution and from the pregnant liquor generated in the Acacia reactor by electrowinning. The gold-laden cathodes are treated in an onsite refinery to produce gold doré bars.

4.10.1.2 Processed Ore Containment (and Tailings Ponds)

Tailings Containment Area

As described in Section 4.10.1.3 and shown in Figure 4-19, disposal of the tailings slurry in Second Portage arm is the preferred option due to the following factors: reduced potential for ARD and metal leaching from the tails, ease of operation in the Arctic climate, and lower capital cost. The mining and processing operations will produce approximately 22 Mt of tailings over the project life. The tailings will

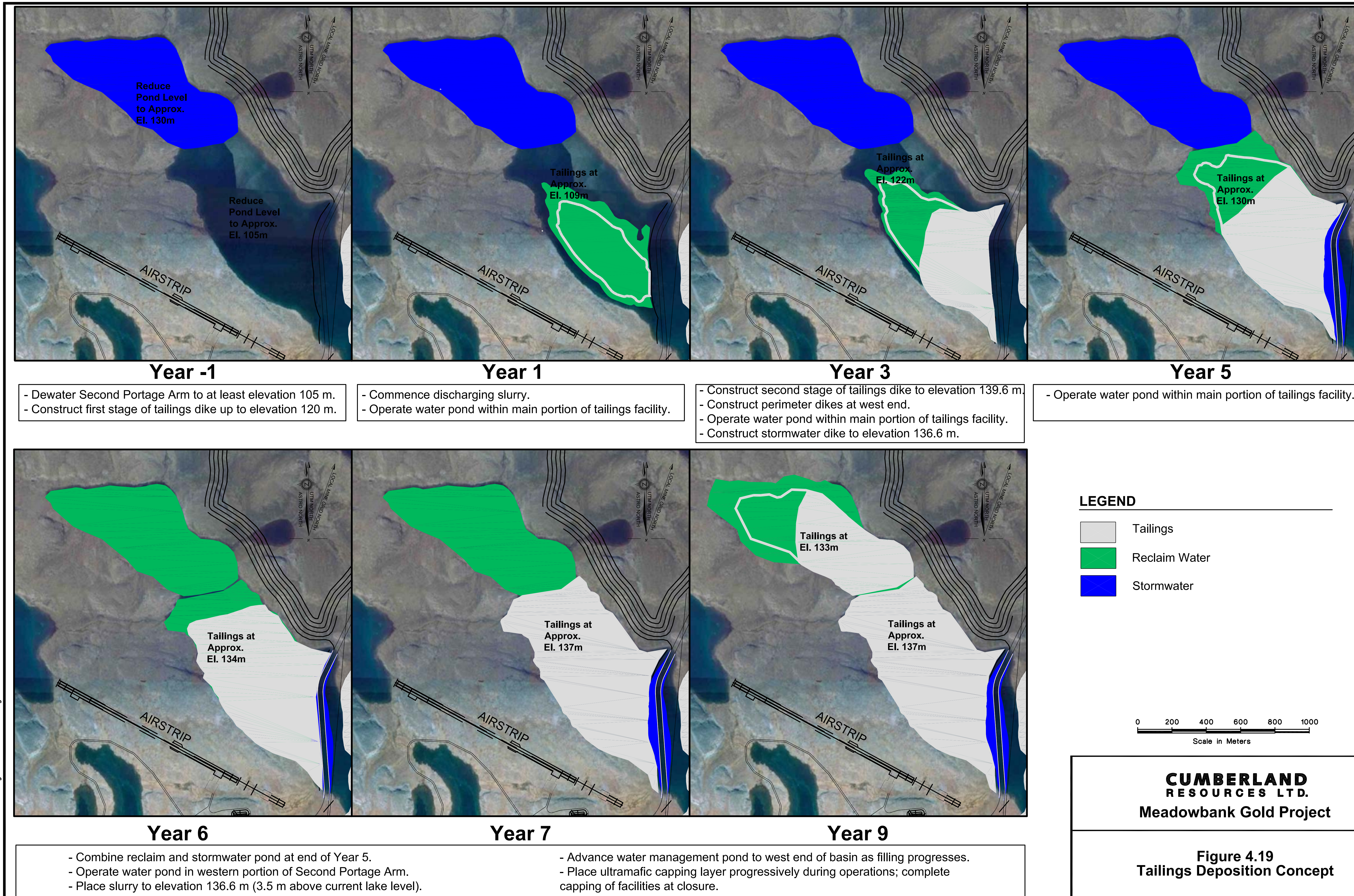


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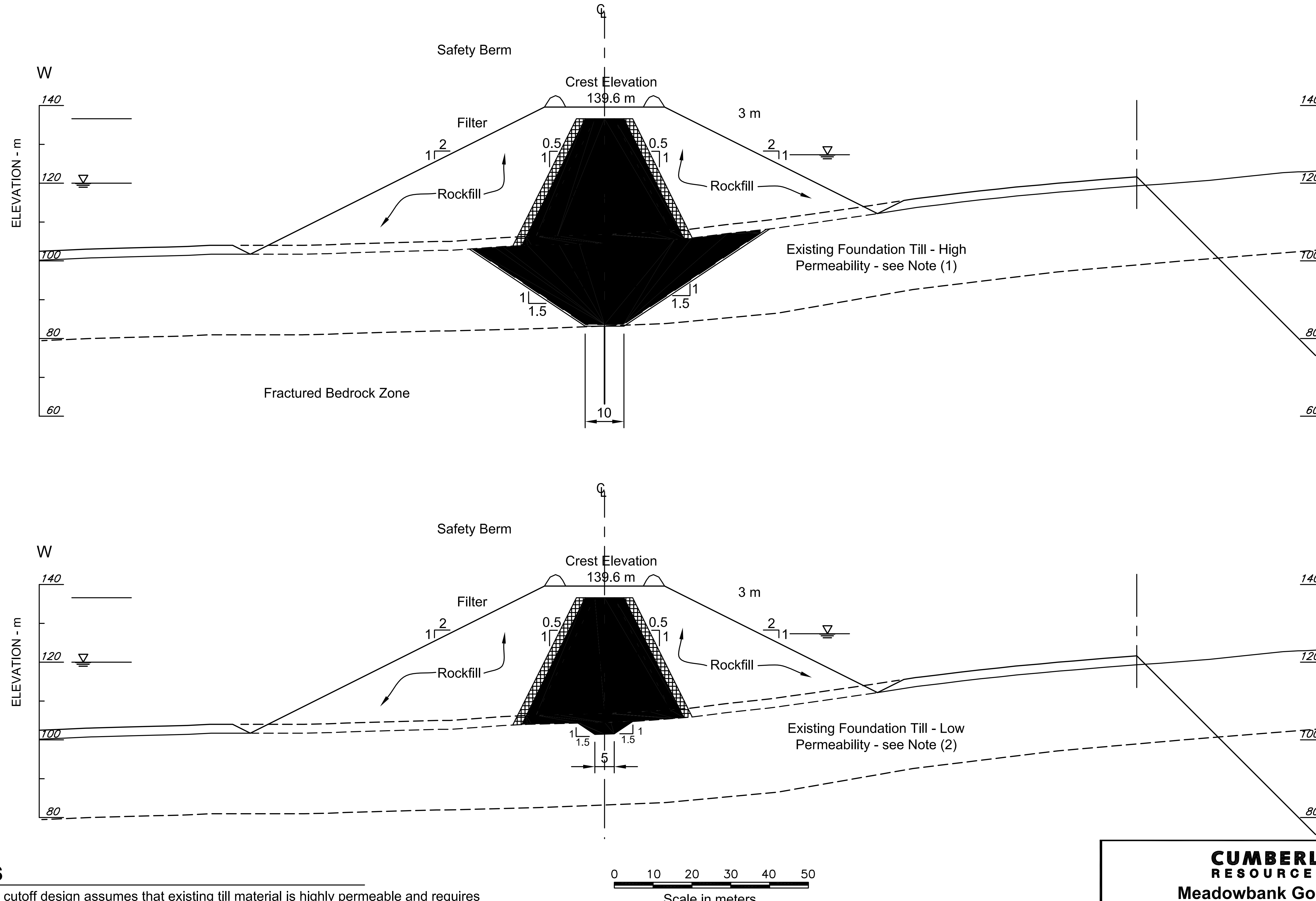
Figure 4.19
Tailings Deposition Concept

Source: Golder Associates TailingsPondAndJan04.dwg be deposited in an impoundment created within the northwest arm of Second Portage Lake through the construction of a retaining dike across the lake. Excess supernatant and any water seepage from the storage facility will be collected and treated prior to discharge to Third Portage Lake. To minimize water treatment requirements, separate water storage ponds, including reclaim and attenuation ponds, will be used to efficiently manage captured process water, dike seepage, and surface runoff during mine operations.

Expected conditions at the tailings dike and storage facility on completion of mining operations are summarized below.

Tailings dike - Basic engineering for the tailings dike is shown in Figure 4-20. The tailings dike will be constructed on the west side of the North Portage pit from overburden till material and rockfill obtained from pre-stripping and open pit mining. During operations, the tailings dike will control seepage from the northwest arm of Second Portage Lake and from the tailings impoundment. The dike will have a low-permeability till core blanketed by upstream and downstream granular filter zones and shouldered by IV on the upstream slope and IV and IF on the downstream slope; the upstream and downstream slopes will be two horizontal to one vertical (2H:1V). The crest will be a minimum 30 m wide. The tailings dike is designed to be structurally stable under unfrozen, partially frozen, and frozen conditions.

Tailings storage facility – Tailings will be transported by pipeline from the process plant to the tailings storage facility and spigotted from the tailings dike to progressively fill the impoundment in a westerly direction. The tailings will be initially deposited in a subaqueous environment, but thereafter the majority will be deposited subaerially (in the later stages of the mine life, the water level in Second Portage Arm will be raised about 2 m above the current lake level, or about 1 m higher than the adjacent Third Portage Lake, through the construction of a series of low perimeter dikes). The tailings storage facility, including the impoundment, the reclaim pond, and the attenuation storage pond, is designed to fill the Second Portage Arm. The facility will be closed progressively during mine operations as the height of the tailings deposit increases. Tailings placement operations will be managed to promote a naturally graded, sloping beach surface to direct runoff away from the area



NOTES

(1) Full cutoff design assumes that existing till material is highly permeable and requires foundation cutoff structures.

(2) Partial cutoff design assumes the existing till material is of sufficient areal extent and of sufficiently low permeability that foundation cutoff structures are not required.

(3) All dimensions in metres. All elevations in metres above mean sea level.

Source: Golder Associates figure 031413427SK01.dwg

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Figure 4.20
Proposed Tailings Dike Design Alternatives Typical Cross-Section

before freezing. The final tailings surface is expected to become irregular due to settlement and seasonal melting of surface ice. The facility will be monitored and corrective measures implemented if necessary to limit ponding of surface water within the tailings impoundment during the later years of mine operations.

A cover of non-acid-generating ultramafic rock will be placed over the tailings surface to maintain frozen tailings and minimize erosion from surface water runoff and wind-blown dust. The cover will be at least as thick as the seasonal thaw or "thermal active" layer, as measured during ongoing thermal monitoring throughout mine operations. Based on thermal monitoring conducted to date at the tailings storage site, the cover layer should be at least 2 m thick; this depth of cover has been assumed for feasibility costing purposes only. If required, additional waste rock will be placed over the frozen tailings to maintain the thermal active layer within the cover layer. Over time, the tailings impoundment will freeze to depth, including the existing talik beneath Second Portage Arm.

During closure, portions of the pit dewatering dikes will be breached. This will result in the lake coming into contact with the tailings dike, and potentially applying a source of heat to the dike face. Consequently, a key aspect to the success of the frozen tailings concept will be the ability to maintain the core and upstream (tailings) side of the dike in a frozen state, similar in concept to a natural shoreline. Both steady-state and transient thermal modelling for post-closure indicate that the dike will remain frozen with the lake against its outside face.

To investigate the potential effect of climate change, consistent with the application of the *precautionary principle*, an increasing surface temperature was considered. As discussed in the Mine Waste Management Report, climate change at this site could result in an increase of as much as 5.5°C in the next century. The impact is to extend the time for freezing, but not prevent it. Therefore the potential for groundwater contamination to occur as a result of seepage from the tailings impoundment is considered to be unlikely.

4.10.1.3 Overburden & Waste Rock Disposal

A classification system will be used to identify the appropriate use and storage for all mine rock. Specifically, this system will identify PAG or non-PAG rock types, as well as those with the potential to leach metals. PAG mine rock will be stored in designated areas designed for long-term stability with minimal environmental and aesthetic impact. The relative potentials of the rock types to generate ARD or leach metals under neutral drainage conditions and the implications for potential use as construction rock are presented in Table 4-8.

Table 4-8: Summary of Geochemistry Considerations

	Material Type	Potential for ARD	Potential for ML	Restrictions for Storage or Use in Construction
All Pits	Overburden	None	Low	None
	Tailings	High	High	Requires measures to control ARD
Portage & Goose	Ultramafic & Mafic Volcanic	None	Low	May require collection and treatment of drainage
	Intermediate Volcanics	Variable (none to moderate)	Moderate	Requires measures to control ARD
	Iron Formation	High	High	Requires measures to control ARD
	Quartzite	High	Low	Co-disposal with ultramafic/mafic volcanic or cap/water cover
Vault	Intermediate Volcanics	Low	Variable (low to moderate)	May require collection and treatment of drainage

Waste rock from the North Portage, Third Portage, and Goose Island open pits will be stored within the pits and on the surface in an area to the north of Second Portage Arm and to the west of the Vault haul road (see Figure 4-15). The surface storage area will be constructed to minimize the disturbed area, and will be capped with an ultramafic layer of non-acid-generating rock to constrain the active layer within relatively inert materials. The waste rock below the capping layer will freeze, resulting in low rates of ARD generation in the long term. Most of the waste rock from the Vault pit will be stored in an area northwest of the pit. A small amount will be stored within the pit. Current geochemical predictions indicate it will not be necessary to place capping over the Vault waste rock storage area.

4.10.1.4 Water Supply & Management

A detailed Mine Waste and Water Management Plan has been produced for the Meadowbank project (see Figure 3-1 and Figure 4-21). The plan is designed to minimize project impacts on the aquatic ecosystem of the lakes affected by the pits, including Third Portage, Second Portage, Turn, and Wally

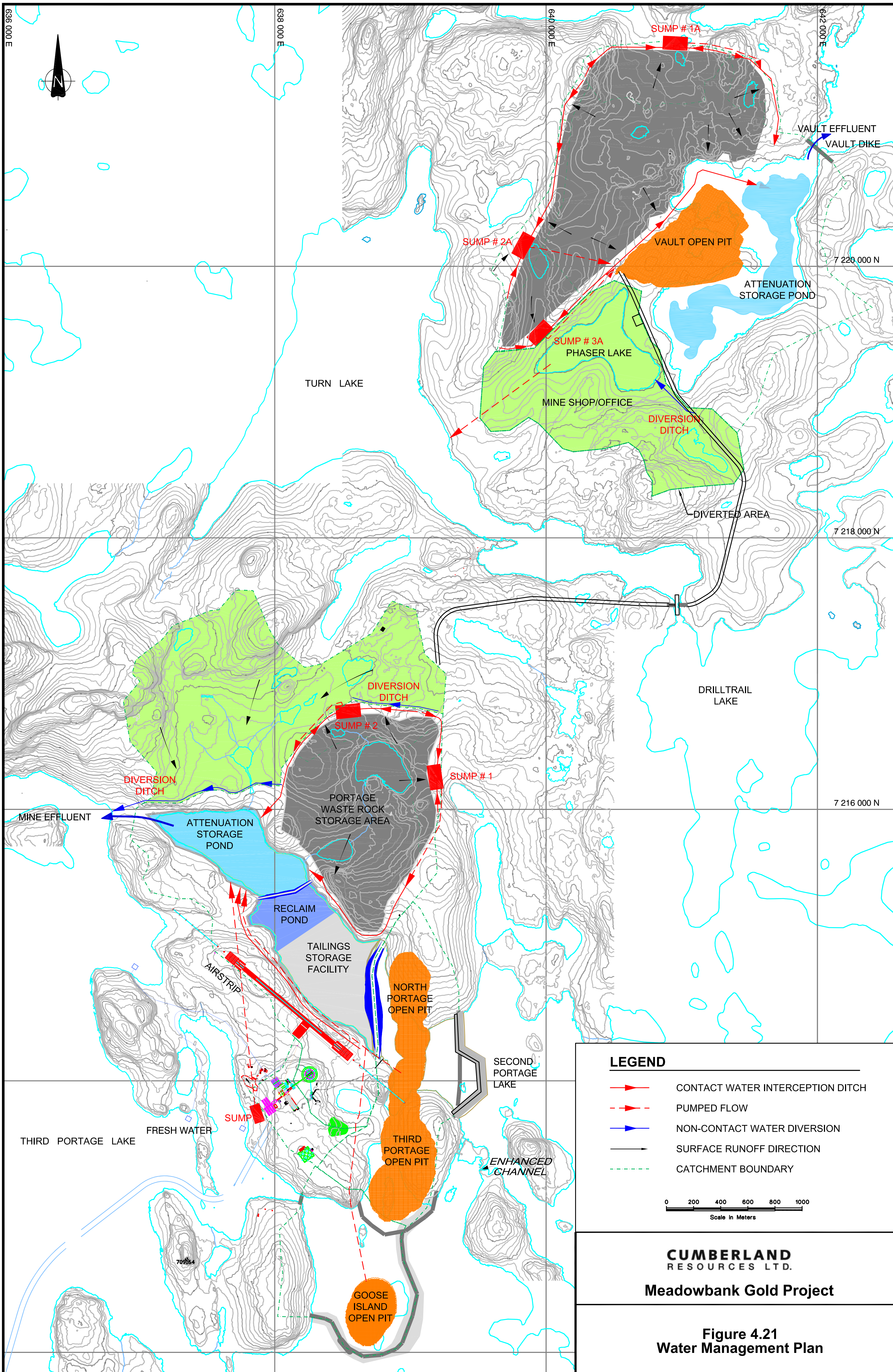

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Figure 4.21
Water Management Plan

lakes. As part of the water management plan, infrastructure such as diversion ditches, sumps, and water attenuation facilities will collect and store surface water and groundwater (contact water) that may have been physically or geochemically affected by mining activities for treatment (if required) prior to discharge to the environment. Water that can be intercepted and directed away from developed areas without contact with project facilities will be controlled by means of natural or constructed diversion channels draining to the neighbouring lakes.

To examine alternatives and predict water quality in the various streams on site, a water balance simulation model was created for the property. This balance is summarized in Tables 4-9 and 4-10. The water management facilities planned to be in place at the end-of-mine operations are described below. Site water flows and containment structures are shown on Figures 4-9 to 4.16.

Fresh Water Supply & Distribution

Before construction of the Goose Island dikes in Year 5, fresh water will be pumped from Third Portage Lake to the plant site through heat-traced, insulated lines. In Year 6, the fresh water pump station will be relocated approximately 1 km from the plant site. The pumps will discharge to an insulated main storage tank located at the plant site, providing both fire and fresh water storage.

Potable water will be drawn from the main storage tank and treated in a skid-mounted chlorination system located in a pre-fabricated structure adjacent to the accommodation camp. The treated potable water will be stored in an insulated water tank. A water distribution pump, also skid-mounted, will distribute potable water to the site.

Reclaim Water

Reclaim water will be pumped from the tailings impoundment area located northwest of the plant site. The pumps are sized to supply process water in the event fresh water is not available. The pumps will discharge to an insulated main storage tank located at the plant site. The reclaim water distribution pumps will be located inside the process building, adjacent to the process water tank.

Table 4-9: Water Balance Model Summary – Portage Mining & Milling Area[a]

Description	Year 1 (2006/07) Inflow m^3/a	Year 1 (2006/07) Outflow m^3/a	Year 3 (2008/09) Inflow m^3/a	Year 3 (2008/09) Outflow m^3/a	Year 6 (2011/12) Inflow m^3/a	Year 6 (2011/12) Outflow m^3/a	Year 10/11 (2016) Inflow m^3/a	Year 10/11 (2016) Outflow m^3/a
Segregated Reclaim Pond[b]								
Tails Storage Runoff	-	-	33,900	-	-	-	-	-
Tailings Transport Water	1,670,400	-	2,227,600	-	742,500	-	-	-
Direct Runoff	44,400	-	36,900	-	-	-	-	-
Direct Evaporation	-	47,800	-	37,700	-	-	-	-
Tailings Pore Water	-	727,200	-	969,500	-	323,200	-	-
Reclaim Water	-	812,600	-	1,258,200	-	-	-	-
Decant to Storm Pond			-	-	-	818,800[e]	-	-
Subtotal	*1,714,800*	*1,587,600*	*2,298,400*	*2,265,400*	*742,500*	*1,142,000*	-	-
Change in Storage[c]	*127,200*		*33,000*		*-399,500*		-	
Stormwater Attenuation & Combined Pond[b]								
Goose Pit[d]	-	-	-	-	309,500	-	520,400	-
North Portage[d]	205,000	-	384,200	-	381,300	-	368,500	-
Third Portage Pit[d]	159,300	-	303,300	-	254,800	-	240,100	-
Rock Storage Runoff	67,900	-	158,000	-	271,800	-	271,800	-
Other Areas Runoff	909,600	-	738,600	-	709,500	-	662,600	-
Tails Storage Runoff	-	-	-	-	84,900	-	164,100	-
Decant from Reclaim Pond	-	-	-	-	818,800[e]	-	-	-
Tails Transport Water	-	-	-	-	1,485,100	-	2,227,600	-
Direct Runoff	10,700	-	14,000	-	90,200	-	38,700	-
Direct Evaporation	-	13,300	-	22,300	-	95,100	-	38,800
Dust Control	-	12,000	-	12,000	-	12,000	-	12,000
Tailings Pore Water	-	-	-	-	-	646,300	-	969,500
Reclaim Water	-	-	-	-	-	1,258,200	-	1,258,200
Decant to Treatment	-	1,351,200	-	1,589,100	-	2,113,100	-	2,315,900
Subtotal	*1,352,500*	*1,376,500*	*1,598,100*	*1,623,400*	*4,405,900*	*4,124,700*	*4,493,800*	*4,594,400*
Change in Storage[c]	*-24,000*		*-25,300*		*281,200*		*-100,600*	
System Total	**3,067,300**	**2,964,100**	**3,896,500**	**3,888,800**	**5,148,400**	**5,266,700**	**4,493,800**	**4,594,400**
Site Change in Storage[c]	**103,200**		**7,700**		**118,300**		**-100,600**	

Notes: [a.] Based on average climate conditions and hydraulic year – 1 October to 30 September. [b.] Stormwater attenuation and reclaim ponds are combined during the course of Years 5 and 6 (2011/12). [c.] Positive change in volume indicates an increase in stored water volume. [d.] Pits include runoff and seepage (groundwater, faults, and dike seepage). [e.] Tailings pond supernatant decanted to stormwater attenuation pond during Years 5 and 6 (2011/12).

Table 4-10: Water Balance Model Summary – Vault Mining Area[a]

Description	Year 1 (2006/07) Inflow m^3/a	Year 1 (2006/07) Outflow m^3/a	Year 3 (2008/09) Inflow m^3/a	Year 3 (2008/09) Outflow m^3/a	Year 6 (2011/12) Inflow m^3/a	Year 6 (2011/12) Outflow m^3/a	Year 10 (2016) Inflow m^3/a	Year 10 (2016) Outflow m^3/a
Stormwater Attenuation Pond								
Vault pit runoff	48,400	-	84,800	-	84,800	-	84,800	-
Rock storage runoff	38,100	-	194,700	-	391,500	-	391,500	-
Other areas runoff	851,200	-	635,000	-	438,200	-	438,200	-
Direct runoff	13,400	-	13,400	-	13,400	-	13,400	-
Direct evaporation	-	31,000	-	31,000	-	31,000	-	31,000
Dust control	-	4,000	-	4,000	-	4,000	-	4,000
Decant to Wally Lake	-	2,681,200	-	893,000	-	893,000	-	893,000
System Total	**951,100**	**2,716,200**	**927,900**	**928,000**	**927,900**	**928,000**	**927,900**	**928,000**
Change in Storage[b]	**-1,765,100[c]**		**-**		**-**		**-**	

Notes: [a.] Based on average climate conditions and hydraulic year – 1 October to 30 September. [b.] Positive change in volume indicates an increase in stored water volume, values of 100 m^3 or less are reported as 0 because they are due to rounding error. [c.] Vault Lake dewatered in Year 1.

4.10.1.5 Pit Dikes & Mine Dewatering

Dike construction and dewatering will be required to enable open pit mine operations beneath the lakes. The following dewatering dikes are proposed:

- Portage pit – East dike with causeway, and Bay Zone dike
- Goose Island pit – Goose Island dike and South Camp dike
- Vault pit – Vault dike.

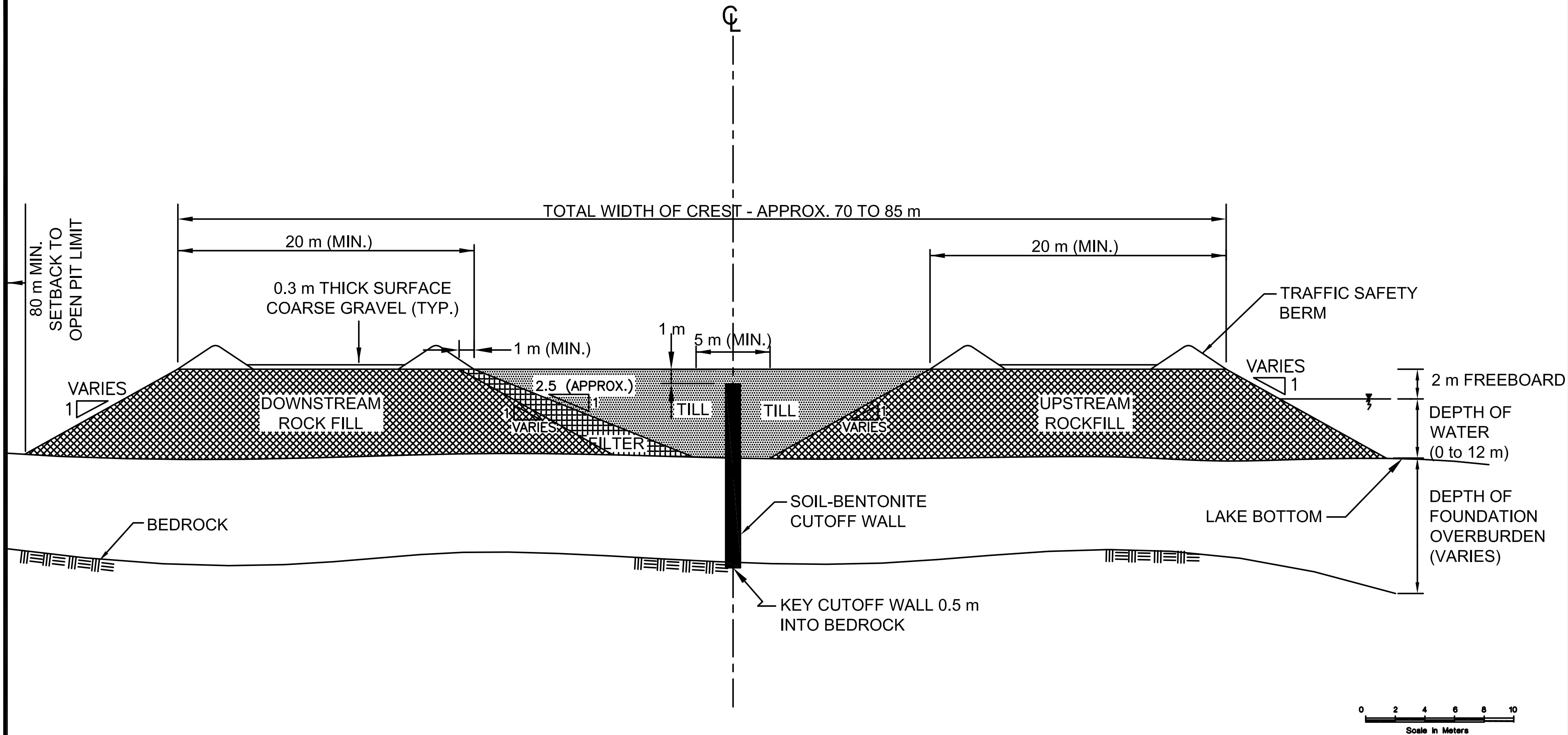
The dikes are essentially designed as flood control structures to permit the proposed open pits to be dewatered below existing lake levels and to minimize seepage flow through the dike structures. To simplify construction and operation activities, the dikes are aligned through shallow water areas.

A typical dike section will include two rockfill embankments with a till core, a filter zone, and a soil bentonite cutoff wall excavated to the underlying bedrock (see Figure 4-22). The dike crests will be at least 2 m above the lake level and will be surfaced with material suitable as a running course for haul trucks. The till core will be constructed of fine-grained soil recovered from overburden pre-stripping in the open pit areas. The soil-bentonite cutoff will be prepared from a mixture of fine-grained soil and a slurry of imported bentonite.

Rockfill materials for dike construction will include iron formation for the upstream shell, intermediate volcanic for the downstream shell, and ultramafic as surface capping from the crest down to water level. Residual seepage through the dikes will be collected in a series of collection ditches and sumps and treated if necessary.

Dike construction will utilize floating sediment curtains to minimize the release of suspended solids into surrounding lake waters. During mining, water collected from the base of open pits will be directed to attenuation ponds and treated as required prior to discharge. At the end of mining operations, the pits will be flooded to minimize the potential for acid generation.

Fish salvage programs are discussed in Section 4.24.1.2, “Monitoring.”



NOTES

1) Sideslopes for rockfill as shown are 1.8H:1V.
   Actual slopes will vary depending on water depth, rockfill grain size, and foundation conditions.
2) NWT Mine Safety and Health Act (1995) states that minimum width of haul road is:
   - for one-lane traffic: 2X width of largest vehicle
   - for two-lane traffic: 3X width of largest vehicle
   - minimum height of safety berm = 0.75X diameter of tire of largest vehicle
3) The 80 m minimum setback is based on a similar setback of Diavik and to be confirmed during detailed engineering design.
4) Largest vehicle assumed to be a 777 haul truck.

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Figure 4.22
Typical Dike Cross-Section
Second Portage, Goose Island, & Bay Zone Dikes

4.10.1.6 All-Weather Roads & Winter Roads

All-Weather Roads

Two types of roads will be constructed at the site: haul roads and service roads. Haul roads will be used to haul ore to the process plant and waste rock to various containment and construction sites; service roads will be used to provide service/maintenance vehicle access to all areas of the proposed facilities. All roads will be constructed by placing non-acid-generating mine waste rock as fill, together with crushed surfacing material to provide an adequate running surface. For safety and security, no public access will be permitted on the site road systems. Except for the crossing of the Turn Lake outlet by the Vault pit haul road, only minor drainages will be crossed by site roads. Relatively small culverts will be installed at such crossings. Regular watering will control dust on the roads during the dry periods. Calcium chloride may also be used if necessary.

Site reclamation activities are described in Section 4.26 and Cumberland's Reclamation and Closure Plan. Detailed procedures for accident and incident response and reporting are provided in Cumberland's Emergency Response Plan.

Mine Access Road

The site will be accessible by land by either a winter road or an all weather road. The haulage route will begin at the storage compound in Baker Lake and enter the site southeast of the mine facilities.

Airport Facilities

An airstrip will be constructed immediately northwest of the mill site using suitable mine rockfill from open pit pre-stripping operations (see Figure 2-4). The airstrip will be 1,650 m long x 50 m wide to accommodate aircraft such as the Hawker Siddley 748. It will be elevated to reduce problems with snow drifting, and oriented to minimize the effect of prevailing winds on landing aircraft. No permanent facilities are planned at the strip for accommodating passengers or freight.

For information on accident and incident response and reporting, see the Emergency Response Plan.

4.10.1.7 Fuel & Explosives Storage Sites

Fuel Storage at Baker Lake

Barges will transport diesel fuel to a lined and bermed tank farm at Baker Lake. Onboard transfer pumps will pump the fuel from the barges to one of two 20 ML capacity tanks within the containment area. P_{50} diesel (Arctic diesel) will be the primary fuel used at site. A fuel pump module installed adjacent to the storage tanks will dispense fuel to highway vehicles and tanker trucks en route to site. The module will be housed in an Arctic container installed on a lined compacted gravel pad. A spill collection sump and pumpout facilities will be provided. From this tank farm, fuel will be trucked via haulage route from Baker Lake to a nearly identical containment facility on site.

Fuel Storage at Site

During the first year of site preparation, approximately 5 ML of diesel fuel will be stored in a steel tank located within a lined berm. A 15 ML storage tank will be built in the first year of construction. The permanent fuel tank farm at site will consist of two bulk storage tanks of 15 ML each, enclosed within a lined berm. The berm will have spill collection sumps and will meet all applicable fire codes, API standards, and insurance underwriter requirements. A fuel unloading and distribution pump module will be enclosed in an Arctic grade container installed on a concrete pad with spill collection and pumpout facilities. The distribution pumps will feed a network system throughout the plant area, supplying fuel to the exterior day tanks at the power plant and boilerhouse. The light vehicle fuel dispensing station and heavy vehicle fuel dispensing station will be located adjacent to the storage facility.

Gasoline

Gasoline will be required in relatively small quantities for small vehicles such as snowmobiles and ATVs. The gasoline dispensing station will have a self-contained, 25,000 L enviro tank with an on-board pump and hoses. The station will be in a bermed area adjacent to the diesel storage tanks.

Aviation Fuel

The most commonly used fuel for turbine engine aircraft, Jet-B, will be stored in a 5,000 L self-contained enviro tank mounted on an elevated pad at the air terminal shelter. This reserve will be only for emergency use by aircraft. The tanker truck with on-board pump and hoses will refill the Jet-B storage tank after use in an emergency. Jet-B fuel will also be available, on an emergency basis, for helicopters.

Explosives

The ammonium nitrate will be stored at the mine site and loaded into the ANFO mixing truck as required. The emulsion, detonators, and accessories will be stored on site in magazines that conform to all regulations surrounding the supply and storage of explosives. The explosives contractor will mix the ANFO and transport the explosives to the work site. Mine personnel will be responsible for loading, priming, and detonating the explosives.

For information on emergency response procedures, see Cumberland's Hazardous Materials Management Plan, Spill Contingency Plan, and Emergency Response Plan, all included in this EIA .

4.10.1.8 Borrow Pits & Quarry Sites

No sources of aggregate or sand have been found in the vicinity of the site. It is currently planned that aggregate and sand will be provided by crushing and screening of intermediate volcanic and quartzite rock.

4.10.1.9 Waste (Domestic & Hazardous) Management

The Meadowbank project will require the transport to site, temporary storage, and use of hazardous materials as part of everyday activities during the pre-development, operation, and closure stages of the project. All hazardous materials used on site will be handled according to safe use and environmentally acceptable disposal practices according to the *Mine Act* regulations. Detailed procedures for accident and incident response and reporting will be established prior to initiation of site activities. In addition, spill response training will be mandated for site construction and operations personnel who handle these materials.

Hazardous materials include industrial chemicals for process and water treatment, and hydrocarbon products, including but not limited to diesel fuel, gasoline, aviation fuel, and lubricants. Hydrocarbon products will be stored on site and used for electrical power generation and the operation of site equipment.

Spilled Materials

In the event of a spill, the released product will most likely penetrate the ground surface and flow toward the water table. Design measures to limit the infiltration and loss of released products will include geomembrane liners, containment berms, fuel aprons, and collection sumps at fuel handling locations. Containment ditches, skirted oil booms, and oil-absorbent pads will be used to limit the release of product into open waterbodies.

Written reports of all product spills associated with mine construction, operation and closure activities will be required, and investigations will be undertaken to assess the nature and extent of the area affected by the spill. Remediation of the spilled material will be subject to the results of the investigations.

Spilled Tailings

Tailings spills may occur within the process area, along the pipeline route to the tailings impoundment, or as seepage from the impoundment itself. The overall site and the tailings line route will be graded such that all site runoff and any tailings spills will drain toward the impoundment or collection sumps. The sumps will be drained by pump and pipeline to the impoundment. Regular monitoring of the tailings pipeline, collection sumps, and impoundment facility will be required during mine operations.

Written reports of all tailings spills associated with mine operation and closure activities will be required to document the release and the investigations undertaken to assess the nature and extent of the area affected by the spill. Remediation of the spilled material will be subject to the results of the investigations.

Non-Hazardous Waste Materials

Inorganic solid wastes from the mine operation will be segregated into material categories including but not limited to concrete, metal, rubber, and plastic. Those materials deemed suitable for onsite deposition will be placed in a designated landfill area within the Portage waste rock storage facility. All other materials considered unsuitable for landfill deposition will be packaged for shipment and disposal off site.

The sewage treatment facilities will be housed in a prefabricated structure adjacent to the construction camp. Grease traps will be provided to handle the flow from the kitchen and shop sewers. A rotating biological contactor treatment system will be installed. During construction, the treated effluent will be discharged to Third Portage Lake. During operations, the effluent will be pumped to the tailings pumpbox, then to the tailings impoundment area.

Solid waste from the accommodation camp, kitchen, shops, and offices will be transported in air-tight containers by pickup truck to a pre-fabricated, diesel-fired waste incinerator located downwind of the facilities.

4.10.1.10 Power

Power at site will be supplied by a diesel-fuelled generation facility. The power output is rated to meet the process plant, ancillary support loads, and camp requirements. Spare units will be installed to accommodate repairs and planned maintenance. The anticipated peak power requirement of 15.5 MW will be met with an adequate number of onsite gensets. In the interests of economics and sustainability, all waste heat from the gensets will be recovered and utilized on site.

Power to the site loads will be distributed from the powerhouse using cable-in-tray and overhead distribution lines as appropriate. The main electrical loads are the main process plant; crushing, reclaim, and pebble crusher; camp and service complex; ancillary loads including water distribution/handling and treatment. The main distribution switchgear will be located in the power station, the electrical distribution hub for the site.

4.10.1.11 Camp Facilities

The camp will consist of modular, trailer-type units supported on shallow foundations. Facilities will include dormitory rooms and common areas for food preparation, food storage, dining, and recreation.

4.10.1.12 Baker Lake Site

A marshalling facility located about 2 km east of Baker Lake will receive construction and operations supplies during the shipping season from late July until early October. The facilities will consist of: a barge unloading ramp and adjacent storage and marshalling area; four upper storage benches, including a fuel storage facility; a storage compound for explosives; and interconnecting roads. A total storage area of approximately 120,000 m^2 will be provided. The entire facility will be fenced.

4.10.2 Project Design

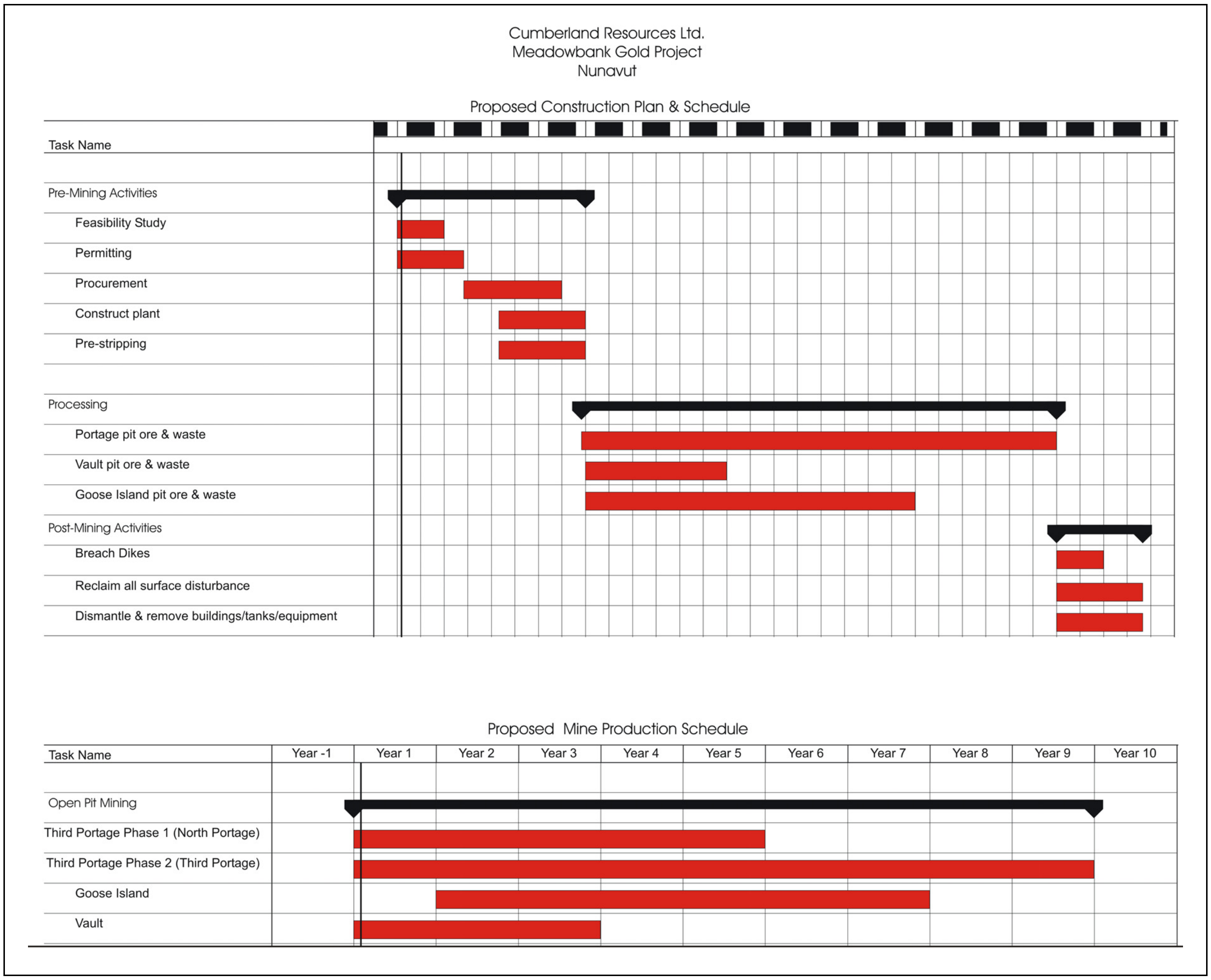
Prefeasibility studies, completed in 2000, emphasized both the cold northern climate and remote location as the principal engineering considerations for successful design, construction, and operation of the project.

The Meadowbank mine is designed to minimize the areas of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to a post-mining use for traditional pursuits and wildlife habitat.

4.10.3 Pace, Scale & Timing of Project

Project milestones are shown in Figures 4-23 and 4-24. The major schedule components are briefly described below.

Figures 4-23 & 4-24: Proposed Construction Plan & Schedule / Proposed Mine Production Schedule



Pre-mining activities – Immediately following permit approval, the tendering and award of long-lead process and electrical equipment will be carried out to obtain the vendor information required to continue with detailed engineering. The engineering design philosophy will be to maximize the use of modular designs to reduce onsite labour requirements as well as capital costs and scheduling. This will allow engineering to advance and critical contracts to be tendered in a timely fashion.

Construction activities – Construction will be started as early as possible to complete the major portion of the civil work and advance the major buildings prior to the onset of winter. Process equipment can continue to be installed indoors during the winter months, leading to substantial completion 18 to 24 months later. Pre-stripping activities to remove overburden, exposing primary ore and associated waste, will be conducted during the same period.

Mining & processing – The Portage open pit will provide the primary ore supply for the process plant throughout the life of mine, with lesser amounts being supplied by the Goose Island and Vault pits. The process plant will be commissioned after 18 to 24 months of construction.

Post-mining activities – The Meadowbank project will minimize the area of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to a post-mining use for traditional pursuits and wildlife habitat.

4.10.4 Future Development

Exploration will continue at the Meadowbank project during mine development and production, focusing on expanding the resource base and extending the mine life beyond its currently proposed 10 years. Opportunities for future development include: expanding the existing deposits where they remain open along strike and at depth; systematically exploring numerous grassroots targets to determine their economic viability; and discovering new deposits in the Meadowbank Trend.

Definition diamond drilling will be conducted to convert present resource ounces into reserves by increasing the density of diamond drill holes within the deposits. Through one or more of these targets, a good probability exists of finding further gold resources in the Meadowbank area.

One significant resource that has been defined on the property but not included in the current mine plan is the PDF deposit. The PDF deposit is located approximately 10 kilometres north-northwest of the Vault deposit and has an inferred resource of 344,000 tonnes grading 5.20 g/t or 57,511 oz of gold. The deposit remains open for further expansion and will be the focus of continued exploration.

Development of a mining and milling complex at the Meadowbank site should have a very positive impact on future exploration in the area by lowering the grade and/or tonnage thresholds required to define economically viable gold deposits due to the reductions in capital costs required to bring these deposits to production.

4.10.5 Technology

The most current concepts have been selected for project design and to determine project impacts in each area where technology is employed (i.e., mining, processing, tailings disposal, and effluent treatment). Although the technologies are considered state-of-the-art, none is so new as to be unproven and all have a demonstrated pedigree of successful operation at other mining locations. The Meadowbank project has no difficult design issues that require new, risky technical solutions; the mining and processing techniques proposed for this project are familiar, proven approaches seen at many mining operations in production today.

4.11 PROJECT ALTERNATIVES

Project alternatives were considered during all stages of project design (i.e., prefeasibility, feasibility, impact assessment). Decisions were made based on traditional knowledge, the *precautionary principle*, common sense, best engineering practices, and financial concerns. Some examples of alternate options are briefly discussed below. For more information, see the Project Alternatives Report, included as part of this EIA submission.

4.11.1 Site & Footprint

4.11.1.1 Plant Site Options

Four plant site locations were assessed; the current location was finally selected based on the following factors: proximity to the main deposits of Third Portage and Goose Island; proximity to the tailings disposal site; relatively large area of flat but elevated terrain, giving room for the anticipated facilities; competent rock at or close to surface for good foundation conditions; remote from culturally sensitive areas. The selected site, shown in Figure 2-4, also offers the best opportunity for water management and spill containment, and reduces overall land disturbance.

4.11.1.2 Portage Rock Storage Facility Options

Four potential rock storage areas on the north side of Second Portage Lake were considered, as shown on Figure 4-25 and summarized in Table 4-11.

Source: Golder Associates.

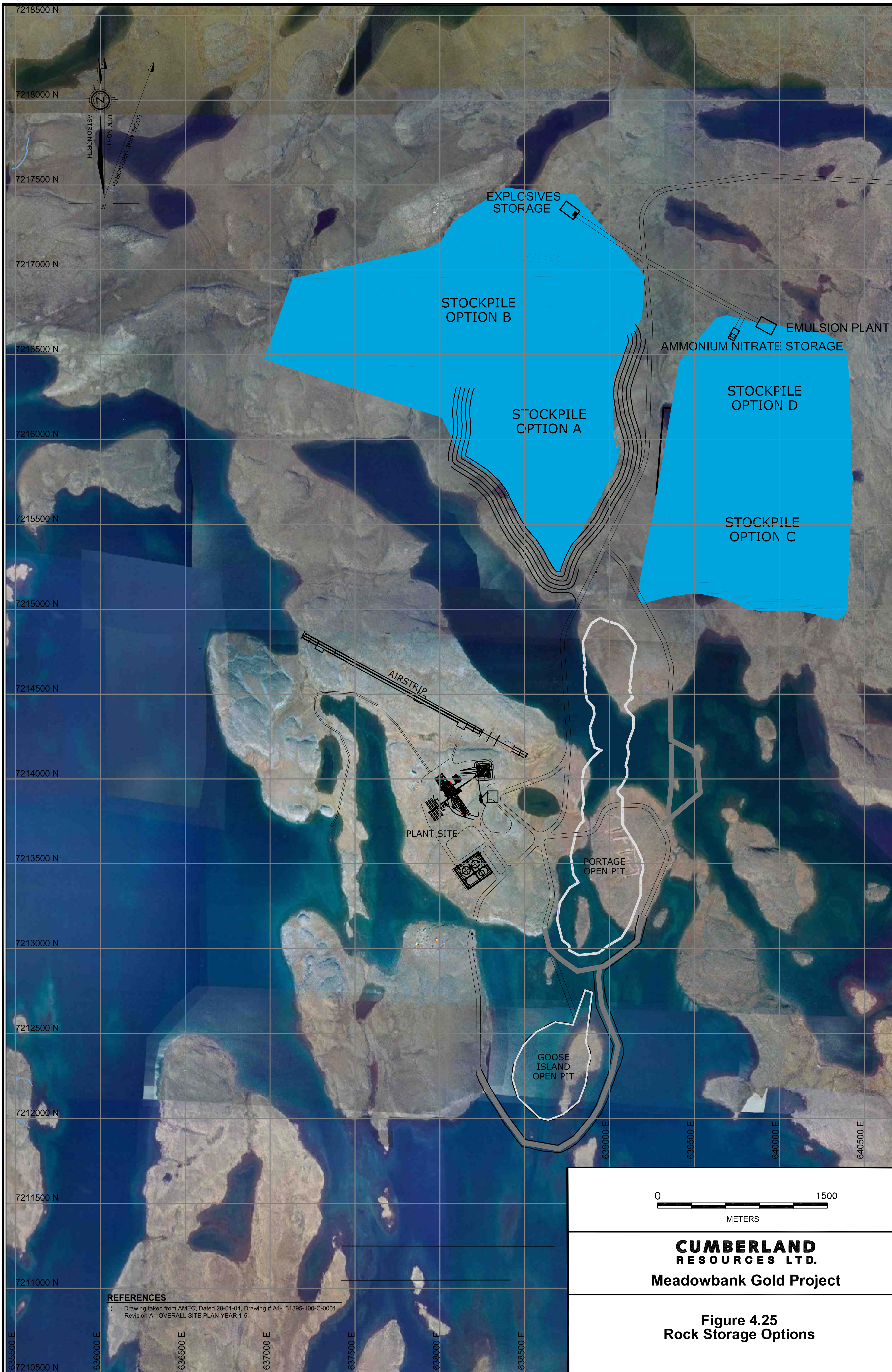


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Figure 4.25
Rock Storage Options

Table 4-11: Summary of Portage Rock Storage Facility Options

Option	Description
A	North from Second Portage Lake – small footprint
B	Northwest from Second Portage Lake – large footprint
C	East from Vault haul road – small footprint
D	East from Vault haul road – large footprint

The options were evaluated using a decision matrix. The key categories that were used to evaluate the options were based on environmental, operational, and cost considerations. Within each category, the individual sub-indicators were assigned ‘weight’ values based on subjective estimates of relative importance, so that the sum of the weights would contribute to the overall option weightings. The results of the decision matrix showed Option A to be the preferred option.

4.11.1.3 Tailings Storage Options

Geochemical testing has shown the tailings to have acid-generating and metal-leaching potential. Consequently, the most suitable methods for storing tailings in an Arctic environment are either subaqueously or subaerially to encourage freezing (or a combination of the two). Several potential site and method combinations were considered for tailings storage, as listed in Table 4-12 and shown in Figure 4-26 (see also Tailings Disposal Technology in Section 4.10.5).

Table 4-12: Summary of Tailings Storage Facility Options

Option	Location	Disposal Type
A	Second Portage Arm & North Portage pit	Subaqueous slurry
B	Second Portage Arm	Subaerial paste or drystack
C	Second Portage Arm	Subaerial slurry
D	Third Portage Lake	Subaqueous slurry
E	East from Vault haul road	Subaerial slurry
F	North of Second Portage Arm	Subaerial slurry
G	North of Second Portage Arm	Subaerial paste or drystack

Again, a decision matrix evaluation was performed, similar to that used for mill site selection, and Option C (slurry disposal in Second Portage Arm) was selected as the preferred option because of the following main advantages: reduced potential for ARD and metal leaching, ease of closure, ease of operation in the harsh Arctic climate, lowest relative capital cost.

Source: Golder Associates

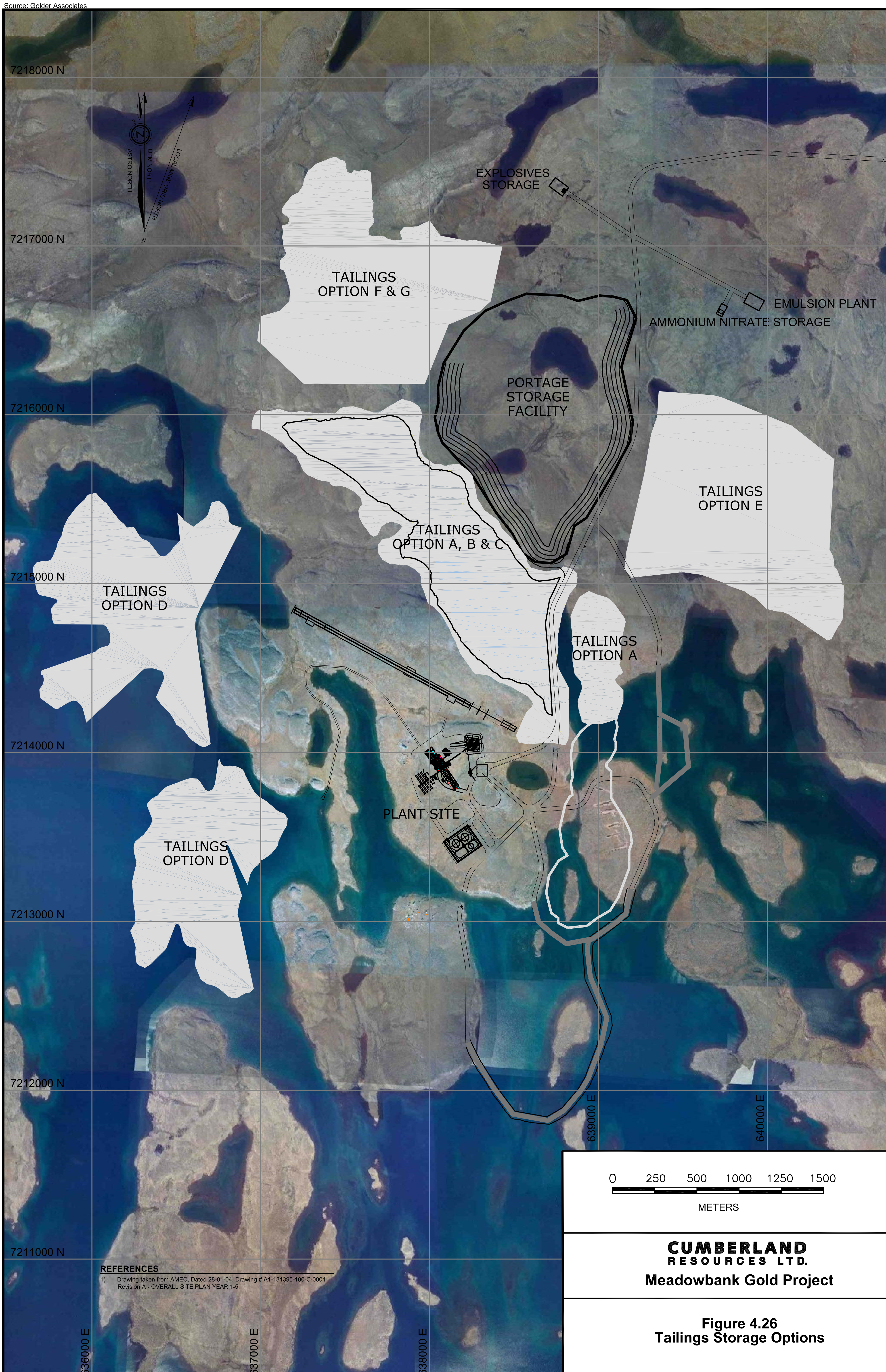


Figure 4.26
Tailings Storage Options

4.11.1.4 Airstrip Options

Two options have been considered for siting the 1,650 m long airstrip. The northern option, aligned along the isthmus between the northwest arm of Second and Third Portage Lakes, was selected over the southern option located on the southwest side of Third Portage Lake. Although the southern option requires less cut and fill, a roadway would need to be constructed over a narrow section in Third Portage Lake. The alignment of the northern option is slightly better and more coincident with the prevailing wind direction from the northwest. It results in a more compact site with less overall disturbance, although it will require placement of a limited amount of fill in Third Portage Lake to achieve full length.

4.11.1.5 Vault Road Alignment

The Vault pit is connected to the main site by a 7 km long haul road that crosses the outlet of Turn Lake. Various alternatives for crossing the lake were considered. The selected alignment avoids lakes as much as possible, minimizes impacts on external drainages, and avoids burial sites. The route crosses the outlet approximately 5 km from the plant site, where the water course is shallow. Other than at Turn Lake, the route requires only minor culvert crossings.

4.11.2 Mining Methods

An open pit mining approach to development has been selected because grades show underground mining to be uneconomical at this time. Underground mining may be an option for the future extraction of the deeper portions of the Goose Island and Vault deposits, which have not yet been sufficiently defined by exploration. The size of the mining fleet takes into account the variability of the deposits and the need for flexibility to achieve a steady supply of 2.5 to 2.7 Mt per year of ore from the various sources. Diesel power was selected over electric since the latter is not well suited to the flexibility required.

4.11.3 Pit Dewatering Dikes

In prefeasibility studies, perimeter dikes were investigated as part of the pit dewatering scheme. All options attempted to use available mine waste rock and considered various alternatives for seepage control. Seepage control measures that were evaluated included use of glacial till soil, geosynthetic clay liner, and slurry or sheet-pile cutoff walls. Various embankment geometries suited to the depth of water and combination of materials were also evaluated.

It was concluded that the combination of a till core with a soil-bentonite cutoff wall will be both effective and economical in preference to a crushed rock core with slurry cutoff wall. The preferred option makes use of available stripped material and eliminates the need for crushing and quarrying. The recommended configuration is two parallel rockfill embankments with a core of glacial till. A soil bentonite cutoff wall will be excavated through the till core and foundation materials to bedrock.

4.11.4 Gold Recovery

Comparative scoping level capital cost estimates were developed for three flowsheet options based on a plant throughput of 5,500 t/d: Base Case (whole ore leaching); Option 1 (flotation concentrate leach); and Option 2 (flotation concentrate and tailings leach). The trade-off study indicated the Meadowbank deposits are more economically amenable to whole ore cyanidation than the more complex bulk sulphide flotation + concentrate cyanidation flowsheet used in the preliminary assessment study. Subsequently, whole ore cyanidation was selected.

4.11.5 Tailings Disposal Technology

Three alternatives were considered for tailings disposal:

1. Filtration of process tailings solids and stacking of filter cake into tailings piles.
2. Thickening/filtration of tailings slurry to a very high density and placement of tailings slurry without solution recovery (filtrate solutions would be recycled).
3. Direct placement of tailings slurry either subaerially or subaqueously within a facility to allow settling of solids and decanting of process solutions for reuse.

The direct placement process (alternative 3) was selected because it operates at a solids concentration of 45% to 55% solids (by weight) which corresponds to the product stream of the gold recovery plant. The recycle of the solutions will allow water quality to be managed within the process and minimize the impact of the process on the surrounding surface and groundwater.

4.11.6 Materials Transportation

Of the four transportation options considered, direct shipping to Baker Lake using adapted tug and barge equipment has been selected based on the pricing and equipment availability inquiries conducted for the feasibility study.

Two overland haulage options from Baker Lake were investigated: the use of tractor-trailer units on an all-weather road, or use of all-terrain tracked or low pressure tired equipment towing trailers or sleds on a winter only road. It was concluded that transportation can be performed by either method; no environmental or technical fatal flaws have been identified. Both methods are still under consideration. A final decision will made for the final EIS.

4.11.7 Energy Sources

Remote northern mining projects typically use onsite diesel generation unless they are within 100 km of a grid supply. This is usually based on considerations of proven technology, reliability, cost, and practicality. In the case of the Meadowbank project, the nearest grid is far to the south, and Baker Lake is itself supplied with power by diesel gensets.

Wind, solar, hydroelectric, and hydrogen fuel cell technologies were researched but found to be lacking, even as supplemental sources to reduce diesel consumption and attendant air emissions. In the interests of economics and sustainability, a heat recovery diesel generation system was chosen.

4.11.8 No-Go Alternative

From a strictly economic view, the no-go alternative would result in a significant lost opportunity since tax and royalty revenues to government and employment, and business contracting opportunities to individuals and companies would be lost. Project expenditures that could exceed $300 over the 18- to 24-month construction phase and $92 M per year during operations (see Table 4-7) would not occur. In addition, the attraction for others to invest in resource development in Nunavut may be compromised and no further exploration would take place at Meadowbank.

From an environmental perspective, the no-go alternative would mean no impacts from mining. Existing site facilities would be decommissioned and the area disturbed by exploration would be restored.

4.12 DESCRIPTION OF PHYSICAL ENVIRONMENT

4.12.1 Bedrock Lithology, Morphology & Structures

The Meadowbank project is located in the Canadian Shield, the largest physiographic region of Canada (see Figure 4-17). The three main rock types comprising the Portage, Goose Island, and Vault deposits are iron formation, intermediate volcanic, and ultramafic volcanic, while a fourth, less common rock type, quartzite, may form portions of the upper west pit wall of the Goose Island and Portage deposits. Ultramafic volcanic waste is considered non-PAG, while 85% of iron formation rock is PAG. Intermediate volcanic rocks in Goose and Portage deposits are PAG, while only 25% of Vault intermediate volcanic waste rock is designated as PAG (see Table 4-8).

Faults are suspected in the project area based on strong lineament trends through bedrock exposures. Two main faults have been encountered in geotechnical drilling completed to date. Stratigraphic contacts are also pervasive structures. No sites of palaeontological or palaeobotonical significance were found.

4.12.2 Geomorphology & Soils

4.12.2.1 Geomorphology

Landforms are dominated by hummocky bouldery glacial till plains and scattered boulder till moraines with frequent bedrock outcropping in isolated exposures, elevated plateaus, and elongated ridges. Localized north- to northwest-trending glacial drumlins preserve evidence of regional ice flow. Rare glaciofluvial kames and sinuous eskers form isolated topographic features.

The periglacial geomorphic processes observed in the area are typical of areas underlain by permafrost, although the relatively thin cover of overburden and dry conditions on site subdue their expression. Terrain features and geomorphic processes associated with excess ground ice and generally wet conditions exist locally and are commonly associated with low-lying bogs. Some of the processes observed at site include: frost wedging and frost shattering, resulting in blocky colluvial slopes; cryoturbation; solifluction; and thaw subsidence and nivation.

4.12.2.2 Soils

Block fields of weathered parent material interspersed with thin veneers of till or organics are common; however, the predominant surficial material is locally derived glacial till. Till thickness, as determined from core and reverse circulation overburden drill holes, ranges up to 12.5 m with an average of less than 3 m. In general, till is unsorted, medium brown, silty, sandy and stony, with between 20% and 40% locally derived volcanic, sedimentary, and lesser granitic clasts. Clast sizes range from granule to boulder with a high proportion in the granule to pebble range. In most of the channels between the lakes and ponds, coarse-grained soils are common. In some, the finer organic material and sediments have been removed by flow between lakes, leaving a stony pavement. In others, solifluction has brought coarse-grained material into the low-lying areas from adjacent slopes.

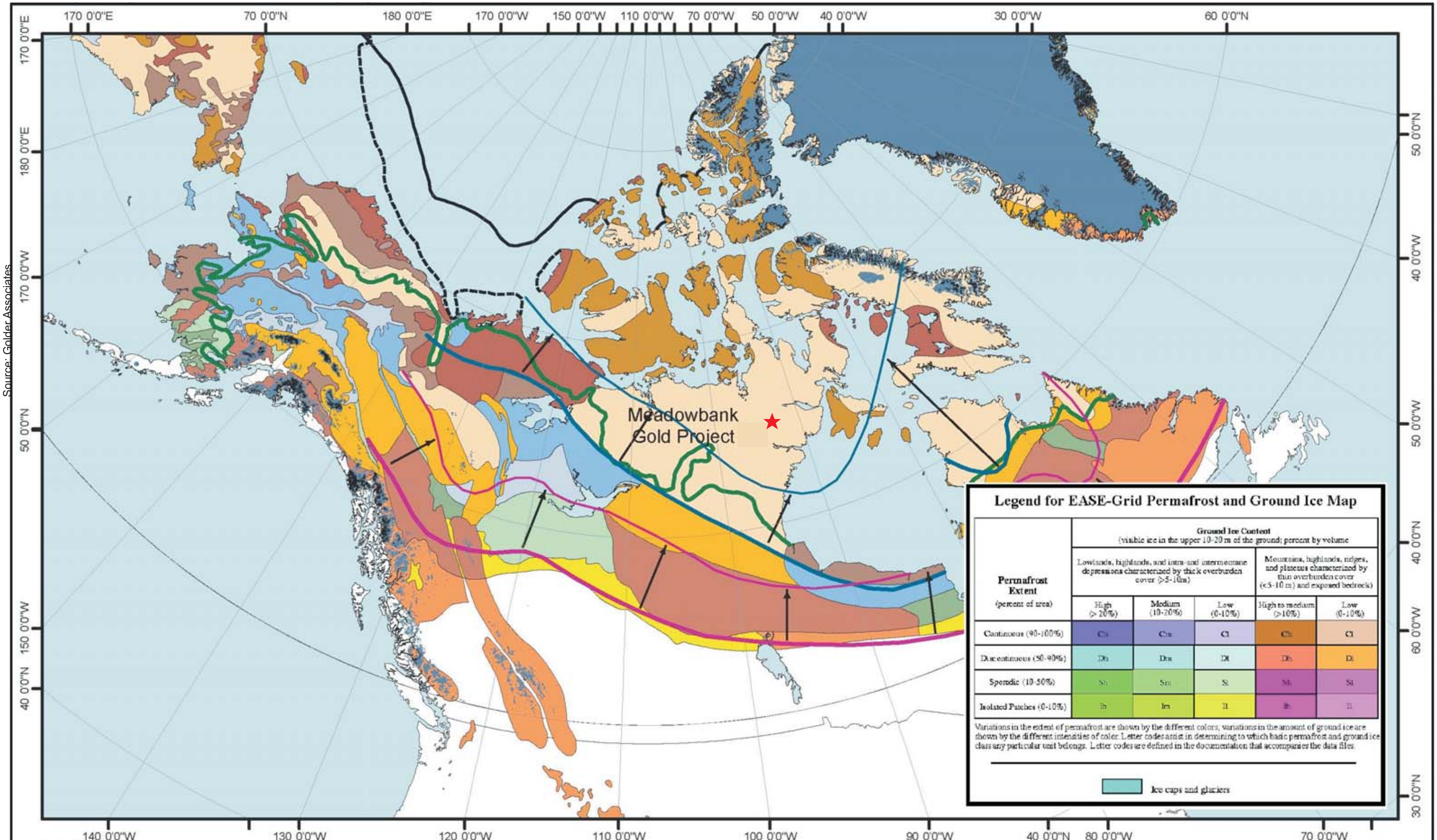
Small deposits of deltaic sand and fine gravel flank some streams along Third Portage Lake. Glaciofluvial deposits are volumetrically insignificant. The site was above the last glacial marine transgression; consequently, no glaciomarine deposits are known in the area.

4.12.3 Permafrost

The project is located well within the zone of continuous permafrost (see Figure 4-27). Permafrost depths are estimated to be between 450 and 550 m, depending on proximity to lakes, slope, aspect, and other site-specific conditions.

The measured active layer depth in the project area currently ranges from about 1.3 m in areas of shallow overburden and away from the influence of lakes, up to 4.0 m adjacent to lakes, and up to 6.5 m beneath the streams connecting Third Portage and Second Portage lakes.

Lake ice thickness is estimated to be around 1.5 to 2.0 m thick during mid- to late-spring, depending



LEGEND

- Treeline
- Sea-ice Edge Limit
- Subsea Permafrost Limit
- Southern boundary of discontinuous permafrost - Present
- Southern boundary of discontinuous permafrost - Predicted
- Southern boundary of continuous permafrost - Present
- Southern boundary of continuous permafrost - Predicted
- Predicted movement of permafrost boundaries

REFERENCE

Brown, J., O.J. Ferrians Jr., J.A. Heginbottom, and E.S. Melnikov. 1998. Circum-Arctic Map of Permafrost and Ground-Ice Conditions. Boulder, CO: National Snow and Ice Data Center/World Data Center for Glaciology. Digital Media.
Predicted permafrost boundaries based on Woo et al., 1992.
PROJECTION: Lambert Azimuthal Equal Area

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Figure 4.27
Permafrost Map of Canada

on site-specific conditions of water depth and exposure. Consequently, where water depth is greater than about 2 to 2.5 m, taliks are expected (on the basis of geothermal modelling calibrated to in-situ ground temperature measurements, round lakes that do not freeze to the bottom in winter and have a diameter in the order of 570 m or greater will have a talik that extends through permafrost. Elongated lakes that do not freeze to the bottom and have a width in the order of 320 m or greater will have a similar talik). Based on these analyses, the taliks beneath Second and Third Portage lakes likely extend through permafrost. The talik beneath Vault Lake likely does not penetrate through permafrost.

The ground ice content of permafrost soil and rock in the Meadowbank area is expected to be between 0% and 10% (dry permafrost) based on regional scale compilation data. An electromagnetic survey (EM31) of the proposed mine site indicated that the majority of the areas covered by the survey are underlain by dry permafrost (upland areas). Excess ground ice is, however, expected in limited areas such as lowlands that are characterized by marshy and poorly drained conditions, commonly with patterned ground evidence.

4.12.4 Potential for Instability

The main deposits at the Meadowbank project are situated adjacent to lakes or trend off-shore and beneath lakes. Consequently, a significant component of the project involves lowering the water level in Second Portage and Vault lakes to allow mining to proceed. The initial drawdown of the lakes will expose lake bottom sediments and till in the lake basin side slopes and lake bottoms, which could result in slumping of sediments on steeper lake basin slopes. Lowlands adjacent to lakes as well as lowlands along inflowing streams feeding Second Portage and Vault lakes will also be affected. The original active layer in these lowlands can be expected to deepen because lowering the water table allows more summer heat into the ground. Where the advancing thaw front at the bottom of the active layer encounters excess ground ice, thaw subsidence can be expected. Where the ground ice is in fine-grained mineral and/or organic soils, subsidence may be accompanied by local slumping and release of high suspended sediment loadings in runoff waters entering the water management areas of Second Portage and Vault lakes. The lowering of lake levels will promote aggradation of the permafrost into the former unfrozen lake bottoms. This will be accompanied by frost penetration, moisture redistribution, and ground ice growth, resulting in freezing-induced displacements of the soils and underlying rock. Overall, there are no physical features or processes observed in the area that would prohibit the development of the proposed mine.

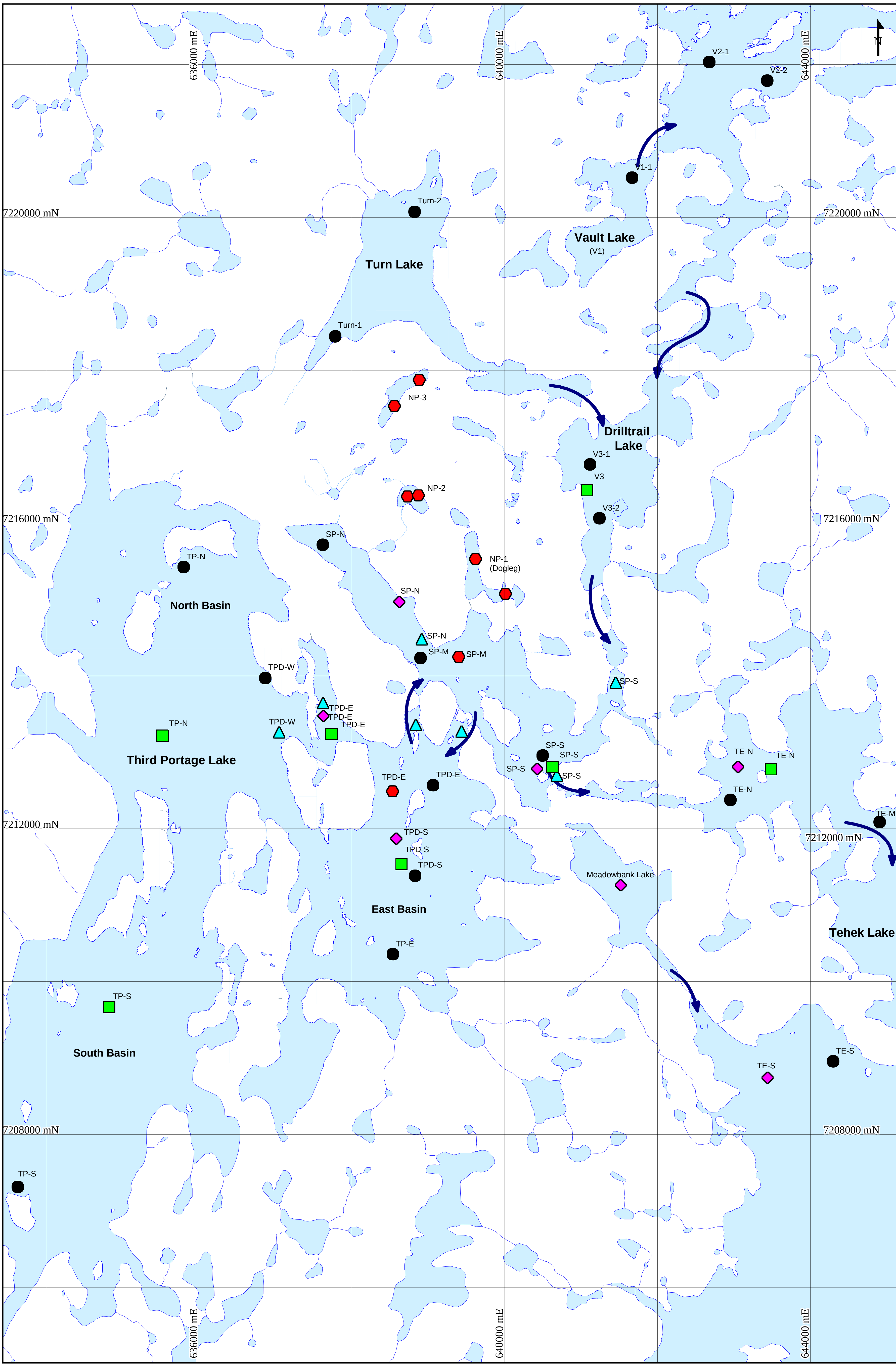
4.12.5 Hydrology / Hydrogeology

The Meadowbank project is located close to the surface water divide between the Back River basin, which flows north to northwest towards the Arctic Ocean, and the Quoich River basin, which flows east to southeast into Chesterfield Inlet.

Almost all streams in the project area are fed from lake outflows and are relatively short, small-to-medium channels, feeding into downstream lakes in a cascading network. Turn Lake drains southeast into Drilltrail Lake, which drains into Second Portage Lake. Third Portage Lake drains north into Second Portage Lake across a narrow strip of land dividing the two lakes via three distinct outflow channels: a western channel, a center channel, and an eastern channel (see Figure 4-28 for a depiction of historic sampling stations and water flow direction). Water level and discharge monitoring were carried out using automated hydrometric monitoring equipment that was selected, procured, and installed by the Water Survey of Canada, Yellowknife.

Snowmelt runoff in the region begins in the period between the end of May and the middle of June, and the snowmelt peak is often the largest runoff for the year. Secondary peaks due to rainfall events can occur throughout the summer, sometimes exceeding the snowmelt peak. Streamflows typically decline through the late summer and fall, with freeze-up estimated to occur approximately at the end of September for the smallest streams, and at the end of November for the medium channels. All channels are thought to freeze to the bottom with zero flows over the winter period.

In areas of continuous permafrost, there are two groundwater flow regimes: a deep regime beneath the permafrost and a shallow regime in the active layer near the ground surface (see Figure 4-29). The deep groundwater regime is connected to taliks located beneath large lakes. The water level elevations in lakes that have these deep taliks provide the driving force, or hydraulic head, for the deep groundwater flow. The presence of the thick and low permeability permafrost beneath land



LEGEND

- Flow Direction
- 2003 Sampling Station
- 2002 Sampling Station
- 1998 Sampling Station
- 1997 Sampling Station
- 1996 Sampling Station

Scale 1: 50,000

0 1,000 2,000
metres

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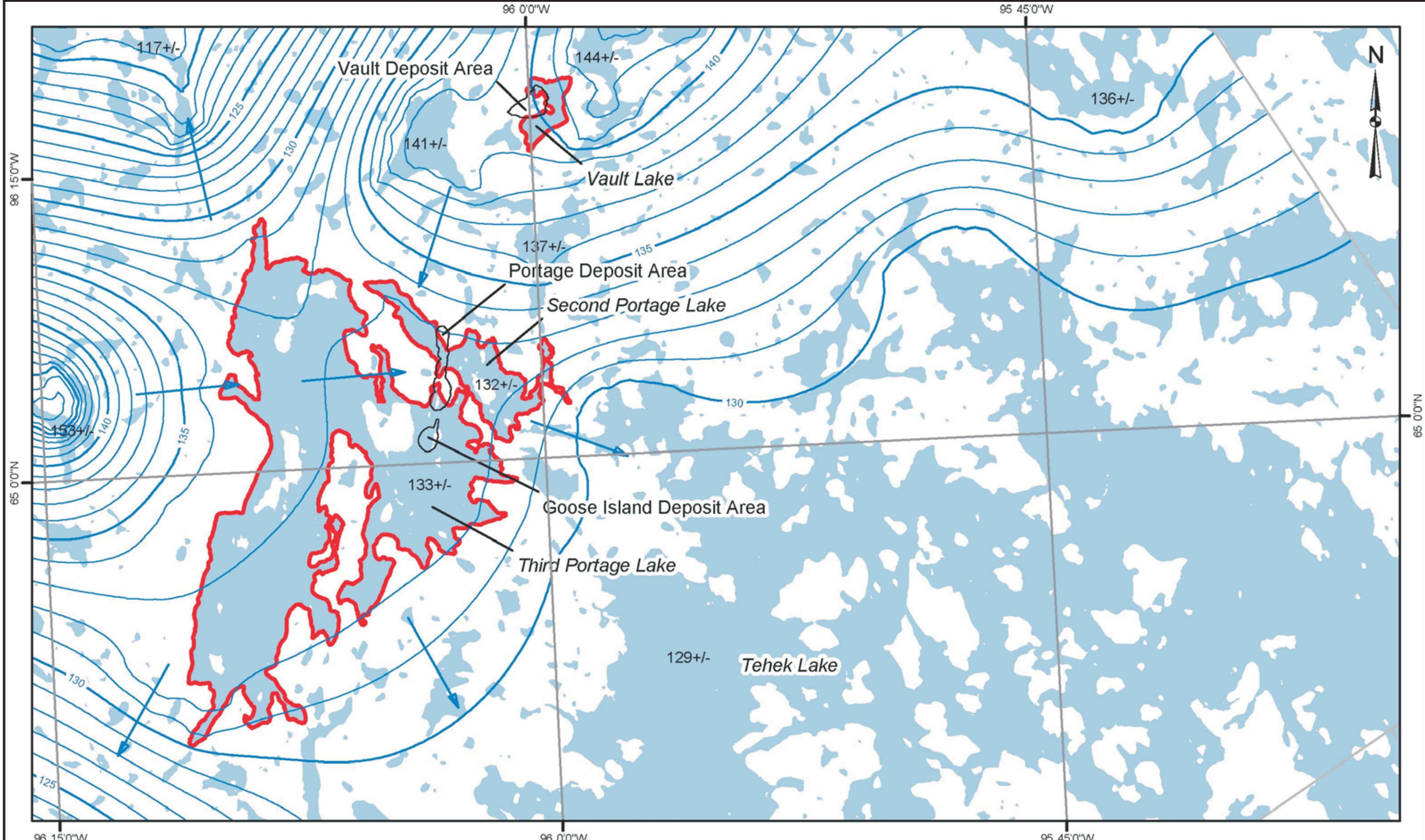
Figure 4.28

Historic (1996-2003) Sampling Stations & Flow Directions Project Area Lakes

N:\Bur-Graphics\Projects\2003\1413\03-1413-427\GIS\aprs\figure-03-7_groundwater-flow.mxd



LEGEND

- Proposed Open Pit Crest
- Inferred Groundwater Contour (1 m interval)
- Inferred Groundwater Contour (5 m interval)
- Inferred Groundwater Flow Line
- 133 Waterbody (elevation in masl)

0 1,000 2,000 4,000 Meters

Scale - 1:125,000

REFERENCE

District of Keewatin, Northwest Territories, Department of Energy, Mines and Resources, Mapsheets 66A/16, 56E/04, 66H/01, 56D/13

Datum: NAD83 Projection: UTM Zone 14

NOTE

Water levels vary annually and may differ from recently surveyed elevations.

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Figure 4.29
Inferred Regional Groundwater Flow

located between large lakes results in negligible recharge to the deep groundwater flow. Smaller lakes, which have taliks that probably do not extend down to the deep groundwater regime, do not influence the groundwater flow in the deep regime. Consequently, recharge to the deep groundwater flow regime is predominantly limited to areas of talik beneath large surface water bodies.

On a regional scale, groundwater flows in a northwest direction from the northwestern end of Third Portage Lake and in a southeast direction from the southeast end of Third Portage and Second Portage lakes. On a local scale, the northwest portion of Second Portage Lake has the lowest water level in the area and consequently forms a discharge zone (groundwater flows from high elevation water levels to lower elevation water levels) with groundwater flowing from a higher elevation lake located to the east, through the deep groundwater flow system and then up into this portion of the lake.

From late spring to late summer when temperatures are above 0ºC, the active layer becomes thawed. Within the active layer, the water table is expected to be a subdued replica of the topographic surface. Groundwater gradients, or the slope of the groundwater level, are assumed to be similar to topographic gradients. Locally, groundwater in the active layer would flow to local depressions and ponds that drain to Second Portage and Third Portage lakes or would flow directly to Second Portage and Third Portage lakes.

There does not appear to be a detectable difference in the hydraulic conductivity of the various rock types. Ultramafic rocks, at a given depth, have similar hydraulic conductivity to those of the intermediate volcanics at the same depth. The hydraulic conductivity of the shallow exfoliated and weathered bedrock, regardless of rock type, is generally higher than the deeper, less fractured rock.

4.12.6 Sediment

Sediment can be an important source or sink for contaminants such as metals. Contaminants entering aquatic systems (via tributary streams or directly from local sources) are usually associated with suspended particulate material in the water column that eventually settle in depositional areas as sediment, especially in deeper areas of lakes. Sediment provides a long-term, temporal record of deposition, integrating concentrations over time.

Lakebed substrate in the project area is a key habitat attribute that dictates the species composition and abundance of benthic invertebrates and its importance as feeding habitat by fish. Water depth is the strongest determinant of physical features of lake substrate, especially grain size. Between the surface and about 4 m depth, substrate consists of a heterogeneous mixture of boulder, rock and cobble that is ice scoured and subject to erosion by wave-driven currents. Below 4 m depth, sediment grain size diminishes with sand, silt, and clay, becoming more abundant. At depths of 6 to 8 m and greater, bottom sediment consists of a uniform silt/clay mixture that dominates aerial substrate distribution in Second Portage Lake (70%) and Third Portage Lake (81%).

Sediment samples at depths of 8 m or greater collected from numerous locations throughout the project and reference lakes revealed a great similarity in grain size, organic carbon (2.5% to 5%) and metals concentration. Total metals concentration in sediment was similar among project and reference lakes and over years, suggesting that the erosional and geochemical processes within lakes in the Meadowbank region are similar.

The CCME (2001) has developed sediment quality guideline (SQG) concentrations for several heavy metals that are used to screen sediments for their potential to cause adverse effects on benthic communities. SQG concentrations have been divided into two categories: interim sediment quality guidelines (ISQG) and probable effects level (PEL) concentrations. ISQGs are conservative values that have been derived from available toxicological information and a weight-of-evidence approach to determine the minimum concentration at which adverse effects have been observed in the literature. The PEL is less conservative and represents a concentration at which adverse effects are frequently observed, based on laboratory studies. Exceedances of ISQG or PEL concentrations do not necessarily mean that adverse effects will be observed, as many factors can influence this such as adaptation by animals to naturally high background concentrations (that exceed the PEL), and other substances in the sediments that may bind and make metals less bioavailable (e.g., sulphides, iron hydroxides, total organic carbon (TOC).

At Meadowbank, all sediment metals concentrations observed can be regarded as background because of the near absence of anthropogenic activities. However, despite their pristine nature, several metals exceeded the CCME (2001) ISQG or PEL values. These exceedances do not imply that adverse effects have occurred or are expect to occur. Rather, ISQG and PEL guidelines are relatively conservative and do not reflect site-specific conditions such as regional geochemistry, acclimatization by benthic organisms, or other factors that may limit metals availability. For example, arsenic, cadmium, chromium, copper, nickel, and zinc exceeded either ISQG or PEL sediment concentrations in nearly all project and reference lakes over all years for which data were collected. These results suggest that metals concentrations are generally similar across the area, and reflect the natural, highly mineralized nature of the sediments. Adverse impacts to the benthic community were not observed and fish tissue metals concentrations are low and similar to concentrations in fish found in other pristine lakes.

4.12.7 Water Quality

4.12.7.1 Surface Water

The Meadowbank project area lakes (Second Portage, Third Portage, and Wally lakes) are ultra-oligotrophic, soft water, nutrient poor and isothermal with neutral pH and high oxygen concentrations year round. Limnological conditions tend to be very stable, with uniform, vertical temperature, oxygen and nutrient distributions with only minor, temporary stratification. Water clarity is extremely high with Secchi depths of 10 m or more, with very low dissolved and suspended solids concentrations. Given the absence of tributary streams, there are no external sources of nutrients or sediment that might contribute to nutrient enrichment. Due to the site's northern latitude and climate, lakes in the area naturally experience long periods of cold temperatures and low light levels during the winter months. Ice covers the lakes for extended periods of time each year and low water temperatures exist year round. The ice-free season is very short, with ice break-up in late-June and ice-up beginning in late September.

Maximum ice thickness is at least 2 m by March/April. Because the lakes are ice covered for most of the year, gas exchange with the atmosphere is limited. Oxygen concentration remains high under the ice; however, because of the low rates of biological activity and decomposition of organic material.

Total and dissolved solids in surface waters are low, typically below laboratory detection (<1 mg/L and <10 mg/L respectively) as was turbidity (<1.1 NTU). Hardness (4.4 to 9.5 mg/L), and dissolved anions (chloride, fluoride, sulphate) were also very low (<0.05 to 0.06 mg/L) and also near detection limits. Surface water has circum-neutral pH (6.6 to 7.7) and low conductivity (5 to 77 µS/cm). Nutrient concentrations (nitrogen, carbon, phosphorus) in the project lakes do not differ appreciably within or between lakes and seasons. Values are very low and equivalent to values typical of ultra-oligotrophic lakes. Nitrogen nutrients (nitrate, nitrite, ammonia, dissolved phosphate) seldom exceed 0.001 mg/L while dissolved phosphate ranged from <0.001 to 0.003 mg/L. Dissolved organic carbon (DOC) values range from 1.4 to 2.3 mg/L over all lakes.

Average baseline water qualities in Third Portage, Second Portage, and Wally lakes are presented in Table 4-13. Total and dissolved metals concentrations in surface waters from project lakes are remarkably similar within and between lakes between 1997 and 2002. Total antimony, arsenic, chromium, copper, mercury, and nickel concentrations from project lakes are all below laboratory detection limits and well below CCME (2001) water quality guidelines for the protection of aquatic life. The only metals to exceed detection limits are aluminum (0.006 to 0.014 mg/L), cadmium (up to 0.0015 mg/L), lead (up to 0.0012 mg/L), and zinc (0.001 to 0.019 mg/L).

Only lead marginally exceeded surface water quality guidelines at a few stations. Dissolved metals concentrations comprise the vast majority of total metals concentrations where results exceeded detection limits, indicating that nearly all metals are dissolved and not associated with particulates, which is consistent with the low suspended solids concentrations observed. Lake ice thicknesses of between 1.5 and 2.5 m have been encountered during geotechnical investigations in mid to late spring. It is possible that ice thickness will be greater during the mid-winter period. Taliks (areas of unfrozen ground) are expected where water depths are greater than about 2 to 2.5 m.

Table 4-13: Average Baseline Water Quality in Third Portage, Second Portage & Wally Lakes

Parameter	Units	Third Portage Lake (N=18)	Second Portage Lake (N=14)	Wally Lake (N=3)
Conventional parameters				
Hardness	mg/L	5.3	8.9	17.2
pH	pH units	6.8	7.5	7.3
Dissolved anions				
Total alkalinity	mg/L	4	7	13
Chloride	mg/L	0.5	0.6	0.7
Fluoride	mg/L	0.07	0.07	0.05
Sulphate	mg/L	1.3	2.8	5.3
Nutrients				
Ammonia nitrogen	mg/L	0.01	0.02	0.02
Total kjeldahl nitrogen	mg/L	0.09	0.08	0.11
Nitrate nitrogen	mg/L	0.004	0.007	0.024
Nitrite nitrogen	mg/L	0.001	0.001	0.001
Total phosphate	mg/L	0.002	0.003	0.003
Total phosphorus	mg/L	0.002	0.003	0.003
Organic parameters				
Dissolved organic carbon	mg/L	1.4	1.7	2.2
Cyanides				
Total cyanide	mg/L	<0.005	<0.005	<0.005
Total metals				
Aluminum	mg/L	0.006	0.007	0.008
Antimony	mg/L	<0.0005	<0.0005	<0.0005
Arsenic	mg/L	<0.0005	<0.0005	<0.0005
Barium	mg/L	<0.02	<0.02	<0.02
Beryllium	mg/L	<0.001	<0.001	<0.001
Boron	mg/L	0.1		0.1
Cadmium	mg/L	<0.00005	<0.00077	<0.00005
Calcium	mg/L	1.2	2.3	4.6
Chromium	mg/L	<0.001	<0.001	<0.001
Cobalt	mg/L	<0.0003	<0.0003	<0.0003
Copper	mg/L	0.001	0.001	0.002
Iron	mg/L	<0.03	<0.03	<0.03
Lead	mg/L	0.0006	0.0009	0.0007
Lithium	mg/L	<0.005	<0.005	<0.005
Magnesium	mg/L	0.5	0.8	1.3
Manganese	mg/L	0.001	0.0016	0.0013
Mercury	mg/L	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	<0.001	<0.001	<0.001
Nickel	mg/L	<0.001	<0.001	<0.001
Potassium	mg/L	2	2	2
Selenium	mg/L	<0.001	<0.001	<0.001
Silver	mg/L	<0.00002	<0.00002	<0.00002
Sodium	mg/L	2	2	2
Thallium	mg/L	<0.0002	<0.0002	<0.0002
Tin	mg/L	<0.0006	<0.0005	<0.0005
Titanium	mg/L	<0.01	<0.01	<0.01
Uranium	mg/L	<0.0002	<0.0002	<0.0002
Vanadium	mg/L	<0.03	<0.03	<0.03
Zinc	mg/L	0.005	0.005	0.013

Note: N = number of samples used to calculate average values.

4.12.7.2 Groundwater

Groundwater baseline data were collected from four monitoring wells located within the three main rock types in the area of the Goose Island and Portage deposits (see Section 4.11.5 and Figure 4-29) and from the talik underlying the proposed tailings disposal area at Second Portage arm. Wells were not installed in the Vault deposit as it lies within continuous permafrost.

Some samples reported exceedances of CWQG (Canadian Water Quality Guidelines). Concentrations of total metals generally exceeded those of dissolved metals for all wells. In comparison with groundwater quality, rock leachates obtained from static and kinetic tests generated a greater number of dissolved constituent exceedances of CWQG. This is likely an artifact of the rock leaching test methodology, which accelerates rock weathering. Groundwater quality is nevertheless generally consistent with rock leachate characteristics, with the majority of constituents present in rock leachate also present in the groundwater of the corresponding lithology.

The groundwater is brackish to saline with high total dissolved solids (TDS) and chloride concentrations. Based on data from other sites in the Canadian Shield, it is expected that the salinity of the groundwater will increase with depth. Water samples collected from monitoring wells installed in the talik beneath Second and Third Portage lakes to depths of 175 m have chloride concentrations of up to 626 mg/L and TDS values up to 800 mg/L. This represents a salinity of 1.1, where salinity is equal to approximately 1.8 times the chloride concentration (in parts per thousand). Water samples collected from a number of large lakes in the area have chloride concentrations of less than 1 mg/L. By comparison, sea water has chloride concentrations of approximately 19,000 mg/L.

4.12.8 Air Quality & Noise Levels

Air quality values reported by the Environment Protection Service of the Government of Northwest Territories (2004) were adopted for this project. The reported PM_{10} concentrations were less than 10 µg/m^3 for the undisturbed areas of the NWT. Concentration of other pollutants considered, such as SO_2, NO_x and CO, are expected to be very low in the Meadowbank area, which is in keeping with the undisturbed quality of air in pristine areas.

Baseline noise conditions for the project area are expected to show a L_{eq} of 42.7 dBA for daytime and 35.4 dBA for nighttime based on a 24-hour background sound survey completed in an area that is topographically similar to Meadowbank and absent of any anthropogenic noise sources (Fort McKay area, Northern Alberta.)

4.12.9 Climate & Climate Change

The Meadowbank region is within a low Arctic ecoclimate described as one of the coldest and driest regions of Canada. Arctic winter conditions occur from October through May, with temperatures ranging from +5°C to -40°C. Summer temperatures range from -5°C to +25°C with isolated rainfall increasing through September (see Table 4-14). The long-term mean annual air temperature for Meadowbank is estimated to be approximately -12°C. Air temperatures at the Meadowbank area are, on average, about 0.6°C cooler than Baker Lake air temperatures, and extreme temperatures tend to

Table 4-14: Estimated Average Monthly Temperature & Precipitation – Meadowbank Site

Month	Mean Temperature (°C)	Average Precipitation (mm)			Lake Evaporation (mm)
		Rainfall	Snowfall	Total	
January	-33.7	0	11.3	11.4	0
February	-33.4	0.1	10.5	10.6	0
March	-28.3	0	14.5	14.6	0
April	-18.6	0.8	17.1	17.8	0
May	-7.1	6.2	11.2	17.4	0
June	3.3	18.2	3.8	22.1	7.8
July	10.3	37.7	0	37.8	98.1
August	8.9	40.3	0.9	41.2	103.0
September	2.1	30.4	8.9	39.3	49.4
October	-8.1	6.8	30.7	37.5	0.1
November	-20.7	0.2	23.3	23.6	0
December	-28.6	0	14.8	14.8	0

Note: Rounding of monthly averages has occurred. Temperatures and precipitation were estimated based onsite data (1997 to 2003) and adjusted Baker Lake data (1946 to 2003). Lake Evaporation based onsite data. (AMEC, 2003).

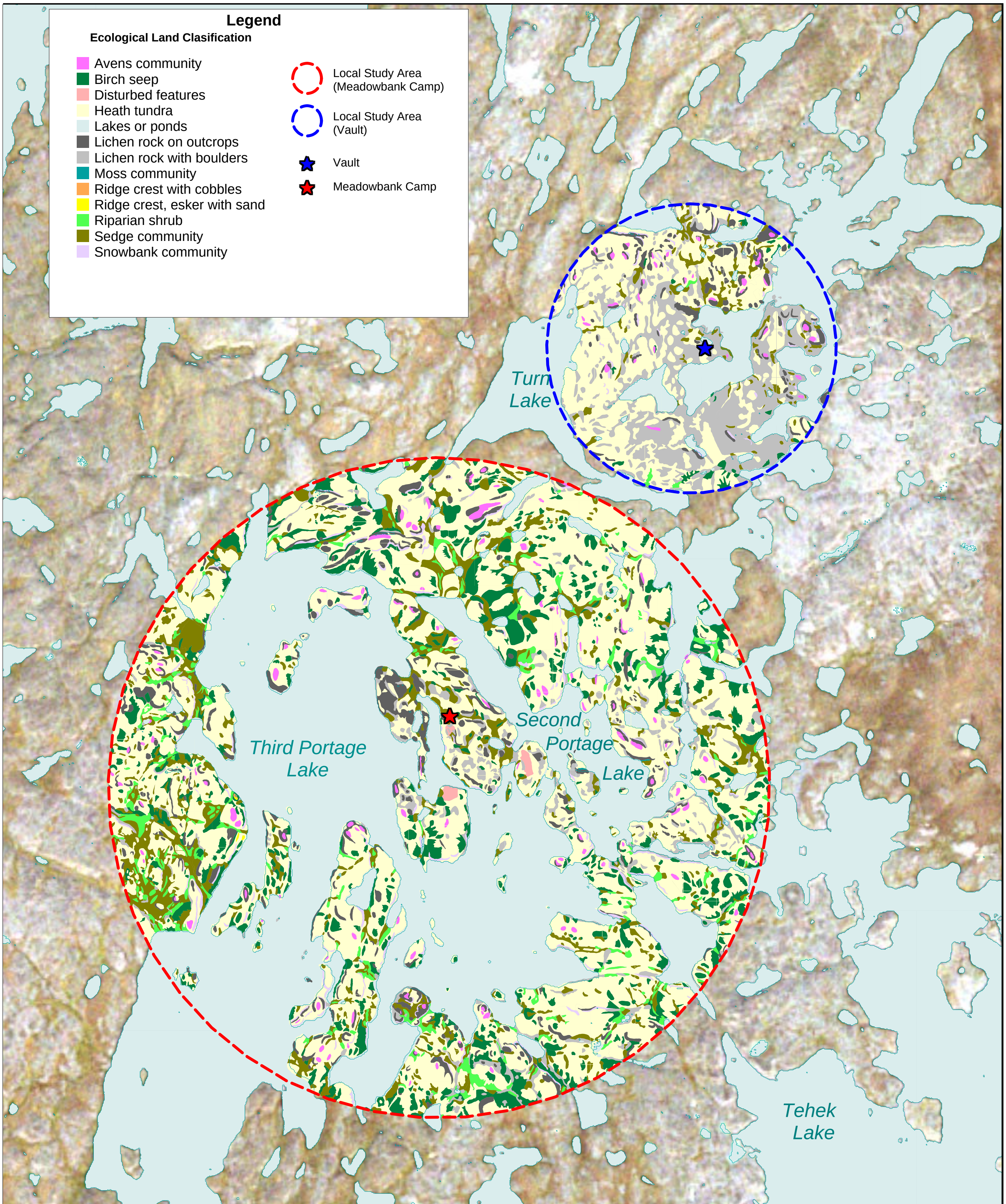
be larger in magnitude; this climatic difference is thought to be the effect of a moderating maritime influence at Baker Lake. Skies tend to be more overcast in the winter than the summer. The average annual wind speed is 10 km/h and winds tend to be most frequently from the west and east-southeast quadrants. Light to moderate snowfall is accompanied by variable winds up to 70 km/h, creating large, deep drifts and occasional whiteout conditions. Monthly rainfall, snowfall, and total precipitation values were adjusted for undercatch using the values reported by Environment Canada for Baker Lake to develop estimates of adjusted monthly and annual values for Meadowbank, for the period 1949 to 2003. The resulting adjusted mean annual rainfall, snowfall, and precipitation totals for Meadowbank are 144.0 mm, 148.8 mm, and 292.8 mm, respectively.

According to the Intergovernmental Panel on Climate Change (IPCC, 2001), the global mean surface air temperature is projected to increase by 1.4°C to 5.8°C from 1990 to 2100. These projected temperatures are amplified at high latitudes such as the Canadian Arctic where temperatures are expected to increase by 3°C to 4°C by 2050, rising 5°C to 7°C across the mainland by 2100. By the middle of the 21st century, the effect of temperature change is predicted to reduce near-surface permafrost by 12% to 15% once equilibrium conditions become established under the new temperatures. The predicted increase in active layer thickness of 15% to 30% will reach equilibrium relatively much faster.

4.13 DESCRIPTION OF BIOLOGICAL ENVIRONMENT

4.13.1 Vegetation & Wildlife Habitat

No rare or regionally unique vascular plants or plant communities were found within the Meadowbank LSA during baseline studies of vegetation communities. As shown on Figures 4-30 and 2-2, water is the largest ELC unit in the LSA, comprising 40% of the area. The most common vegetated ELC units are the Heath Tundra community (34%) and the Lichen-Rock community (10%). Two of the wetter ELC units, Sedge community and Birch Seep community, are also relatively common, comprising 13% of the LSA. Eskers and their typical ridge top ELC units (e.g., Avens community) are rare in the area. The southern section of the LSA consists mainly of Heath Tundra with patches of the



Ecological Land Classification within the LSA Boundary

Area of Detail

NORTH

600 0 600 1200 1800

Scale in metres

SCALE 1:85,000

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Figure 4.30

Acknowledgements: Original drawing by AXYS Environmental Consulting Ltd.

Birch Seep community and the Lichen-Rock associations. In the northern section of the LSA, the Lichen-Rock community – Boulder Association is the most abundant ELC unit with patches of Heath Tundra and Birch.

A detailed assessment and analysis of ELC distribution within the RSA and LSA can be found within the Baseline Terrestrial Ecosystem Report. A summary of the distribution of ELC units in the LSA as compared to the RSA is provided in Table 4-15. Because of slight differences in how ELC units were described between the RSA and LSA, some units were combined. For example, the RSA analysis of ELC unit distribution provided values for both deep and shallow water, whereas the LSA analysis only provided a value for water.

Table 4-15: Area & Percent Cover of ELC units in the LSA & RSA

ELC Unit	Availability in LSA (ha)	% of LSA	Availability in RSA (ha)	% of RSA
Avens, Moss, Snowbank	168	1.8	N/A	N/A
Birch Seep	622	6.6	56,925	5.6
Disturbed	10	0.1	4	<0.1
Esker (Sand/Gravel)	1	<0.1	2,032	0.2
Heath Tundra	3,160	33.7	282,446	27.7
Lichen-Rock – Bedrock	337	3.6	137,760	13.5
Lichen-Rock – Boulder	601	6.4	262,674	25.8
Riparian Shrub (Birch)	168	1.8	6,845	0.7
Sedge	585	6.2	29,485	2.9
Water	3,733	39.8	241,135	23.6
Unclassified	0	0.0	673	<0.1
Total	**9,385**	**100**	**1,019,979**	**100**

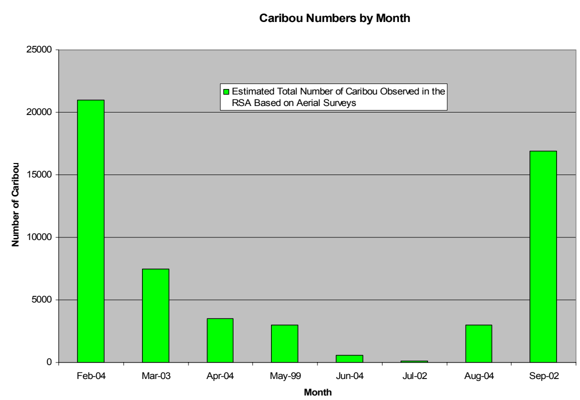
4.13.2 Wildlife

4.13.2.1 Ungulates

Caribou

The barren-ground caribou population accruing in the Meadowbank area is listed as secure by the Government of Nunavut (GN, 2001), and is not listed federally (COSEWIC, 2004). The only listed population is the Dolphin and Union herd (Special Concern) which occurs north of Meadowbank along the Arctic Ocean. Individuals from this herd are unlikely to winter in the Meadowbank area. According to both baseline data and traditional knowledge, no caribou calving grounds are found within the RSA. The Beverly calving grounds are west of the RSA, and the Qamanirjuaq calving grounds are to the south (BQCMB, 1999). Caribou are present in the Meadowbank RSA in all seasons, but based on aerial surveys, are most abundant in the winter. In February 2004, an estimated 21,000 caribou were recorded. Other baseline surveys conducted by Cumberland estimate the approximate numbers of caribou within the RSA as ranging between 600 in (June 2004) and 16,900 (September 2002). Caribou survey results are shown in Figures 4-31 and 4-32.

Figure 4-31: Estimated Numbers of Caribou in the RSA Based on Aerial Surveys

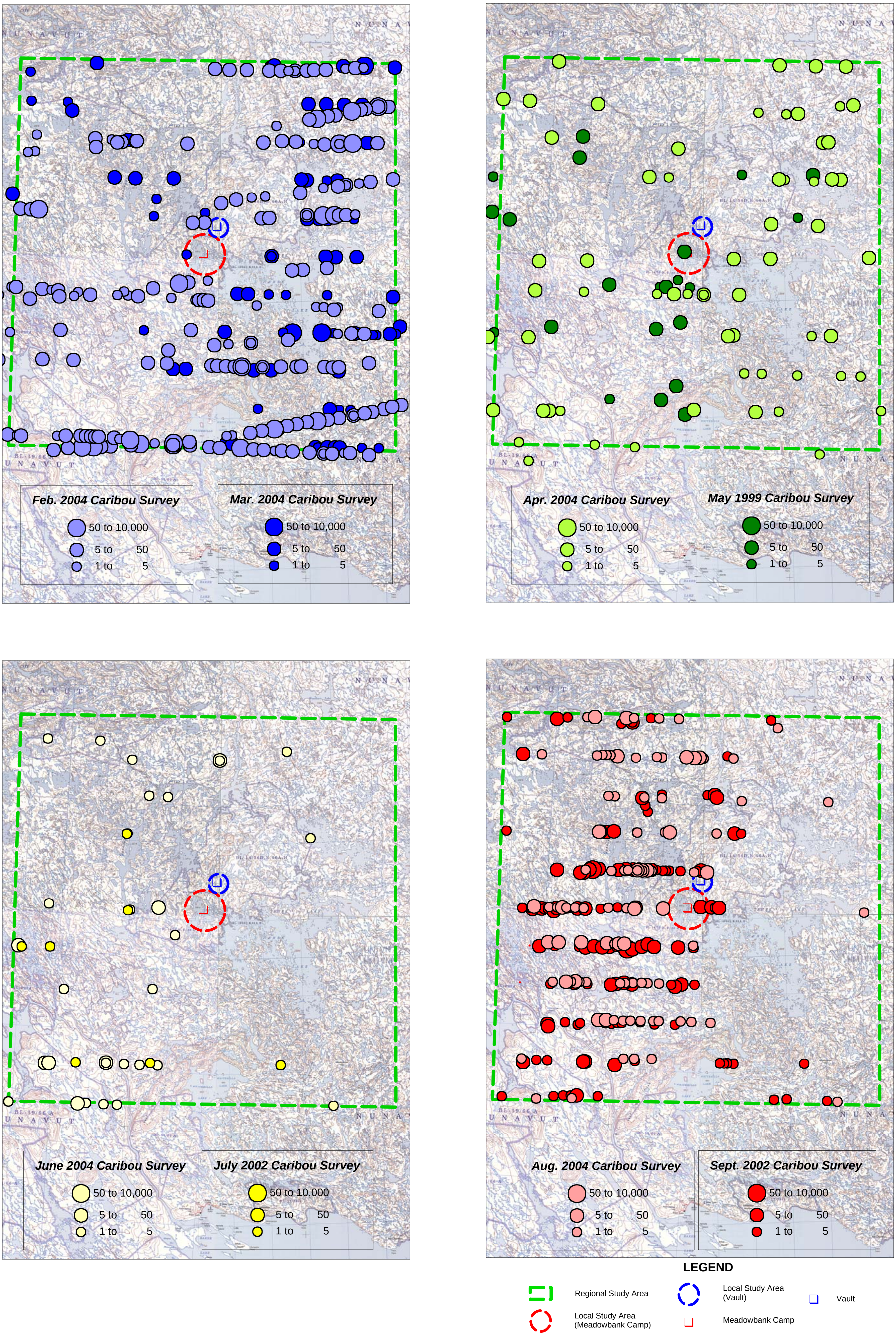


Radio-collaring data from the governments of Nunavut and the Northwest Territories suggest that individuals wintering in the Meadowbank area may originate from any one of several identified herds in mainland Nunavut, including the Beverly, Qamanirjuaq, Lorillard, Wager Bay, Boothia Peninsula, and Ahiak herds. Based on the patterns of seasonal abundance observed to date, the Meadowbank area does not appear to represent critical caribou habitat during spring migration, calving, or summer post-calving (see Figure 4-33).

Muskox

The muskox is now listed as secure in Nunavut (GN, 2001), and is not listed federally (COSEWIC, 2004). Nunavut is home to most of Canada's muskox, with a population of about 60,000 animals (JWEL, 2001). The species was once hunted to near-extinction and has only recently begun to re-establish populations in parts of Nunavut.

Based on seasonal sampling and as confirmed by traditional knowledge, a small but relatively stable—and possibly increasing—population of muskox resides in the vicinity of the project site. Herd sizes



Seasonal Number and Distribution of Caribou Recorded During Aerial Surveys in the Meadowbank RSA

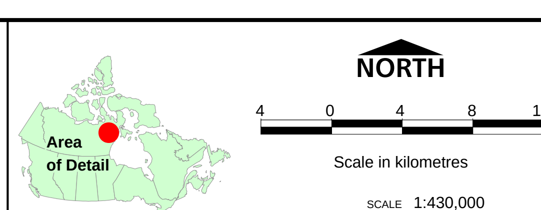


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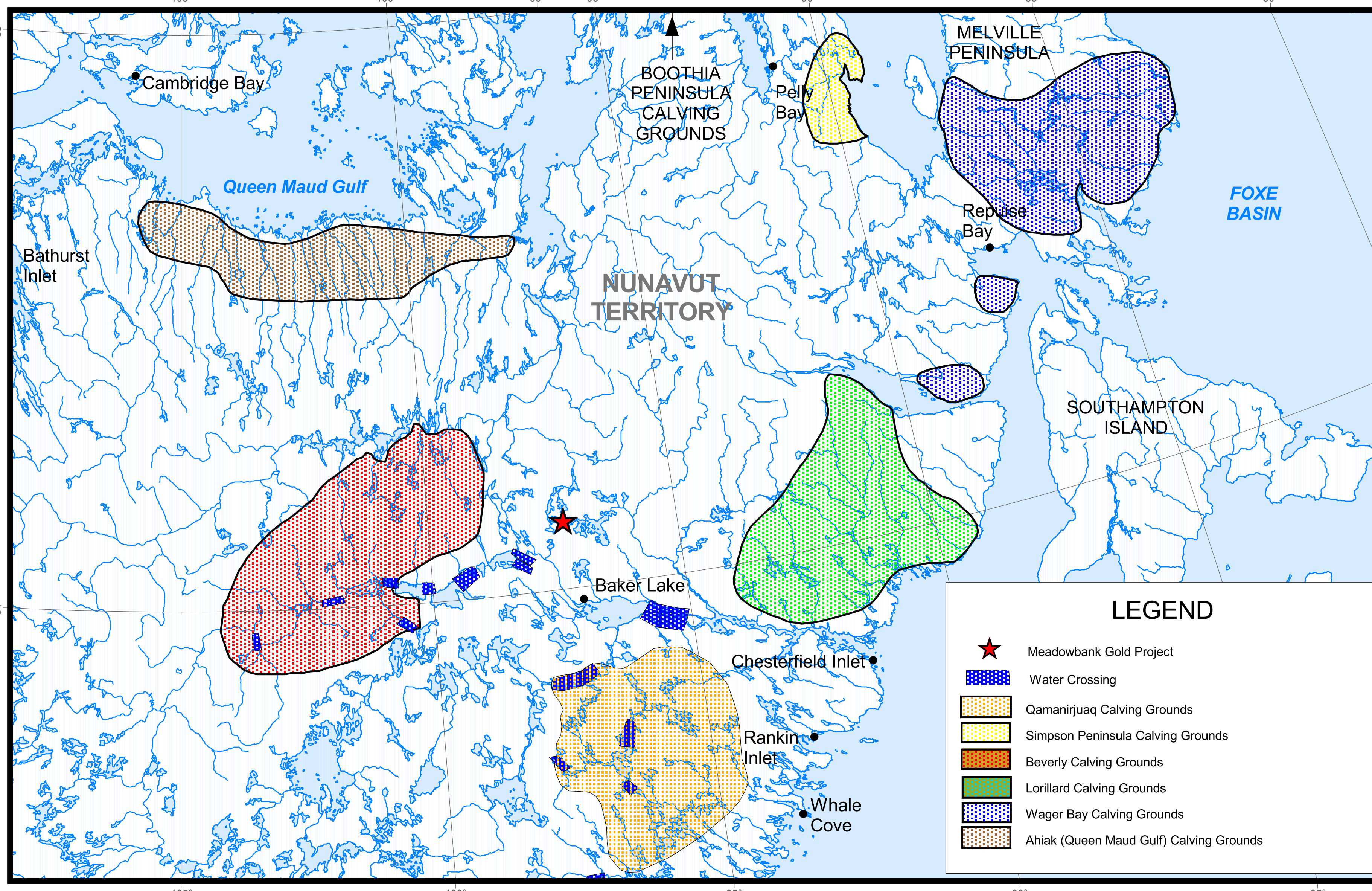
Figure 4.32



Location of the Meadowbank Gold Project in Relation to Known Caribou Calving Grounds and Water Crossings in Nunavut

NORTH

50 0 50 100 150

Scale in kilometres

Acknowledgements: Caribou calving locations from Ferguson 1987.

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Figure 4.33

range from single individuals to up to 80 animals. Baseline surveys in February 2004 located herds ranging from 12 to 80 animals (cow/calf) and documented a total of 108 individuals. An estimated number of muskox for the RSA is difficult to determine because of their clumped distribution; however, a population of between 500 to 1,000 animals is likely. These numbers are supported by surveys undertaken in the central Kivalliq Region by the DSD in the summers of 1999 and 2000, which estimated a density of 0.043 muskoxen per km^2 (i.e., 430 individuals/10,000 ha) in an area that included the western half of the RSA.

4.13.2.2 Predatory Mammals

Grizzly Bear

The grizzly bear is designated as sensitive in Nunavut (GN, 2001), and is listed as a species of Special Concern by COSEWIC (2004). It is currently on Schedule 3 under the *Species at Risk Act* and may be added to the Schedule 1 pending a public consultation process. Grizzly bears are distributed across most of mainland Nunavut except for in the northeast and the coastal fringe south of Chesterfield Inlet. Population density decreases from west to east, but traditional knowledge suggests that the grizzly's range is expanding eastward. There is no demographic data for grizzly bears in Kivalliq, but the west Kitikmeot population is thought to be stable or slightly increasing.

A sow with two cubs was seen during an aerial survey (May 1999) within the RSA. Little other evidence of grizzly bear was recorded during wildlife surveys of the RSA and LSA. These data suggest that a small population of grizzly bear occurs in the Meadowbank RSA, as would be expected for a wide-ranging species typically existing at low densities (e.g., three individuals/1,000 km^2). An increased number of bears observed and killed in the Baker Lake area in the last few years has lead to concerns by local residents that the grizzly bear population is increasing rapidly and may need to be controlled.

To address these concerns, a joint project has been undertaken by Cumberland, HTO, World Wildlife Fund (WWF), and DSD to gather traditional information about the grizzly bear population.

Wolverine

The wolverine is listed as sensitive in Nunavut (GN, 2001), and the western Canadian population (which includes Nunavut) is considered to be of Special Concern (COSEWIC, 2004). It is currently on Schedule 3 of the *Species at Risk Act* and may be added to Schedule 1 pending a public consultation process. Wolverine is an important furbearing species for residents of Baker Lake, and maintaining a healthy population of the species is important for local trappers. Population estimates for the NWT and Nunavut suggest there is a stable (or increasing), sparsely distributed population of more than 3,000 animals (Northwest Territories' Department of Resources Wildlife & Economic Development (NWTRWED, 2001).

Wolverine and their sign have rarely been detected in the study area. Single wolverines were observed several kilometres south of the Meadowbank site in April 2002, in September 2002, and most recently in June 2004. Such infrequent sightings are expected given the wide-ranging habits and low densities of this species. This assumption is supported by traditional knowledge.

Wolf

The wolf is listed as sensitive in Nunavut (GN, 2001), but is not federally listed (COSEWIC, 2004). Wolf populations are stable or increasing within their range, except in northern Alberta and some parts of the NWT. According to traditional knowledge gathered, wolf harvesting in the Meadowbank area has increased in recent years; however, regional population numbers and trends remain poorly understood. Their patterns of distribution, densities, territory boundaries, and dispersal movements are influenced by interactions between packs and by prey abundance and distribution.

Wolves were observed infrequently throughout the RSA during all survey sessions, but were most common in the fall, likely related to increased caribou abundance at that time of year. Wolves apparently reproduce in the area as two young pups were observed with two adults during the September 2002 RSA survey. Camp personnel also observed wolf pups within the LSA, on the east side of Turn Lake in July 2002.

4.13.2.3 Small Mammals

Arctic Hare

The Arctic hare is considered to be secure in Nunavut (GN, 2001), and is not listed federally (COSEWIC, 2002). The species is widely distributed north of the treeline in Canada. Likely predators of the Arctic hare in the Meadowbank area are raptors, Arctic foxes, wolves, and wolverines. Arctic hares were recorded in relatively small numbers in the spring, summer, and fall within the LSA, but were the second most frequently observed mammal species (after caribou) within the LSA in the fall. Hare pellet densities and direct observations during ground surveys also indicate that Arctic hares are common throughout the Meadowbank LSA. These observations are supported by traditional knowledge.

Arctic Ground Squirrel

The Arctic ground squirrel (or sik sik) is considered to be secure in Nunavut (GN, 2001), and is not listed federally (COSEWIC, 2004). Arctic ground squirrels are found throughout the northern boreal forest and Arctic tundra; however, information on the abundance and distribution of this species in the Arctic is scarce. Arctic ground squirrels were recorded in relatively small numbers in the spring, summer, and fall in the LSA. They were, however, the most frequently observed mammal species in the LSA in the summer. Arctic ground squirrels were also observed throughout the Meadowbank RSA. Burrows were concentrated in areas with sandy substrates suitable for digging, such as eskers and grassy slopes.

Collared Lemming

The status of the collared lemming in Nunavut is undetermined (GN, 2001), and the species is not listed federally (COSEWIC, 2004). Collared lemmings have a nearly circumpolar distribution and are well known for their population cycles. Lemmings were not observed during the field surveys, suggesting that this species could be at the low phase of its population cycle (every three to four years). Although the collared lemming has not yet been observed in the Meadowbank area, it is highly probable that it occurs there.

Northern Red-backed Vole

The status of the northern red-backed vole in Nunavut is undetermined (GN, 2001), and the species is not listed federally (COSEWIC, 2004). The northern red-backed vole is found throughout much of northern Canada and also exhibits marked population fluctuations. The northern red-backed vole has been recorded incidentally several times in the Meadowbank area, and is expected to be common throughout the area.

4.13.3 Birds

4.13.3.1 Raptors

Nesting habitat for breeding falcons and hawks in the Meadowbank LSA is considered to be low since preferred nesting areas such as cliffs are virtually absent. However, habitat suitability for foraging raptors is moderate to high as the area contains large areas of heath tundra combined with grassy meadows, bare rocky areas, patches of low shrub, and shallow and deep-water habitats, which support prey such as Arctic hares, rodents, passerines, ptarmigan, shorebirds, and waterfowl.

Baseline surveys indicate—and traditional knowledge confirms—the presence of four raptor species in the Meadowbank area: rough-legged hawk, gyrfalcon, snowy owl, and peregrine falcon. Of these four, only the peregrine falcon has been identified as a species of “Special Concern” by COSEWIC (2004) and is on Schedule 3 of the *Species at Risk Act*. During baseline surveys, most raptor sightings were made in the western half of the RSA, particularly, in the northwestern portion. Fall surveys found that observations of raptors were most often associated with heath tundra and esker habitats, presumably because such sites provide potential foraging and nesting habitat.

Peregrine falcons have been confirmed to be nesting in the RSA. In the summer of 1998, camp personnel observed a nesting falcon along the Meadowbank River and in spring 1999, an inactive nest site within 2.5 km of the field camp was noted; however, no peregrine falcons were observed during the June 2003 or 2004 breeding bird surveys within the LSA. The rough-legged hawk was recorded in low numbers (less than five visuals per season) in the Meadowbank RSA and LSA in the spring, summer, and fall surveys and was associated primarily with heath tundra habitats, although observations were also made in lichen-rock sites. Gyrfalcon was also recorded in low numbers (less than five visuals per season) in the Meadowbank LSA and RSA in the spring and fall, but never in the summer. The breeding status of the snowy owl in the Meadowbank area is uncertain since no owl nests were observed during the June 2003 and 2004 breeding bird surveys in the LSA. Snowy Owls were seen, however, during baseline surveys in the summer and fall in the LSA and were the most frequently recorded raptor (10 visuals) during the fall 2002 ground survey in the LSA. Snowy owls were observed in low numbers (<5 visuals per season) in the spring and fall in the RSA.

4.13.3.2 Waterfowl

During aerial and ground baseline surveys, 10 waterfowl species (not including loons) were recorded in the study areas: tundra swan, greater white-fronted goose, snow goose, Ross' goose, brant, Canada goose, mallard, northern pintail, long-tailed duck, and red-breasted merganser. Of these, snow geese and Canada geese were observed in greater numbers than any other species. Although no evidence of reproduction was documented during any of the baseline surveys (including waterfowl nesting surveys), some nesting likely occurs in the area. However, none of the waterfowl species suspected to breed in the project area have been observed in large concentrations.

Traditional knowledge confirms that waterfowl arrive in the general area of the proposed project from mid- to late May, but fall departure dates differ considerably among species. Departure dates for snow geese may be protracted throughout August and September since birds from west Hudson Bay and the central Arctic seemingly migrate through interior southern Keewatin. Summer and fall aerial surveys conducted in the RSA indicated that in terms of relative abundance, the snow goose was the most common waterfowl key wildlife species, followed by the Canada goose, and greater white-fronted goose. The snow goose was also the most frequently observed waterfowl species during the fall survey, whereas the Canada goose was most common during the summer survey. Both snow goose and Canada goose were regularly reported by camp personnel during the migratory periods.

During all seasons, waterfowl were associated primarily with aquatic habitats in the Meadowbank area although Heath Tundra and Lichen-Rock sites were occasionally used for foraging. Suitable foraging habitat for waterfowl is limited since the lakes in these areas are ultra-oligotrophic and the wetlands are considered to be relatively unproductive.

4.13.3.3 Other Breeding Birds

During baseline surveys, twelve species of birds appeared to be nesting within the LSA, of which the Lapland longspur was the most common. A total of 209 breeding longspur pairs was recorded on 26 plots (i.e., an average of eight pairs per plot) during the June 2003 breeding bird surveys with numbers of pairs per plot (i.e., 400 x 400 m area) ranging from three to a maximum of 13. This maximum number of pairs represents almost one pair per hectare, but the average density was closer to one pair per two hectares.

The horned lark was the second most frequently recorded nesting passerine species in the LSA. Forty-four breeding pairs were recorded on 23 of 26 breeding bird survey plots in 2003. The maximum number of breeding pairs recorded on a plot was three pairs. The average density was one pair per ten hectares. Rock ptarmigan was the third most common breeding bird species observed during June 2003 breeding bird surveys of the LSA, with 12 breeding pairs recorded in the 26 survey plots. Breeding evidence included females with chicks, nest with eggs, pair courtship behaviour, and other breeding-related behaviours. The average density of nesting pairs of ptarmigan observed in the Meadowbank area during June 2003 breeding bird surveys was one pair per 35 ha. This density falls within the normal range for the species.

Relatively few shorebirds were recorded in the Meadowbank area during baseline surveys. The most common shorebird species was the semipalmated sandpiper, which was recorded in several extensive sedge meadows during the breeding bird surveys. A total of five pairs was documented within breeding bird survey plots (i.e., approximately 1 pair per 83 ha), but others were observed incidentally between plots during the survey period. Semipalmated sandpipers recorded during breeding bird surveys were primarily associated with wet sedge meadows adjacent to small lakes and ponds. The density of pairs for the Sedge community would be a maximum of one pair per six hectares.

Uncommon breeding birds observed during breeding bird surveys included savannah sparrow, American pipit, hoary and common redpolls, American golden plover, and sandhill crane. A nesting pair of sandhill cranes was observed approximately 1 km south of South Camp during the June 2003 breeding bird surveys.

4.13.4 Aquatic Plants & Organisms

Overall, the Meadowbank project lakes support healthy communities of plankton, benthos, and fish that are typical of oligotrophic Arctic lakes free from anthropogenic impacts. For detailed information on this topic, see the Baseline Aquatic Ecosystem Report and Baseline Fish Habitat Report, both of which are included as part of this EIA submission.

4.13.4.1 Periphyton, Phytoplankton, Zooplankton & Benthic Invertebrates

There are no macrophytes along shorelines or rooted in shoals. Aquatic vegetation consists of a thin layer of algae coating rocks to a depth of 6 m (periphyton) and small plant plankton (phytoplankton) suspended in the water column. Phytoplankton are primary producers that are grazed by herbivorous zooplankton species throughout the year, especially during the open water season when primary production within lakes is greatest. Together, periphyton and phytoplankton provide an important food source for certain benthic invertebrate species and form the base of the food web.

The periphyton community of the project lakes is dominated numerically by blue-green algae, diatoms, and green algae. The dominance of blue-green algae that is capable of fixing atmospheric nitrogen suggests that the project lakes are nitrogen-limited, a contention supported by the low nutrient concentrations measured in the water.

At least 40 species of phytoplankters, representing the six major classes of algae, were identified in the Meadowbank project lakes: chrysophytes (golden-brown algae), diatoms, chlorophytes (green algae), dinoflagellates, cryptophytes, and cyanophytes (blue-green algae). Chrysophytes, by virtue of their large numbers, comprised the greatest biomass (76% to 86%) of total phytoplankton biomass in all project lakes. Diatoms (10%) and dinoflagellates (12%) were the next most abundant groups. Mean phytoplankton biomass was very consistent among project lakes and over years, ranging from 100 to

177 mg/m^3. Species composition and biomass of major taxa was also consistent between project and reference lakes and is representative of commonly occurring phytoplankton species found in other nutrient-poor, oligotrophic Arctic lakes.

All of the zooplankton taxa identified from the project lakes are common and well-known in this region of the Arctic. There were no unusual or uncommon species identified. Diversity and abundance of the zooplankton community of the project lakes was low and reflected the nutrient-poor, low productivity status of the lakes. Calanoid copepods were the most abundant group (55% of all enumerated organisms) in all lakes over all years. Cyclopoid copepods were the next most abundant group (40%), followed by Cladocera (5%).

Abundance and biomass of zooplankton typically increases over the course of the summer from 3,000 zooplankters/m^3 in June to 9,000 zooplankters/m^3 in August. Temporal factors (e.g., season), and the growth of zooplankton strongly influenced the richness and density of the species over time. There were no large differences in zooplankton community structure or biomass among lakes or over time, because of the similarity in the physical, chemical, and limnological properties of the project and nearby reference lakes.

The benthic invertebrate community of Meadowbank project and reference lakes is dominated by the aquatic larval stages of insects, especially chironomids, both in terms of abundance and species diversity. This is typical of most Arctic and temperate lakes. Mean density of major taxonomic groups (oligochaetes, bivalves, chironomids, and other taxa) from project lakes were reasonably similar among years, ranging from 2,500 to 8,300 m^2.

Chironomid larvae comprised between 50% and 86% of organisms in benthic samples from all study lakes between 1997 and 2003. Dominant genera included *Procladius*, *Tanytarsus*, *Rheotanytarsus*, *Paratanytarsus*, *Tanytarsini*, and *Heterotrissocladius*. Sphaeriidae bivalve clams were the second most abundant benthic group (12% to 26%), followed by oligochaetes (1% to 9%). Hydracarina (mites), cladocerans, other aquatic insect larvae, harpacticoid copepods, tadpole shrimp, amphipods, and flatworms each comprised less than 1% of total density of benthic organisms.

4.13.4.2 Stream/Lake Bottom Substrates & Fish Habitat

Substrate along shorelines and shallow shoals consists of a heterogeneous mixture of large boulder and cobble, areas of sloping, fractured bedrock shelves, and occasional patches of cobble and coarse gravel. There is no fine substrate, such as sand, in shallow water at depths of less than 4 m. Very coarse substrates predominate to depths of at least 4 m, at which point there is a transition to finer substrates to about 6 m. At depths greater than 6 to 8 m, substrate is predominantly silt/clay with a few partially buried individual boulders or cobble patches. Shallow, coarse material provides abundant habitat for spawning, rearing, and foraging by fish in all project lakes. Habitat at depths greater than >8 m provides foraging habitat for round whitefish and overwintering habitat for all species.

Lakebed substrate is a key habitat attribute that dictates habitat function (e.g., spawning, feeding) and the extent to which fish utilize particular habitats. In general, coarse, heterogeneous sediment mixtures have a higher habitat value because of greater diversity and structure. Coarse sediment is required for spawning, nursery, and shelter habitat by fish. Sediment comprised of an even mixture of fine substrates with little or no complexity is very common, but has lesser value than heterogeneous substrate. Fine substrate habitat is used for feeding by some species and does not provide good, direct habitat for most other life history needs for most species. See Figures 4-34 and 4-35 for more information on fish habitat values.

4.13.4.3 Fish

Fish are the most recognizable aquatic organisms in the Meadowbank study area and represent the top of the food chain. Ultimately, fish provide a food source for some birds, such as loons, and occasionally, for local residents of Baker Lake. According to traditional knowledge, however, the lakes in the Meadowbank area are fished very infrequently.

Lake trout and round whitefish dominate abundance in all lakes, which is consistent with the typical species composition of many Arctic lakes in this region. Other fish species present in the project lakes include land-locked Arctic char, ninespine stickleback, slimy sculpin, and burbot (see Figure 4-36). Because of permafrost, cold winter temperatures, and low relief, drainage is slow and diffuse,

Figure 4-34: Relative Value of Fish Habitat in Second & Third Portage Lakes

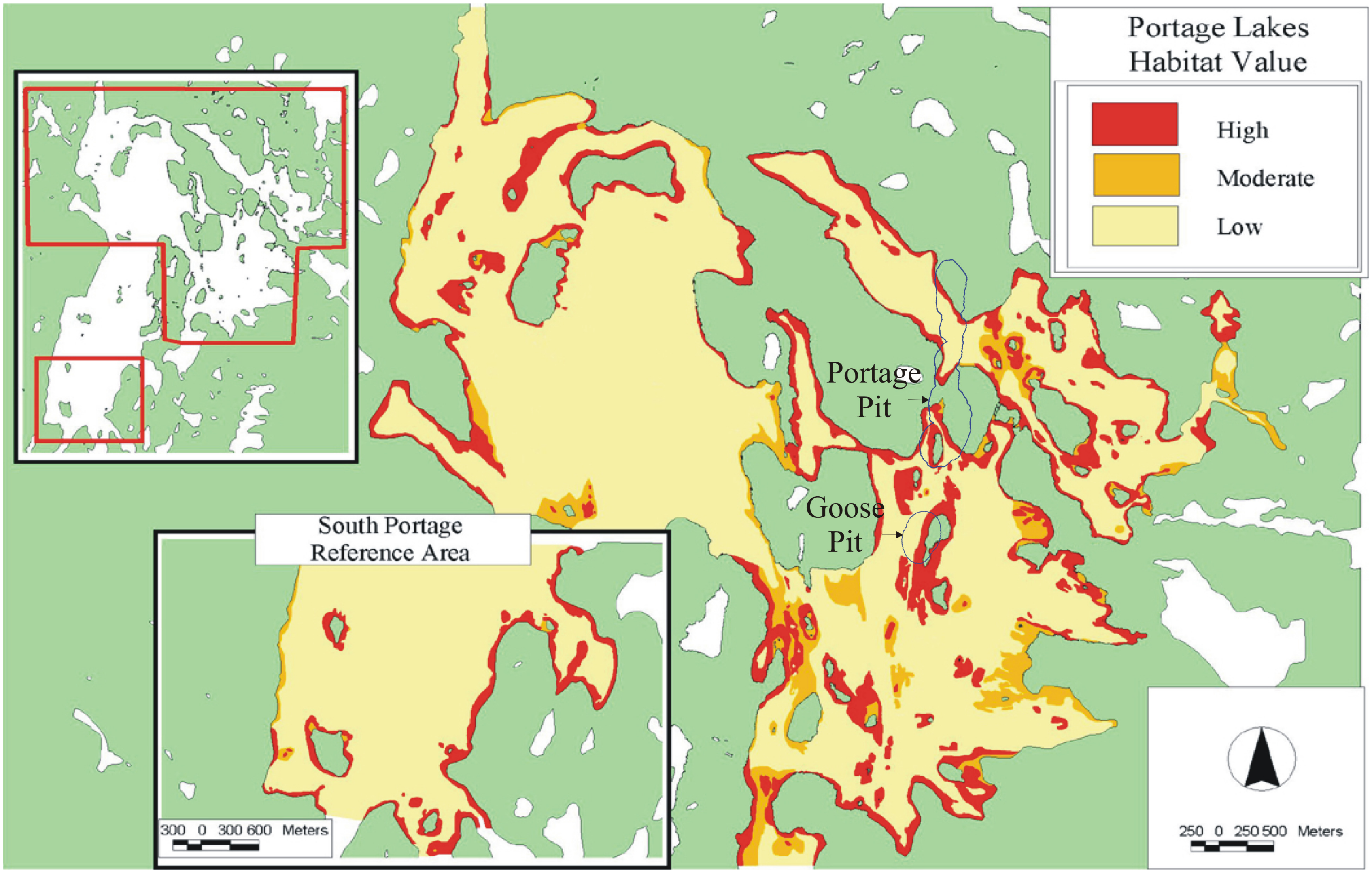


Figure 4-35: Relative Value of Fish Habitat in Vault Area Lakes

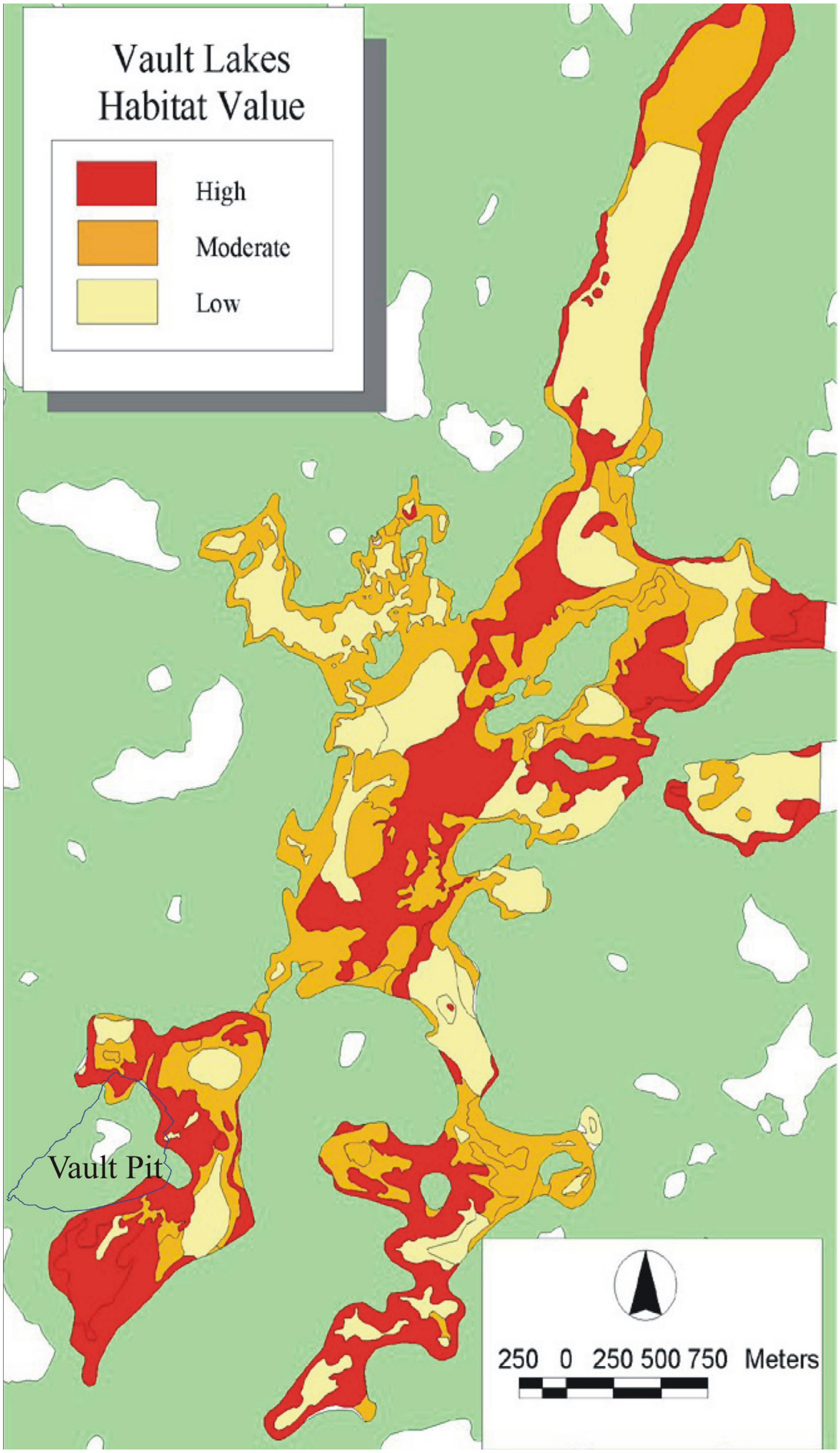
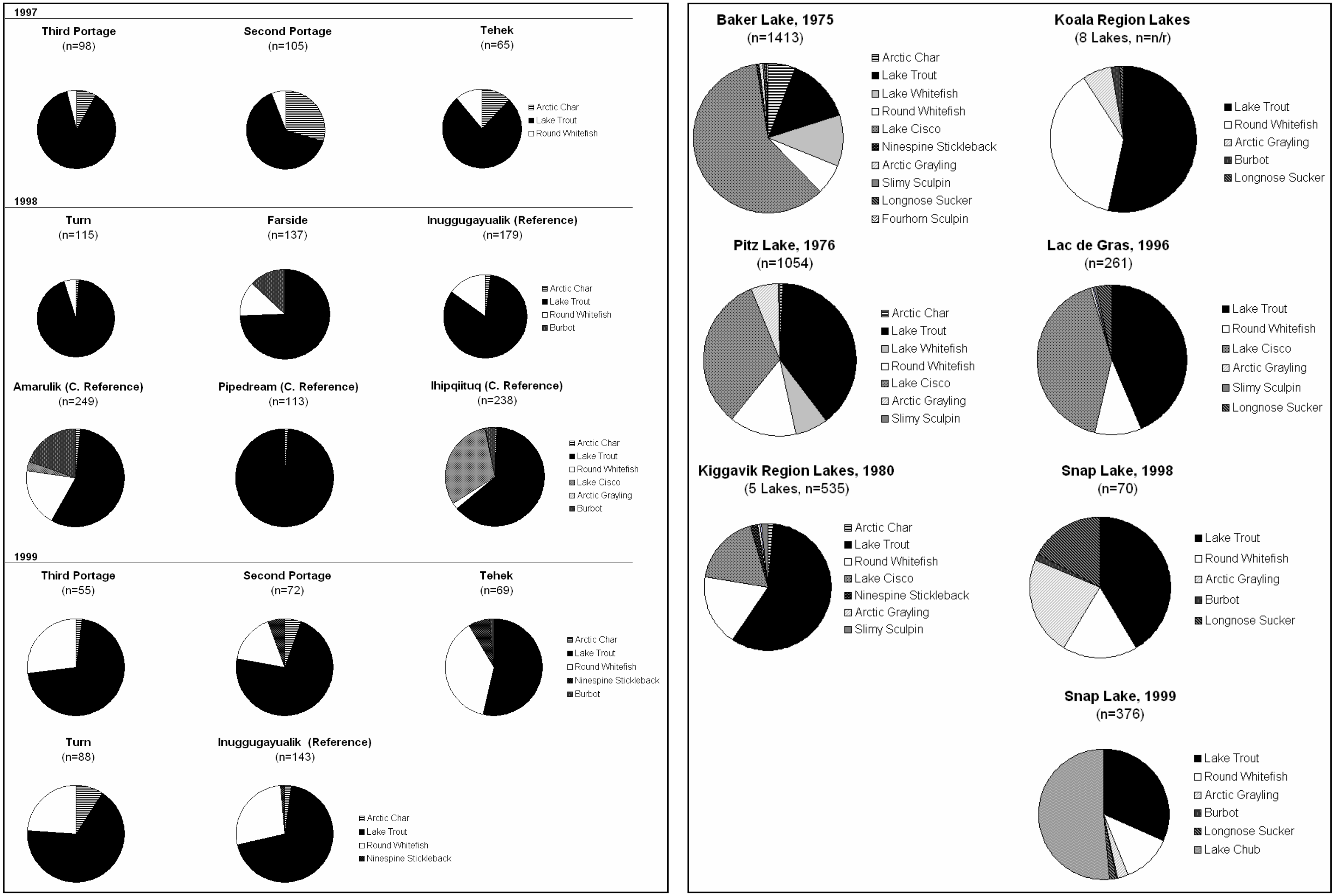


Figure 4-36: Relative Abundance of Fish Species



preventing movement by fish between the lakes during any other time but spring. Cold water temperatures and the absence of stream habitat prohibit the presence of Arctic grayling and suckers.

Fish species composition and relative abundance (based on catch-per-unit-effort statistics) was similar among project and reference lakes. Arctic char were somewhat less abundant in Third Portage Lake than downstream lakes. Fish from project lakes are healthy and were in good condition in all years. Concentrations of metals in tissue, including mercury, were low and typical of what would be expected in fish from remote lakes unaffected by anthropogenic activities. The size distribution of lake trout covered a wide range, up to 1.1 m and 20 kg weight. All lakes had somewhat bimodal size distributions of fish with a relatively larger number of fish between 200 and 300 mm in length, and a second mode between 500 and 550 mm, with a few large (>800 mm) individuals. Size and condition data of trout from project lakes was similar to or slightly less than trout elsewhere in remote Arctic lakes. This may be due to the highly oligotrophic, low productivity nature of the project lakes that limits growth rate and ultimately, fish size.

4.14 DESCRIPTION OF SOCIOECONOMIC ENVIRONMENT

4.14.1 Regional & Local Socioeconomy

After its formal creation on 1 April 1999, Nunavut promptly set about establishing a consultative process to determine priorities and strategies for the economic and social development of the new territory. The work took into consideration a number of unique features of the economy and population, and outlined the significant challenges in improving the well-being of the population. With a commitment to developing a more diversified economy, the government is faced with addressing a broad range of constraints, from poor health and educational status of the population to a lack of transportation and communications infrastructure.

4.14.1.1 Population

Kivalliq Region, one of three administrative regions in Nunavut, had an estimated population of over 7,500 people in 2001 spread among seven communities, the largest of which is Rankin Inlet (over

2,200 people) and the smallest of which is Whale Cove (less than 350 people). Baker Lake, with an estimated population of over 1,500 in 2001, is the only inland community in the region.

Table C.1 in Appendix C provides demographic data on Baker Lake, Kivalliq Region, and Nunavut. Additional data can be found in Cumberland's Baseline Socioeconomic Study. These data indicate that populations at the community, regional, and territorial levels are characteristically young, with about 40% below the age of 15. The gender imbalance, particularly in Baker Lake, is also substantial.

4.14.1.2 Economic Activity & Incomes

Table C.1 in Appendix C also provides data on economic activity. The economy is mixed, combining the formal wage economy with traditional ways of life. Formal employment is predominantly in the tertiary, or service sector, with government (including health and education) providing over 50% of jobs at the regional level. Over the last five years, Baker Lake has seen an increase in the participation rate. This, in combination with population growth, represents a significant increase in the number of people looking for work and consequently a large increase in the unemployment rate. The unemployment rate in Baker Lake is higher than that of the region and territory. Women tend to participate less in the formal economy and are more likely to be unemployed in the territory.

In an economy that is predominantly one of government services, there is little economic opportunity for a growing labour force with minimal formal education. Poor formal employment prospects have translated into a recent decline in family incomes, which in Baker Lake are already substantially lower than in the region and the territory. Incomes in Nunavut also compare unfavourably with the rest of Canada. A comparatively high cost of living compounds the problem. Family incomes have decreased although average full-time earnings have increased; a further indication that mounting unemployment is the driver of decreasing economic welfare.

4.14.1.3 Education

Both Kivalliq Region and Baker Lake underperform relative to Nunavut as a whole with respect to educational achievement. As is the case for economic activity, there is gender balance in high school completion rates between males and females in Baker Lake, although overall across Kivalliq Region, women's educational achievement is higher. Of particular concern in Baker Lake is the apparent increase in the percentage of young people who do not complete high school, as compared to the older generations. Discussions with educational professionals suggest a number of reasons for this, including lack of employment opportunities as a disincentive. In addition, the pattern of non-Inuit teachers rotating in and out of communities creates few opportunities for sustained, culturally appropriate support for students.

The school data in Table C.2, Appendix C, indicate that although secondary schooling is now available in all communities in Kivalliq Region and the growth in school attendance is generally high, only in communities more successfully integrated into the formal economy such as Rankin Inlet and Arviat are students graduating in significant numbers. In Baker Lake, for example, only two students graduated from secondary school over a four-year period from 1999 to 2003.

For students who do graduate, both in Kivalliq Region and in Baker Lake, there is opportunity for post-secondary study. Nunavut Arctic College offers a range of courses, including some courses specific to preparation for employment in the mining sector. Because of the potential for an expanding mining sector in Nunavut, and thus the potential for employment of Nunavut residents, Cumberland and the college are working with Kivalliq Partners in Development on a more comprehensive approach to training in this industry. Cumberland's involvement includes providing a list of jobs for their training program that are relevant to the project and the mining industry as a whole. It is noteworthy that many skills learned through such training, particularly in combination with job experience in the mining sector, would be transferable to other economic sectors. The college also offers high school upgrading courses.

4.14.1.4 Traditional Activity

Participation in traditional ways of life is high, at about 50% both in Nunavut as a whole and in Baker Lake. This figure is likely higher for Inuit males between the ages of 15 and 54. Traditional ways of life provide food, clothing, and services that would otherwise have to be purchased. This activity shapes social relationships and is a source of individual identity and values, sustaining Inuit culture. It is also a source of cash income, through the sale of products such as furs and art, and increasingly through the offering of tourism services rooted in the Inuit experience of the land.

4.14.1.5 Health & Wellness

The challenges to community health and wellness are large. Although there is little data, discussions suggest that many health problems are experienced more by males. Suicide, substance abuse, smoking, teenage pregnancy, sexually transmitted disease (STD), and life expectancy statistics in Nunavut are substantially worse than in the rest of Canada. For example, the suicide rate is nine times the Canadian average, the STD rate over 15 times higher, and life expectancy almost 10 years lower. Many of these are interrelated; for example, high rates of substance abuse and smoking affect life expectancy, and suicide is considered to be strongly related to substance abuse. Many of these, although individually experienced, spill over as community effects, causing a breakdown of families, crime, and child neglect.

In response to health challenges, the government of Nunavut spends 21% of their total operating budget on health and social services, second only to education, and in 2003/2004 planned to spend 40% of their total capital budget on health facilities. Health centers are located in the larger Kivalliq Region communities, including Baker Lake. Health professionals are available to address existing problems, but also to deliver counselling and awareness intended to prevent problems from arising. Although there is some evidence across the north that large investments are bringing about improvements in health and social services, there is some distance to go towards closing the disparity that exists in health status between Inuit and other Canadians.

As indicated above, Nunavut has had some success in ensuring that education and health facilities are available in all communities. The depth of service suffers in many cases, as small populations do not create constant demand for more specialized services. Even a community the size of Baker Lake sees most types of health professionals (e.g., doctors and dentists) only on a visiting basis. These visits are supplemented with video teleconferencing, and a large percentage (20%) of the operating health budget is used to bring people to services when local services are lacking.

4.14.1.6 Crime

Crime statistics are a reflection of health (particularly substance abuse) and economic challenges. Nunavut has particularly high rates of violent crime and sexual assaults relative to the rest of Canada. The figures shown in Table C.3, Appendix C, seem to suggest that crime, particularly youth crime (almost all of which statistically is committed by males), rose significantly between 1996 and 2001. Part of this rise reflects a demographic shift to a younger population, but it is also certainly exacerbated by exigent socioeconomic conditions. Communities across the north are increasingly concerned about their youth, who have in the recent past been less likely to participate in traditional ways of life but have not had the opportunity to move into the wage economy.

4.14.1.7 Housing & Transportation

Adequate housing plays an important role in facilitating job and school performance, in family relations, and in health status. Although overcrowding appears to have eased in response to vigorous government action to address the shortage of housing, increasing demands due to high population growth will continue to place stress on families. The statistics show that the housing shortage in Baker Lake may be less than elsewhere in the territory, although discussions in the community indicate that the figures under-represent demand, and that crowding is a serious social issue.

Providing transportation to a general populace is a challenge in Nunavut, with its many small communities spread across a very large land area. All communities can be reached by air and water; however, there are no roads between population centers, water access is seasonal, and air transport is costly. Telecommunication facilities are available in all communities, but are again costly. While the government has made significant efforts to build local businesses, limited and/or expensive physical infrastructure represents a severe constraint.

4.14.2 Archaeology & Heritage Resources

Archaeological surveys covered three main areas of study: the mine site and vicinity, the haulage route corridor, and selected sites around Baker Lake. Identified sites are shown in Figure 4-37. For more information on these sites, see the Baseline Archaeology Report and Section 4.4 of this EIS.

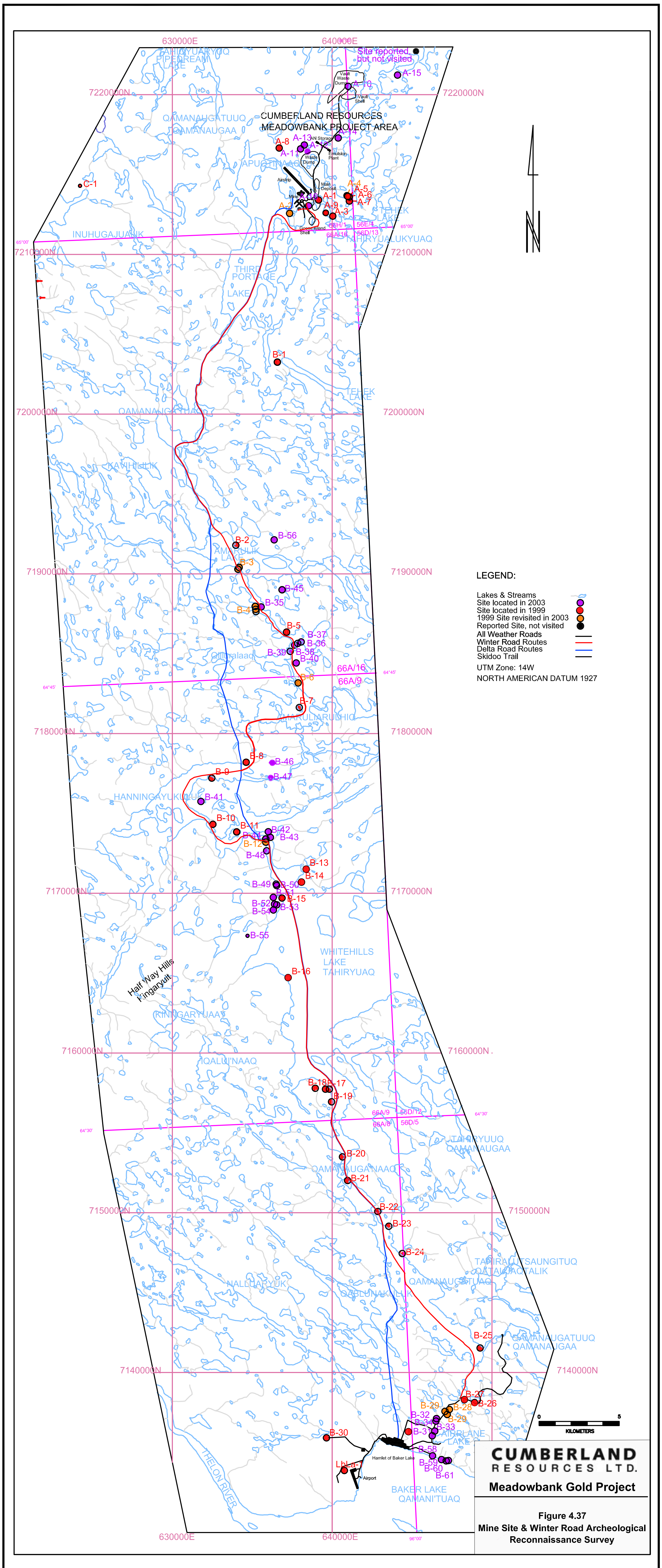


Figure 4.37
Mine Site & Winter Road Archeological Reconnaissance Survey

The area between Baker Lake and the mine site is considered primarily a transit route to the Back River, a traditional winter hunting and fishing area as evidenced by the many campsites and other heritage features along the road. Most of the sites observed in the study area were temporary campsites less than 50 years old. Pre-Dorset and Dorset age sites were not encountered.

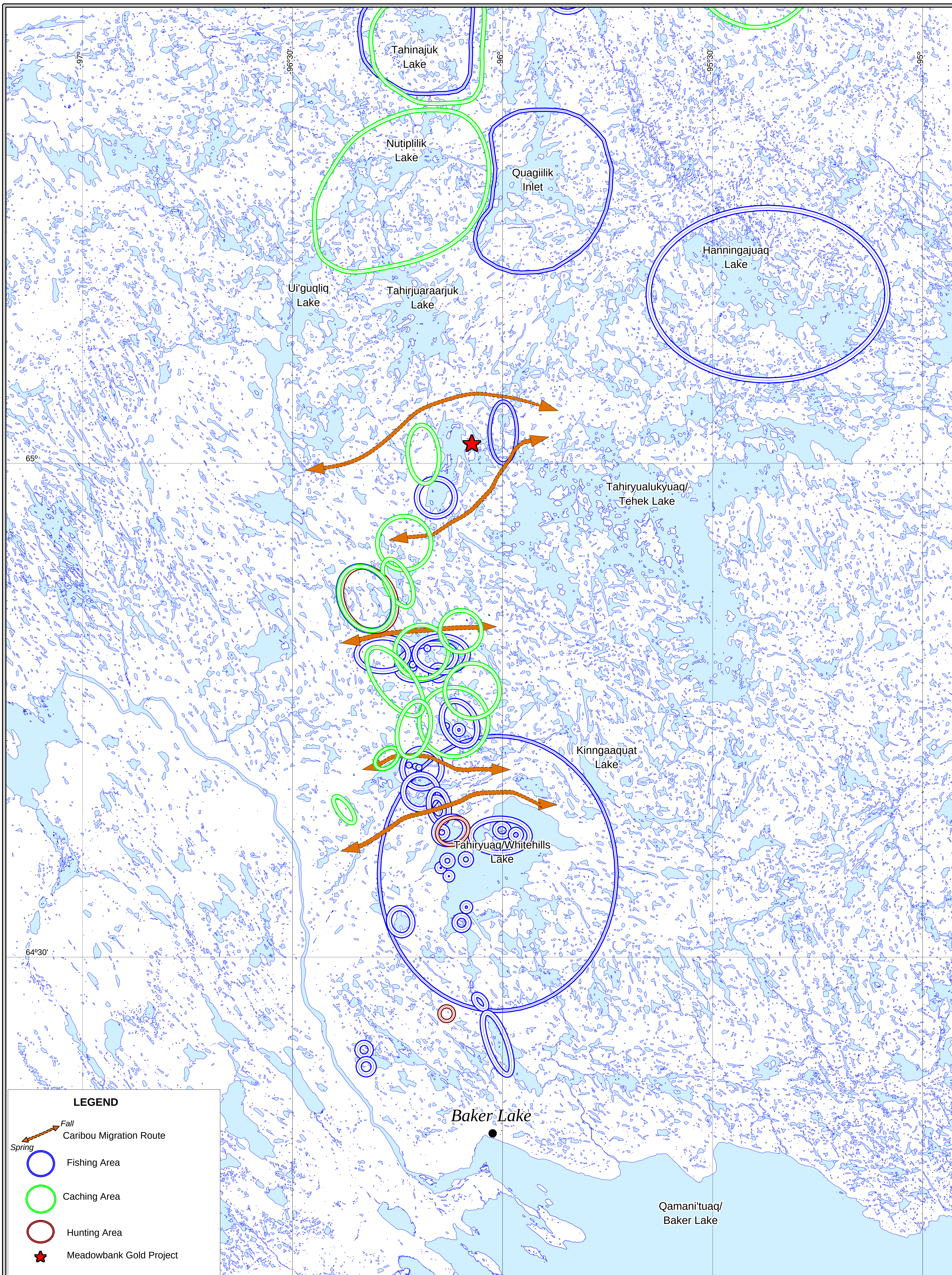
Table C.4 in Appendix C lists sites considered to be within 250 meters of the disturbance zone of the mine site or within 50 m of the center line of the haulage route from Baker Lake.

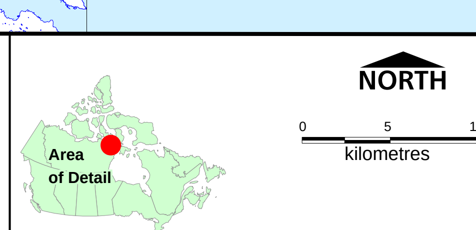
4.14.3 Traditional Knowledge

Traditional information has been collected during public meetings (1996 to 2004) and site visits by Elders to the camp. Traditional studies were also undertaken to determine traditional use and traditional ecological areas within and around the Meadowbank project area. The study was accomplished by way of interviews with thirteen local Inuit Elders (men and women) from the Meadowbank area in association with the staff at the Inuit Heritage Centre in Baker Lake. An archaeologist (Deborah Webster) and heritage consultant (Hattie Mannik) were also consulted.

According to the Elders of Baker Lake, the area between Baker Lake and the Meadowbank site was most commonly used as part of a transportation corridor between Baker Lake and the Back River, their traditional winter hunting and fishing area. While hunting and fishing activities were, and still are, conducted near the property, these activities seem to be of an opportunistic nature while enroute to somewhere else. The Inuit also stop to camp at various lake sites—including the Portage Lakes—but these sites are not annually used. More permanent camp sites utilized by both current residents and their ancestors are further north. Traditionally Tehek and the Portage Lakes were used for fishing, fox trapping, caribou hunting, and food caching, all of which are still practiced today (see Figure 4-38). This area is also reported by the Elders to be very spiritual, and grave sites exist along the shore of Second Portage Lake. There are also other grave sites located randomly throughout the area between Baker Lake and the Meadowbank study site (see Figure 4-39).

No known traditional use areas occur within the footprint of the proposed development area. All traditional use areas outside of the project will be protected by future management plans developed





Traditional Land Use - Fishing, Hunting, Caching and Caribou Migration

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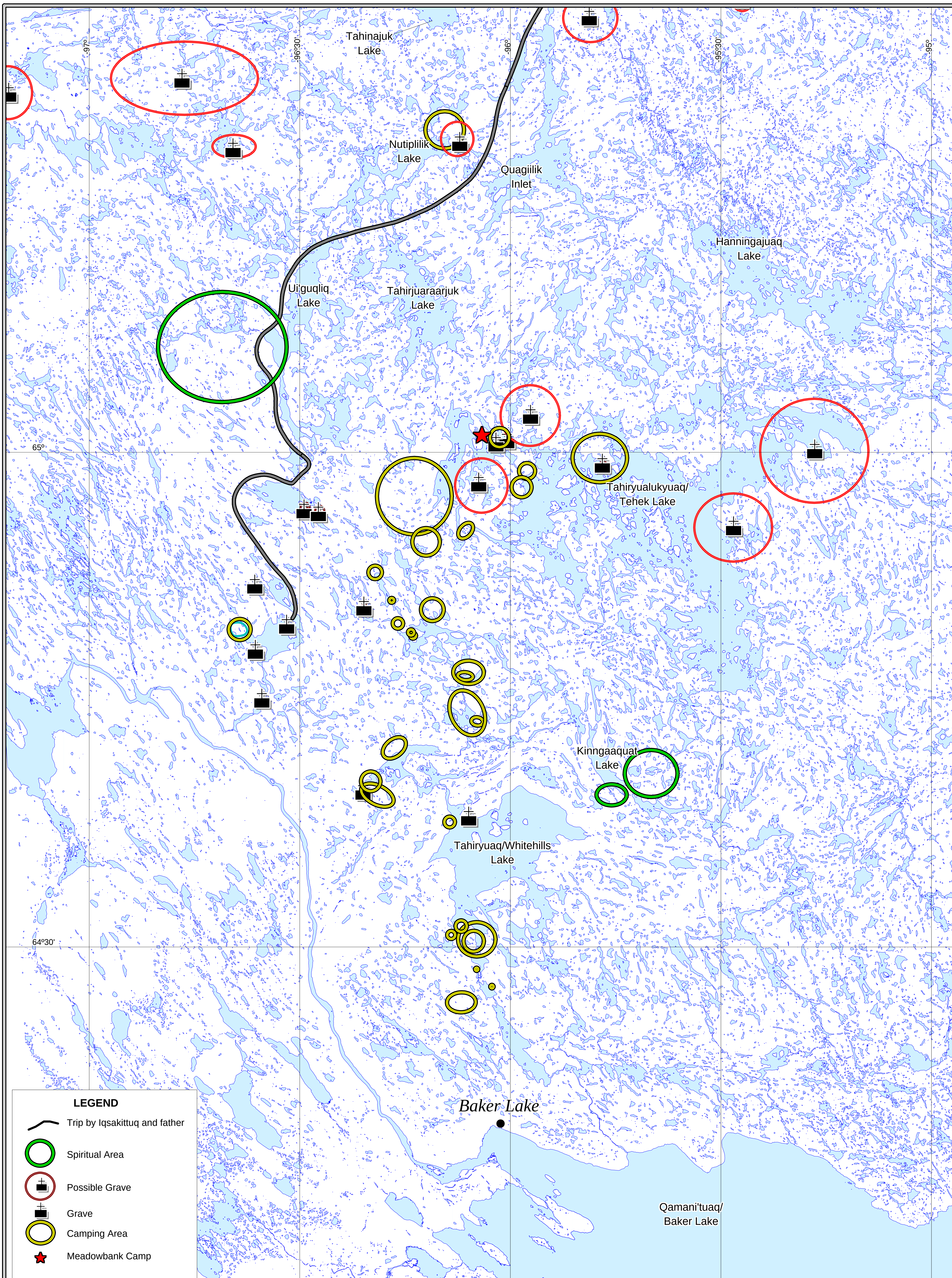
Figure 4.38



Traditional Land Use - Graves, Spiritual Areas & Camps

NORTH

0 5 10
kilometres

SCALE: 1:430,000

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Figure 4.39

between Cumberland and Inuit Elders, Heritage associations, and the local government. Every effort will be made to ensure that traditional sites are not disturbed or altered.

See Section 4.4 and the Baseline Traditional Knowledge Report for more information.

4.15 SPATIAL BOUNDARIES

For assessment of effects on the ecosystem from project related actions and other actions, the RSA was established on a VEC-specific basis. RSA's for each VEC were grouped into the following four categories: air quality and noise; physical ecosystem (surface water quality, surface water quantity and permafrost); terrestrial ecosystem; and fish habitat and fish population. RSA and LSA spatial boundaries are shown for each VEC in Figure 4-40.

4.15.1 Air Quality & Noise

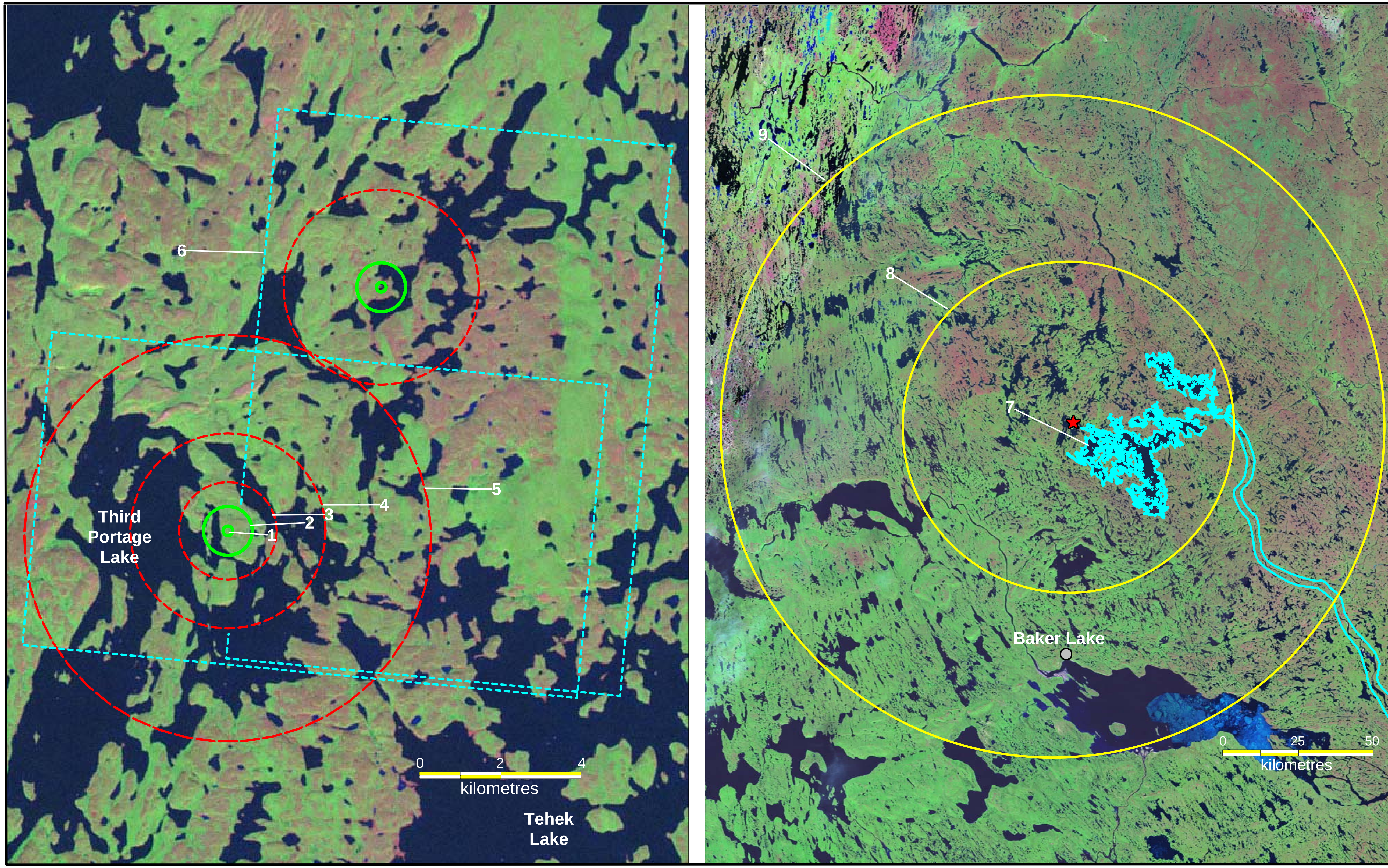
The RSA for the cumulative air quality and noise assessment was defined in preliminary dispersion modelling with AERMOD model and resulted in the selection of a 5 km zone around the emission sources. The RSA is extended south north by 7 km resulting from the distance between the processing plant and the Vault mine.

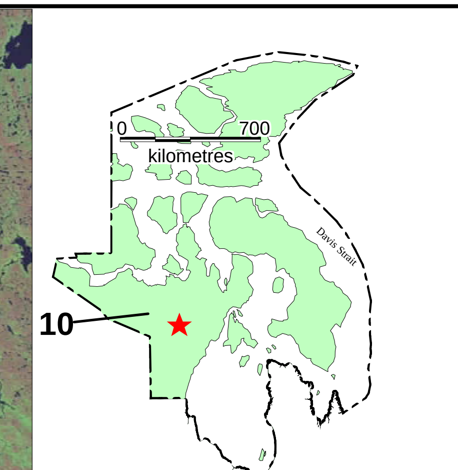
4.15.2 Physical Ecosystem

The Regional Study Area (RSA) for assessment of cumulative effects on surface water quality, surface water quantity and distribution, and permafrost was established as the unit area where regional effects would extend beyond the directly affected zone and may extend into the main basin of Tehek Lake, and the Quoich River system.

4.15.3 Terrestrial Ecosystem

The Regional Study Area (RSA) for assessment of cumulative effects on terrestrial ecosystem was established on a VEC-specific basis. At the VEC level, spatial boundaries vary depending on variables such as home range size, distribution, and densities. For example, the collared lemming has a much smaller home range than the barren-ground caribou. Other species, such as geese are primarily migratory and may travel thousand of kilometres from the project area, while other animals such as the





LEGEND

1: *LSA-Vegetation (100m radius)*
2: *LSA-Breeding Birds, Small Mammals (500m radius)*
3: *LSA-Raptors & Waterfowl (1km radius)*
4: *RSA-Vegetation (2km radius)*
5: *LSA-Ungulates & Predatory Mammals (5 km radius)*

5: *RSA-Small Mammals & other Breeding Birds (5 km radius)*
6: *LSA-Water*
7: *RSA-Water*
8: *RSA- Raptors & Waterfowl (50 km radius)*
9: *Predatory Mammals (100 km radius)*
10: *RSA-Ungulates (Mainland Nunavut Territory)*

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Figure 4.40
Spatial Boundaries
Regional & Local Study Areas

wolverine and grizzly bear have large home ranges that may extend well beyond the 100 x 100 km RSA (as defined for baseline survey and monitoring purposes). Accordingly, unique spatial boundaries have been established for each terrestrial VEC (see Table 4-16).

4.15.4 Fish Habitat & Fish Population

The RSA for assessment of cumulative effects on fish habitat and fish populations has been defined similar to that for physical ecosystem described above. Specifically the RSA would extend beyond the northernmost bay of Tehek Lake, which receives water from both the Portage and Vault (Vault, Wally, Drilltrail) systems into the main basin of Tehek Lake, and into the Quoich River system. This assessment is consistent across VECs such as lake trout spawning habitat or productivity of benthic habitats.

4.16 TEMPORAL BOUNDARIES

Temporal boundaries varied with the component of the biophysical environment and cultural resource being considered. Where possible, temporal boundaries were defined as the four project phases associated with the proposed development (i.e., construction, operation, closure, and post-closure).

Cumberland plans to mine these deposits over an 8- to 10-year period, starting with a two-year construction, 8 to 10 years of operations and two years for closure activities. Post-closure activities will end in approximately 25 years after closure, depending on regulatory requirements and post-closure monitoring. Temporal boundaries for each project phase including temporary closure (3 to 12 months), long-term shutdown (greater than 12 months), and exploration

4.17 DATA ACQUISITION METHODOLOGY & DOCUMENTATION

See Section 4.3 for details.

4.18 DATA ANALYSIS & REPORTING

See Section 4.3 for details.

Table 4-16: Spatial boundaries for Terrestrial Ecosystem VECs (in radius centered on project facilities)

VEC	**RSA**	**Justification**
Vegetation	2 km	Vegetation is sedentary and vulnerable primarily to activities in close proximity
Ungulates	Mainland Nunavut	Caribou individuals from several herds, including Ahiak, Boothia Peninsula, Beverly, Qamanirjuak, Lorillard, and Wager Bay are known to occur in winter Muskox are wide-ranging and have been thought to be moving northeast out of the Thelon River valley
Predatory Mammals	100 km	Grizzly bear, wolverine, and wolf are wide-ranging species with large annual home ranges[1]. Predatory mammals occur at very low densities within the study area
Small Mammals	5 km	Small mammals are quite resilient (i.e., easily habituated) to human activity Of small mammals, Arctic hare are the widest ranging (home range of 4 to 20 ha[2])
Raptors	50 km	Birds nesting in close proximity to mine facilities may be disturbed during the nesting season Nesting birds may forage considerable distances away from nesting areas Some species (e.g., rough-legged hawk) are migratory and undergo long-distance movements
Waterfowl	50 km	Birds nesting in close proximity to mine facilities may be disturbed during the nesting season Species may be wide-ranging during the breeding season All species are migratory, moving long-distances to wintering grounds
Other Breeding Birds	5 km	Passerines are quite resilient (i.e., easily habituated) to human activity During the breeding season, most species are restricted to home ranges <1 km^2

Notes: 1. For males in Arctic habitats – Grizzly bears: 6,000 to 7,000 km^2; Wolverines: 100 to 900 km^2; and Wolves: >60,000 km^2. **2.** Macdonald 1995.

4.19 IMPACT ASSESSMENT METHODOLOGY

The impact assessment methodology applied to the Meadowbank Gold project follows accepted, well-established protocols and procedures that are consistent with NIRB and the Canadian Environmental Assessment Act (CEAA). The ultimate purpose of the methodology is to assess the magnitude, duration, spatial extent, frequency, and timing of adverse effects caused by the project on VECs and VSECs in as quantitative a manner as possible. Using a decision framework specific to individual VECs and VSECs (i.e., impact matrices), each project component was assessed to determine if the long-term viability of an ecological component or socioeconomic condition may be significantly adversely affected.

It is important to remember that the assessment of significance of residual effects is made after mitigation is applied. For example, construction and maintenance of a berm around the fuel tank farm will ensure that in the unlikely event of a spill, significant adverse impacts will not result to the water quality or fish populations of the receiving environment because the berm has considerably reduced the risk of fuel entering the aquatic environment. Thus, the impact of a spill into the receiving environment is considered, but is not assessed with the same rigor as a potential impact that is more likely to occur. As per NIRB's request, Cumberland has also determined the potential significance of unmitigated impacts to ascertain the positive effects of mitigation.

4.19.1 Summary of Key Concepts

A number of key concepts were applied during the impact assessment:

Focus on valued ecosystem components – Valued ecosystem components (VECs) are defined as those environmental attributes or components identified as a result of an ecological and social scoping exercise. These may be determined on the basis of perceived public concerns related to social, cultural, economic, and aesthetic values. They may also reflect scientific concerns of the professional community as expressed through the social scoping procedures (i.e., hearings, questionnaires, interviews, workshops, media reports, etc.) and through technical studies.

Integration of traditional knowledge – Cumberland has endeavoured to include the knowledge and understanding of the local people and culture in all aspects of planning and implementation of project development.

Use of linkage matrices to identify impacts – Developing impact matrices (see Appendix B) was a critical step in identifying how a particular mine activity may cause a tangible effect which, even after mitigation has been applied, may impact VECs in a significant or unacceptable way. The impact matrices establish the relationship between all project-related activities, physical effects, mitigation, and residual ecological effects.

Focus on critical issues – One of the purposes of developing detailed impact matrices was to identify the most critical issues that could adversely affect VECs during the various project phases. Detailed discussions have been developed around these issues, whereas less attention has been given to generic issues or effects that are not considered to be significant (i.e., acceptable) and/or are easily mitigated.

Precautionary principle – To the best of its ability, Cumberland used the *precautionary principle* to guide the development of this project by assuming that lack of scientific certainty is not a valid reason for avoiding environmental action during any phase of project design where there are threats of serious or irreversible damage. Cumberland has built a safety margin into all decision-making and has incorporated traditional knowledge as an additional guide.

Focus on residual impacts – Ultimately, the effects remaining after all mitigation effort has been applied (i.e., residual effects) are of greatest concern. Therefore, considerable attention has been given to identifying, quantifying, and describing these residual effects so that a determination of potential significant/unacceptable and/or cumulative effects is facilitated.

Linkage to environmental management systems – As part of this EIA submission, various management plans provide supporting documentation and a discussion on mitigation and monitoring strategies to address residual impacts.

4.19.2 Selection of Valued Ecosystem Components

Extensive consultations were held with government regulators, Baker Lake residents, and other stakeholders regarding the components of the ecosystem that were of greatest value or concern. Information from these consultations has been described and summarized in the Baseline Traditional Knowledge Report included with this EIA submission. Based on this selection process, the key VECs were determined to be: air quality, noise, permafrost, water quality, surface water quantity, fish populations, fish habitat, vegetation, ungulates, predatory mammals, small mammals, raptors, waterfowl, and other breeding birds. (Note: VSECs are listed in Section 4.20.4.1.) Baseline studies were conducted to determine the presence/absence, distribution, and abundance of the VECs identified during the consultation and literature review phases. Baseline information was used to better understand how widespread project effects on any VEC might be.

4.19.3 Describing & Classifying Impacts

4.19.3.1 Approach

CEAA defines environmental effects as “any change that the project may cause in the environment, including any effect of any such change on health and socioeconomic conditions, on physical and cultural heritage, on the current use of lands and resources.” The magnitude of this effect is related to “the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.” To define a “significant effect” we have incorporated the principals of the above statements and followed NIRB’s Terms of Reference guidelines for this project. Simply stated, any project-related residual effect (i.e., effects remaining after appropriate mitigation has been applied) that causes adverse effects to an ecological resource to such a degree that the resource is measurably impaired within a local or regional context, or whose function is measurably impaired over the long-term, is significant.

4.19.3.2 Assessment Criteria

Criteria for evaluating the significance of residual effects have been developed for this project based on best practice, professional judgment, and experience on other impact assessments for similar projects. Where possible, quantitative and integrative methods to assess significance are used, combining information gathered from field investigations, quantitative and semi-quantitative modelling (e.g., water quality modelling, blast design), statistical analysis, and technical studies designed to address specific questions. In applying mitigation to determine residual effects, available guidelines and legislation to protect aquatic biota and habitat have also been incorporated into the design of facilities or procedures. The intent of this process is to be transparent and document decision pathways so that others can review the process that was used to determine the likelihood of residual impacts, how mitigation has avoided or reduced an impact, and the significance of impacts, particularly residual impacts.

4.19.3.3 Significance

To determine significance based on the evaluation criteria, a transparent, step-wise process combining the outcome of individual criteria has been established to arrive at an overall conclusion. Significance is therefore determined depending on a particular combination of previously defined criteria (see Section 4.19 below).

4.19.3.4 Cumulative Effects Considerations

The reduction and elimination of cumulative effects, both temporal and spatial, is an integral goal of this EIA and the various management plans (see Figure 3-1). Despite the fact that Meadowbank would have a relatively small footprint in a large, undeveloped region, future developments in the area and certain unrelated additive effects that only become measurable when combined, cannot always be anticipated. A more detailed discussion on cumulative effects is provided in the Cumulative Effects Assessment in this EIA.

4.20 INDICATORS & CRITERIA

Definitions regarding magnitude, spatial extent, frequency, duration, and timing of impacts have been assessed for project-related activities as applied specifically to individual VECs (see Appendix B). These criteria are shown in Table 4-17 and defined below.

Table 4-17: Significance Evaluation Matrix for Project Impacts

Magnitude	Spatial Extent	Frequency	Duration	Timing	Conclusion About Significance
High	Regional	Any	Any	Any	Yes
	Local	Any	Permanent	Any	Yes
		Any	Long-term	Any	Yes
		Frequent to Continuous	Medium-term	Any	Yes
		Rare to Continuous	Short-term to Medium-term	Any	No
Medium	Regional	Any	Medium to Permanent	Any	Yes
		Frequent to Continuous	Short-term	Any	Yes
	Local	Frequent to Continuous	Long-term to Permanent	Any	Yes
		Rare to Infrequent	Long-term to Permanent	Any	No
		Continuous	Short-term to Medium-term	Any	Yes
		Rare to Frequent	Short-term to Medium-term	Any	No
Low	Regional	Frequent to Continuous	Long-term to Permanent	Any	Yes
		Rare to Infrequent	Long-term to Permanent	Any	No
		Any	Short-term to Medium-term	Any	No
	Local	Any	Any	Any	No

Magnitude – is a measure of the intensity or severity of the effect of a mine-related activity relative to a change from background conditions. Magnitude is somewhat subjective and takes into consideration such factors as ecological relevance, degree of change from baseline conditions, certainty of occurrence, and ecological resilience. The certainty with which the magnitude of an effect can be quantified has a strong influence on whether magnitude is ranked as high, medium, or low.

Spatial extent – is a measure of the geographic boundary of effects and has been divided into LSA and RSA areas.

Frequency - is a measure of how frequently effects will be felt by the VEC using standard measures (e.g., weeks, months, years).

Duration - is the length of time in weeks, months or years that an effect is expected to persist. The endpoint is recovery or return to baseline of the ecological component and is linked to reversibility and ecological resilience (i.e., the likelihood of the potential for recovery from an effect), providing an indication of when/if the impact will diminish.

Timing – indicates whether the impact overlaps with a sensitive period of a VEC.

4.21 IMPACT ASSESSMENT

The impact matrices provided in Appendix B, which were developed for each VEC and VSEC, examined the project according to project components and activities for each phase of project development. As per the Terms of Reference, the focus of these matrices was on *significant impacts*.

4.21.1 Project Components & Activities

Sections 4.21.1.1 to 4.21.1.15 of the Terms of Reference are discussed in Section 4.20.2 in conjunction with the physical and biological environmental components. This structure was adapted to avoid unnecessary duplication, facilitate ease of understanding, and preserve an ecosystem-based approach to the impact assessment and individual project components. For specific information on the impact of project components and activities, please refer to the impact matrices in Appendix B.

4.21.2 Physical & Biological Environmental Components

4.21.2.1 Landscape & Terrain

Impacts to the landscape and terrain include possible disturbance to the active layer, ice lenses, permafrost, and taliks. There are both non-project and project components that could affect these four features during various phases of project development. These components are described below.

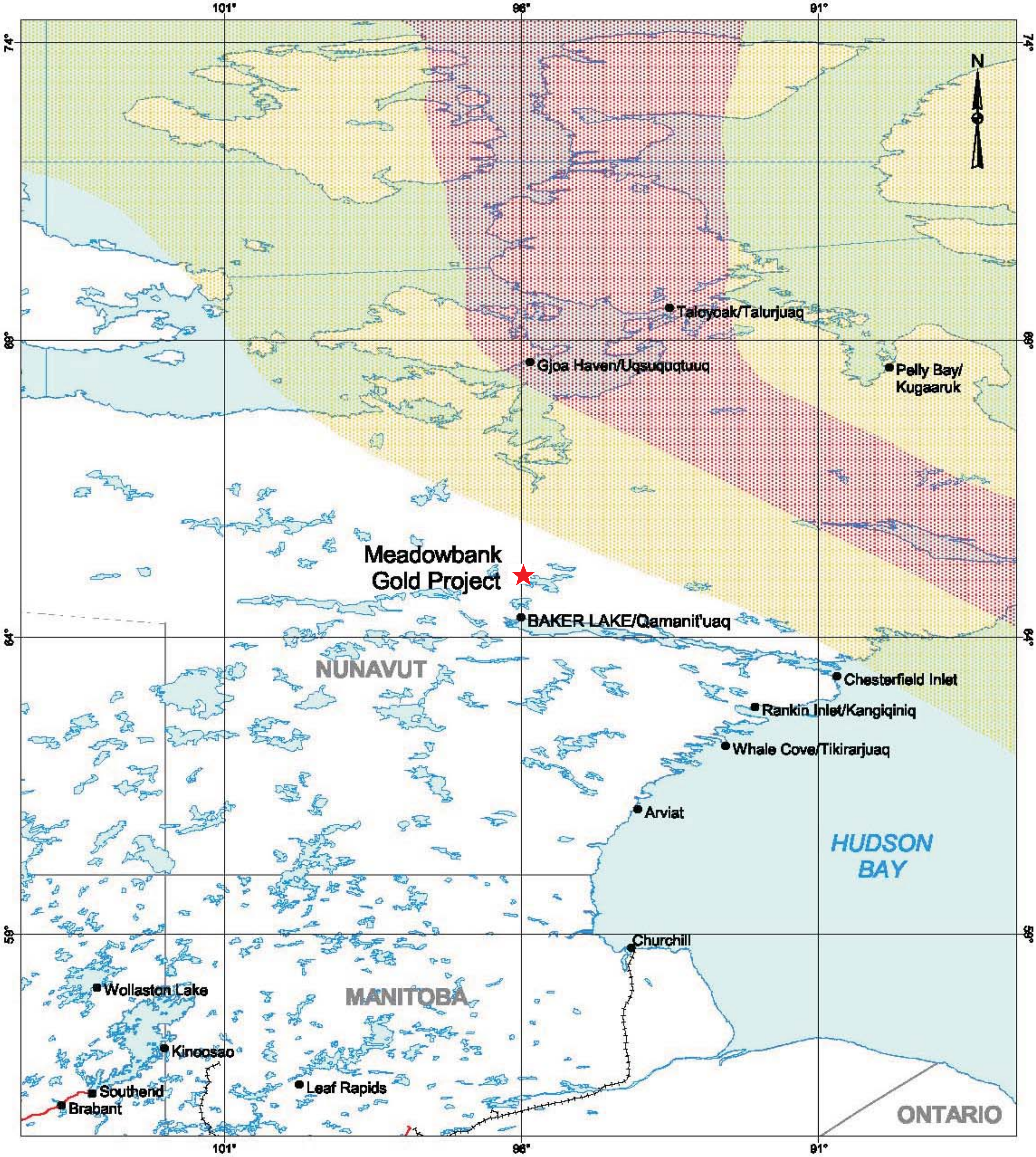
Non-Project Components

Seismicity (Construction, Operation, Closure) – The project is located in an area of low seismicity (see Table 4-18 and Figure 4-41). The design of structures can easily accommodate predicted peak ground accelerations and seismic shaking is expected to have negligible impact on the natural physical environment.

Table 4-18: Peak Horizontal Ground Accelerations for Meadowbank Site

Return Period of Seismic Event (years)	Peak Horizontal Ground Acceleration (g)
100	0.018
200	0.025
475	0.034
975	0.044

Source: Seismic Risk Calculation for Meadowbank project Site, Geological Survey of Canada, Natural Resources Canada.



200 0 200 Kilometers

Scale - 1:10,000,000

LEGEND

- Meadowbank Project
- Town/Village

Peak Horizontal Ground Acceleration (g), for 10% probability of exceedance in 50 Year Event

- 0 - 0.039
- 0.04 - 0.079
- 0.08 - 0.109
- Provincial Border
- Water
- Primary Highway
- Railroad

REFERENCE

Base digital data obtained from ESRI Inc.,
DATUM: WGS84 PROJECTION: Geographic

CUMBERLAND
RESOURCES LTD.

Meadowbank Gold Project

Figure 4.41
Seismic Zoning Map

N:\Bur-Graphics\Projects\2003\1413\03-1413-427\GIS\apr\figure-03-2_seismic-zoning.apr (Layout: 8.5x11 Portrait) December 19, 2003

Existing conditions / stability (Construction, Operation, Closure) – Rock- and soil-related terrain instability is a minor concern in the Meadowbank project area. Although permafrost will degrade in certain areas, for the most part the permafrost is "dry," and has low ground ice content. The exception is the wetlands occupying lowlands adjacent to lakes and ponds. Here excess ground ice is present and thaw instability is foreseeable. These impacts can be managed with best permafrost engineering practices as part of dike construction, drawdown and rewatering of lakes, pit development, and waste rock facilities and tailings storage facility construction and closure.

Project Components

Project components and/or activities in the mine plan that could have an effect on the landscape and terrain, and which many require mitigation, include: (1) dewatering, (2) rock storage facilities, (3) tailings storage facilities, (4) dikes, (5) ditches, (6) heated buildings, and (7) rewatering. These are described in more detail below according to project development phase.

1. *Dewatering (Construction)* – Shoreline wetlands and some inflowing streams will be affected by lowered water tables, which will cause nearby active layer thicknesses to increase. As wetlands are associated with excess ground ice, some combination of thaw subsidence, local thaw instability and sediment production is expected. The effects are expected to be short lived, spanning construction, but quickly stabilizing during construction or early operations. If mitigation is needed, effective methods are available. Silt fences can be used to control the movement of fines into the remaining lake water or ponds. Drawdown pumping can be curtailed. Clarification ponds can be constructed in diked off portions of the lake bottoms, including the use of natural obstructions and closed depressions on the lake bottoms. Other measures involve the placement of a stabilizing rockfill, commonly in conjunction with a geotextile, thus insulating the thaw unstable area and slowing the rates of thaw and sediment production.

2. *Rock Storage Facilities (Operation)* – Construction of the rock storage facilities is expected to be straightforward except for a few isolated locations where foundations comprise wetlands. Special construction control measures are available to limit impacts. The internal temperature is expected to become superchilled and freeze, which will limit internal drainage as infiltrating runoff becomes frozen.

The internal temperature will be monitored during operation so that the final topographic configuration and capping thickness can be optimized.

3. *Tailings Storage Facilities (Operation, Closure)* – Ice is expected to become entrapped during placement and freeze-back of the tailings. Up to 30% has been allowed, but actual amounts will not be known until operations commence. This amount would result in the final height of the tailings storage facility increasing by about 3 m above current lake elevation, a height that can easily be accommodated and would have a negligible impact on the closure configuration.

The tailings storage facility will be progressively reclaimed during mine operation with a nominal 2 m thick cover layer of non-potentially acid-generating ultramafic rock. After closure, the active layer will be confined within the capping layer, hence maintaining the underlying tailings in a frozen state. The freeze-back conditions and final cap configuration will be confirmed by performance monitoring with ground temperature measurements during operations and closure.

Thermal modelling suggests that the tailings will freeze in the long term, and that the talik below Second Portage Arm will freeze before seepage from the tailings impoundment reaches groundwater below the permafrost or Third Portage Lake (closure). Therefore, the potential for deep groundwater contamination to occur as a result of seepage from the tailings impoundment is considered to be low. Ground temperature monitoring will be undertaken during operations and closure to confirm the predicted freeze-back conditions.

4. *Dikes (Operation)* – The proposed tailings dike is needed to contain within the Second Portage Lake northwest arm approximately 20 Mt of tailings. Aggradation into and preservation of permafrost in the core and upstream (tailings) side of the dike is a key aspect of the design concept. Both steady-state and transient thermal modelling for the post-closure indicate that the dike will become frozen during operation and remain frozen after closure, even with Third Portage Lake waters lapping against the downstream side and even when climate change warming is considered. Monitoring of ground temperatures and sub-permafrost pore pressures in the dike and its foundation will be undertaken during operation and post-closure to ensure that freeze-back and grouting are effectively mitigating groundwater flow between the tailings storage facility and Portage pit / Third Portage Lake.

5. *Ditches (Operation)* – Ditches will cause local degradation of permafrost. Attempts will be made to avoid crossing ground ice rich areas where thaw instability is a concern. A variety of mitigation measures is available where ice rich areas cannot be avoided.

6. *Heated Buildings (Operation)* – Heated buildings have the potential to thaw permafrost, causing instability where ground ice is present. The plant site has been located in an area where “dry” permafrost conditions are expected; however, a range of mitigation alternatives is available to limit or prevent thaw, as required by unexpected ground ice conditions.

7. *Rewatering (Closure)* – Rewatering or flooding of affected portions of Third Portage Lake as well as Vault and Phaser lakes has the potential to cause impacts. Rewatering rates will be controlled through the incorporation of engineered structures into the detailed design of the dikes. As the water levels rise, new permafrost on the previous lake bottoms will degrade. Although this loss is considered a low impact, it may result in localized mud-line instability and/or elevated sediment entrainment. This condition is expected to be both very localized and short-lived, and mitigation measures are available.

Rewatering of the pits will flood areas previously underlain by permafrost and will create a through-going talik over the course of many centuries. The impact is considered low because water chemistry is expected to reach background standards relatively quickly and the through-going talik will be similar to taliks under most large nearby lakes, including that of Second Portage and Third Portage lakes where the rewatered Portage pits are located.

The shoreline of the affected portion of Second Portage Lake (i.e., between the Tailings and East dikes) will experience approximately a 1 m higher water level than the baseline elevation of 133.1 masl, as it becomes part of Third Portage Lake.

4.21.2.2 Air

The following air quality issues are of primary concern: emissions resulting from combustion of diesel fuel in the power plant and vehicles including nitrogen oxides, carbon monoxide, sulphur dioxide, and particulate matter; and fugitive dust emissions from tailings, overburden and waste disposal, and process operations (including ore hauling).

Diesel Fuel Emissions (Construction, Operation)

A limited number of point emission sources will be present at the plant, the most significant being the exhaust stacks of the diesel power plant. Combustion of diesel fuel involves emissions of nitrogen oxides (NO_x) with most of the nitrogen oxide converting to nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), water vapour (H_2O) and some small quantities of unburned hydrocarbons (HC), total organic compounds (TOC), particulate matter (PM), and other compounds. The project's maximum electrical demand is estimated to be 15.5 MW, which will be supplied by three diesel generators in operation with a fourth on stand-by. Table 4-19 shows the expected emission rate of contaminants from the power plant based on US EPA (2000) emission factors.

Table 4-19: Emission Rate of Contaminants from the Power Plant

Compound	**SO_2**	**NO_2**	**CO**	**CO_2**	**TOC**	**PM_{10}**	**$PM_{2.5}$**
Emission Rate	0.54 g/s	63.0 g/s	14.4 g/s	3.04 kg/s	1.86 g/s	0.912 g/s	0.879 g/s

Various mining equipment and haul trucks powered by diesel engines will exhaust contaminants such as nitrogen oxides, volatile organic compounds, particulate matter (mainly small sizes, less than 10 µm (PM_{10}) and 2.5 µm ($PM_{2.5}$) of aerodynamic diameter), carbon monoxide, and carbon dioxide. The worst case scenario for emissions associated with materials transportation will involve hauling ore from the Vault pit to the processing plant approximately 7 km away. To calculate exhaust emissions, it was estimated that the project would use 11,200 m_3/a of diesel fuel with approximately 250 ppm sulphur for mobile sources (trucks). The emission factors compiled from the US EPA AP-42 (1997) were used for the estimates shown in Table 4-20. Suspended particulates (SP) and particulate matter ($PM_{2.5}$) are the sum of haul truck exhaust emissions and wheel entrainment dust emissions.

Other potential sources of emissions are the milling and materials handling operations, although no particulate matter is anticipated from these wet streams. Potential dry PM emission sources include the truck dump bin vent, primary crushing, ore stockpile, pebble crushing plant, and furnace. Plant design specifies installation of dust control equipment that will depress emissions of PM to the ambient air for all these sources.

Table 4-20: Mobile Sources – Total Emissions

Compound	Emission Rate
Suspended particulates (SP) ≤30 µm	62.93 g/s
Particulate matter ≤2.5 µm ($PM_{2.5}$)	3.08 g/s
Methane (CH_4)	0.076 g/s
Nitrogen oxides (NO_x)	2.93 g/s
Sulphur dioxide (SO_2)	0.17 g/s
Volatile organic carbon (VOC)	0.03
Carbon dioxide (CO_2)	1.065 kg/s
Carbon monoxide (CO)	2.69 g/s
Nitrous oxide (N_2O)	4.69 mg/s

Fugitive Dust (Construction, Operation)

The main sources of fugitive dust at the project site will include stockpile wind erosion, the tailings area, and the waste rock disposal facility. Fugitive dust from the coarse ore stockpile will comprise emissions from conveyor ore drop at the top of the pile and wind erosion. Estimated conveyor emission of suspended particulates (< 50 µm) will be 0.1139 g/s and the fugitive dust loss from the stockpile due to wind action for particulates <30 µm will be 0.031 g/s. Exposed surface layers of tailings containing fine grain particles of wastes discarded from the gold ore processing are subject to regular erosion by wind and water. Prediction of fugitive dust emission caused by wind erosion has been conducted for estimated areas of tailings beach that may be exposed at specific times during the operation of the proposed Second Portage Lake tailings facility. The specific time periods considered are at the end of Years 3, 5, and 7. Predicted emissions of particulates <30 µm (PM_{30}) would vary from approximately 5.6 kg/h in Year 3 to 9.3 kg/h in Year 7. Three distinct source activities within the disposal cycle can cause dust emissions from the waste rock disposal site: equipment traffic in storage area, waste aggregate unloading (handling), and wind erosion of pile surfaces and ground areas around open rubbles. Estimated fugitive emissions from the waste disposal area of approximately 0.9 km^2 induced by wind erosion will be approximately 108 kg/d during dry and windy weather, and waste disposal traffic will generate 1,347 kg of dust daily during dry weather, regardless of wind speeds. Dust emissions from road travel between the mining sites and the processing plant will cause dust entrainment by vehicle wheels and the wake created by moving vehicles. This source will be the largest contributor to all dust emissions at site. The daily dust emissions will be 5,382 kg. This includes mitigation by 29% due to days with measurable precipitation.

Dispersion Modelling (Construction, Operation)

Dust and gaseous contaminants will disperse in the atmospheric air. Their permissible concentrations are regulated by Canadian, provincial, or territorial ambient air quality objectives or guidelines (AAQO). The ground level concentrations of particulates, sulphur dioxide, nitrogen oxides, and carbon monoxide were predicted by dispersion modelling. Such modelling is a widely accepted technique for predicting the effect of air emissions on the environment.

The modelling results for the point sources and mobile sources combined, including road dust generated by haul trucks, shows compliance with AAQO for all contaminants, except particulate matter (PM_{10} and $PM_{2.5}$). Such a situation can be expected during the dry weather when continuous ore hauling on the dirt road is taking place. Commonly used mitigation techniques include road watering, use of chemical dust depressants, or road surface hardening. These measures would reduce dust concentrations to acceptable levels. Dispersion modelling of fugitive dust originating at coarse ore stockpile, tailings area, and waste rock disposal facility showed compliance with all applicable ambient air quality objectives.

Secondary air pollutants, including sulphur compounds, nitrogen oxides, and ozone are feasible within the project air shed. When released to the atmosphere with truck exhaust or diesel plant emissions, NO_x might enter into a series of chemical reactions with air components. Nitrogen chemistry is driven by the photochemical dissociation of nitrogen dioxide (NO_2), but the products formed depend on other substances able to react with the photochemically excited NO_2 molecules, especially with atmospheric ozone (O_3).

Anthropogenic ozone creation is engendered by photochemical reactions between oxides of nitrogen and volatile organic compounds in the presence of favourable meteorology. Appreciable ozone creation tends not to occur unless atmospheric temperatures are high (> 30°C). The atmospheric conditions in Nunavut tend not to be conducive to ozone creation because high atmospheric temperatures are rare and extremely low temperatures of the atmosphere are common. In addition, absence of industrial facilities inhibits creation of anthropogenic ozone.

Greenhouse gases (GHG) such as carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) are produced during fuel combustion in diesel engines. Nearly all of the fuel carbon is converted to CO_2 during the combustion process. Formation of another greenhouse gas, carbon monoxide (CO) will also take place, but its amount is insignificant compared to the amount of CO_2 produced. Considering that the total use of the diesel by the project will be 40,000 m^3 annually, the GHG emissions were calculated to be 190,768 tonnes per year as CO_2 equivalent. The 2000 estimates of greenhouse gas emissions in Canada are 726,000,000 tonnes (Environment Canada, 2001). Therefore, the GHG emission estimates will be merely 0.026% of the total Canadian emissions based on 2000 statistics.

The impact of air disturbance on plants and wildlife will be low because of mitigation efforts. A monitoring program will be implemented to ensure the effectiveness of these techniques.

4.21.2.3 ***Noise*** *(Construction, Operation, Closure)*

Anticipated noise levels for the Meadowbank project were modeled using industry standards and the best available noise prediction models. The model output showed elevated, over 70 dBA, sound levels approximately 600 m from noise sources. Noise levels close to the sources would be between 70 dBA and 80 dBA.

This estimate is based on a worst-case scenario in which all noise sources simultaneously contribute to the overall noise level. In some industrial districts the daytime noise level at 70 dBA and the nighttime level of 65 dBA are allowed. The 70 dBA noise is significant when compared to the low-level baseline noise at the project area. However, it is comparable with noise levels generated by industrial facilities.

Noise generation at site will fall into three categories: instant, intermittent, and continuous. Mining activities such as blasting and operation of the primary crusher and mills will be the main sources of noise. The ore processing and gold recovery plant will generate continuous noise associated with ore crushing, grinding, and power generation. Noise due to vehicular movement will be intermittent, but will add to the background noise levels. Air traffic noise related to fixed- and rotary-wing aircrafts will be present on an irregular basis and will be of short duration. Therefore, no consideration is given to aircraft traffic noise in this assessment.

Construction & Closure Phases

During the early site preparation and construction phases of the project, different types of construction equipment would be utilized. This equipment could include a number of machines and devices varying in physical size, horsepower rating, and mode of operation. Consequently, the noise produced can be expected to vary widely. Even for equipment of a single model, variations in sound level at a fixed distance can be expected.

Construction activities would proceed through a number of phases. Each construction phase would have both generic and phase-specific noise sources associated with it. Construction noise emissions are expected to occur during levelling and grading, vehicle/heavy equipment traffic, excavation, pile driving, concrete pouring, steel erection, mechanical installation, and commissioning and start-up. The predominant sources of construction equipment noise are associated with internal combustion engines and impact construction equipment. Expected noise levels would be from 80 dBA to 100 dBA at 15 m.

Operation Phase

When the Meadowbank plant commences operation, the major noise sources will be located at the following three main process areas: crushing, powerhouse, and processing facility. The highest noise levels will be generated by the primary crusher, SAG mill, ball mill, and auxiliary facilities such as the conveyer and haul truck unloading bay. Other noise sources will include front-end loaders, diesel-powered generators, pneumatic valves, compressors, emergency equipment, relief valves, air coolers, small pumps, and service vehicles. The plant operations, such as flotation, leaching, refining, cyanide destruction, and electrowinning will be relatively quiet.

4.21.2.4 Water Quantity & Quality *(Construction, Operation, Closure)*

Water Quantity

To assess water quantity and balance, normal or typical seasonal changes were compared with project-related changes, and then the potential for these changes to cause adverse impacts to other VECs (e.g., fish habitat) was determined. This assessment focused on the construction and operation of the dikes and pits because these components have greater potential to affect water level, flow, and circulation in the project lakes than other activities.

There are three key issues during **construction** that can potentially impact water quantity. These are described below:

1. *Impacts of dike construction on water flow* – Construction of the East dike and Bay Zone dike will isolate and eliminate the westernmost and primary connecting channel (i.e., 50% of current flows) between Third Portage and Second Portage lakes. Without mitigation, the natural flow outlet from Third Portage Lake would be constrained, causing higher water levels in Third Portage Lake and increased discharge through the remaining two channels, and possibly overtopping and erosion during spring freshet, and impairment of fish passage. Dewatering of the west arm of Second Portage Lake would exacerbate this problem.

   Construction of the Vault dike will isolate Vault Lake from Wally Lake and eliminate discharge from Vault Lake into Wally Lake during mine operation.

   To mitigate the loss of the westernmost connecting channel between Third Portage and Second Portage lakes, one of the existing channels will be modified to handle increased flows so that similar discharge relative to current conditions occurs. The new channel will also improve fish passage to Third Portage Lake, thereby increasing fisheries values.

2. *Impacts of dewatering impoundments on water balance* - Lake areas impounded behind dikes during construction will be dewatered prior to pit development. Second Portage Lake behind the East dike will be drawn down by 28 m to allow construction of Portage pit, and 12.2 Mm^3 of water will be pumped from Second Portage Lake to Third Portage Lake. This will approximately double the total annual average discharge from Third Portage Lake (11.6 Mm^3) and is equivalent to an increase in volume of 5.4% and lake level by 20 to 30 cm. Potential adverse impacts are unlikely to result in significant adverse impacts to fish habitat since lake level increases fall within natural fluctuations and shorelines consist of large boulders or bedrock and are ice scoured and very

resistant to wave energy. If dewatering occurred during a wet year, there may be some erosion of vulnerable shorelines. With modifications to one of the channels between Third Portage and Second Portage lakes, lake levels would decrease further and potential impacts reduced.

The projected discharge from Second Portage Lake into Tehek Lake could increase from between 18% to 27% relative to current conditions, thus adverse impacts to stream channel integrity or fish movement into Second Portage Lake are expected to be negligible.

Dewatering of the Bay Zone and Vault Lake involve relatively small water volumes, therefore significant adverse impacts to water quantity, fish habitat, or populations in receiving lakes are not likely to occur.

3. *Impacts of Turn Lake culvert installation* – The crossing will require two 2.5 m diameter round culverts, each 75 m long (to allow side slope ratio of 3H:1V for protection of habitat). The size of the culverts are sufficient to pass 1:100 year flood events, increased discharge due to dewatering of Phaser Lake into Turn Lake, and will not impair water movement out of Turn Lake, nor upstream fish movement. Overall impacts to water flow and Turn Lake water levels are expected to be negligible.

Four key activities during **operation**, such as such as construction and dewatering of Goose Island Zone, and effluent discharge and freshwater intake from Third Portage Lake, will have the potential to affect water quantity. Changes in water balance due to diversion of contact and non-contact water are also considered. These activities are described below:

1. *Impacts on water balance of dewatering Goose Island zone* - The estimated maximum increase in Third Portage lake elevation from dewatering the Goose Island zone is approximately 4 to 5 cm, which is well within typical annual changes in lake elevation (20 to 50 cm), thus no adverse impacts to fish habitat or fish populations are expected. The Goose Island dike will alter water circulation pattern within Third Portage Lake; however, this change is relatively small and will have negligible impact on water quality, fish habitat or fish populations.
2. *Impacts on Turn Lake of Phaser Lake diversion* - The estimated annual drawdown of approximately 1 m and discharge to Turn Lake is not anticipated to affect water balance in the Drilltrail and Second Portage lakes system.
3. *Impacts of consumptive use of freshwater* - Annual consumptive volume, assuming a continuous rate of 130 L/s is approximately 4.1 Mm^3 or 1.8% of the total volume of Third Portage Lake on an

annual basis. Most of this volume will be redirected back to Third Portage Lake via the Second Portage attenuation pond; therefore, no significant impacts to water balance are anticipated.

4. *Impacts of effluent discharge on water balance* - Effluent will be discharged from the attenuation pond in Second Portage Lake to the north basin of Third Portage Lake and from the Vault attenuation pond to Wally Lake only during the open water season. Instantaneous effluent volume discharges to Wally Lake (0.9% of the volume of the Wally and Drilltrail lakes), and to Third Portage Lake north basin (0.9% of total lake volume), are expected to have a negligible effect on water balance on the receiving lakes, particularly since much of this water consists of contact and non-contact water that would normally enter the lake, except that it is first directed towards the attenuation pond to reduce suspended solids.

The most significant activities during **post-closure** related to surface water is the rewatering of the Vault, Goose Island, and Portage pits and expansion of Third Portage Lake. These are discussed below.

1. *Impacts of pit rewatering on lake levels & discharge patterns of contributing water bodies* - As part of the abandonment and reclamation plan, the Portage and Goose Island pits will be rewatered (in the order of 100 Mm^3) over several years and eventually become part of Third Portage Lake. Since instantaneous breaching of the dikes would cause a significant drawdown of Third Portage Lake, rewatering will be achieved by a combination of seepage, precipitation, and partial re-direction of annual freshet flows from Third Portage Lake over several years. Once flooding is completed, the overall lake surface and volume of Third Portage Lake will have increased, while lake surface and volume of Second Portage Lake will have been significantly reduced. The Vault pit will also be rewatered over several years primarily through redirected freshet flows from Wally Lake. Since the drawdown of Third Portage and Wally lakes falls within annual fluctuations, there are no adverse impacts to water balance in contributing lakes. The greatest change in the post-closure landscape is the permanent loss of approximately two-thirds of the surface area of Second Portage Lake, although it should be noted that an overall net gain in aquatic habitat is predicted at post-closure for the project (see Section 4.24.1.2).

2. *Impacts to water circulation of altering lake morphometry* - After closure, the size of Third Portage Lake will have increased to include both the Goose Island and Portage pits and associated impoundment areas. The longitudinal axis of this new arm is nearly parallel with the predominant north-east wind direction, so it is expected that mixing of water in the new arm and the remainder of east basin will be facilitated. The residual area of the deep portions of Goose Island and Portage pits will resist mixing and become a depositional area for sediment. Altered morphometry of Third Portage Lake east basin will cause different wind-driven mixing patterns in

the lake, although this change is not expected to significantly alter fish habitat, turnover rates, or other limnological conditions (e.g., temperature/oxygen profiles, circulation).

Altered morphology of Second Portage will significantly increase turnover rate within the lake, although gross circulation patterns will not be changed and no adverse impacts to water quality, fish habitat, or populations are expected.

Shoreline morphometry, surface water circulation, and discharge in Vault Lake will be similar in post-closure as current conditions, although residence time will increase because of greater lake volumes associated with the Vault pit. The magnitude of morphological change to Vault Lake is small to moderate and is not expected to adversely affect water quality, fish habitat, or populations.

Water Quality

The ambient or baseline water quality in receiving environment lakes in the Meadowbank area is very high, with all conventional and metals concentrations (except lead) below CCME guidelines for the protection of aquatic life (CCME, 2001). Maintaining good water quality is an important goal to which Cumberland will be committed throughout the life of the mine.

Mine activities with the potential to adversely affect water quality in receiving environment lakes include: sediment introduction during dike construction, leaching of metals during dike operation, and discharge of metals in effluent (see Section 4.20.2.8, Item 6). All other activities (e.g., operation of roads and airstrip, mine site runoff, waste rock storage facility) are not predicted to adversely affect water quality in receiving environment lakes during operation, construction, or post-closure.

During mine **operation**, effluent will be discharged from two sources: from Vault Lake attenuation pond to Wally/Drilltrail lakes, and from Second Portage attenuation pond to Third Portage Lake North Basin. Discharge from the Vault attenuation pond is small (0.08 m^3/s, open water season only) and consists of non-contact runoff, pit inflow water, and seepage from the Vault rock storage facility. No treatment is required and water quality in Vault/Drilltrail lakes is not predicted to exceed CCME (2001) criteria. This discharge will be monitored as per MMER. Effluent discharged from Second Portage attenuation pond prior to Year 5 will consist of contact (runoff collected from potential contaminant sources by ditches) and non-contact water and is not predicted to adversely affect water quality. After Year 5, this water will be merged with tailings reclaim water, grey water, and treated sewage prior to attenuation and treatment before discharge to Third Portage Lake. Effluent quality is predicted to be well within MMER concentrations for conventional parameters, metals, and cyanide (Appendix E). At mine **closure**, Portage and Vault pits will gradually be reflooded. The dikes will not be breached until the pit water quality meets MMER guidelines.

Receiving environment water quality in Third Portage Lake north basin is predicted to diminish over time because of the relatively long residence time of water in the lake and conservative modelling assumptions (e.g., no export of metals to sediment; assumes no other factors operating to reduce availability and toxicity). At the end of mine life, it is conservatively estimated that cadmium, chromium, and selenium may exceed CCME (2001) criteria in Third Portage Lake (north and east basin) by nominal amounts (less than two times) and copper by up to four times. Reflecting this uncertainty, the *precautionary principle* was applied to impact prediction. Therefore, there is moderate potential for exceedances of CCME for aquatic life in Third Portage Lake north and east basins during the latter stages of mine life. Efforts are underway to further refine this prediction.

Exceedances of CCME criteria do not necessarily mean that adverse effects on aquatic biota will occur. The Environmental Effects Monitoring (EEM) program is designed to detect adverse effects in effluent using toxicity testing and in the receiving environment using benthic community and fish population assessments. Thus adverse effects will be detected and alteration to water treatment will be made if necessary to eliminate adverse effects. Receiving environment water quality will at all times be safe for wildlife (geese, ducks, caribou) and humans at all stages of mine development. Tables showing the maximum predicted water quality concentrations are provided in Appendix E.

4.21.2.5 Vegetation / Terrestrial Habitat *(Construction, Operation, Closure)*

A comprehensive analysis of the environmental effects of the proposed mine development on vegetation cover is provided in the Terrestrial Ecosystem Impact Assessment (see Figure 3-1). In the LSA, plant cover will be removed or altered due to clearing associated with infrastructure construction, development of waste rock piles, or abrasion caused by vehicle traffic and large structures being dragged over the land. Plant health can be affected by grading, salt application, and dust deposition associated with road use and maintenance. Dust deposition can also lead to early snowmelt, and thus, early flowering in some plant species. The release of grey water or other nutrients from camp operations could also potentially affect plant health and lead to a shift in plant community structure from heath tundra to grass communities. All of the above activities will have impacts on the vegetation cover that will have to be mitigated.

The overall terrestrial habitat losses at the Main and Vault sites are estimated to be approximately 522 ha or 9% of terrestrial habitats available in the LSA (see Table 4-21). The Heath Tundra unit will be subject to the greatest alteration (270 ha; ~8.6% of this habitat available in the LSA). However, the greatest percent loss of existing habitats is the Lichen Rock – Boulder unit, which will be subject to alteration of 15% or 92 ha of existing habitats (see Table 4-21). The Lichen-Rock – Boulder community is not a limiting habitat type as it is very common within the RSA (see Table 4-21).

The combined area of plant community lost due to **construction** of the mine, camp, airstrip, and related facilities at the main site will be 263 ha or 4.7% of terrestrial habitats in the LSA: 132 ha of Heath Tundra, 49 ha of Birch Seep, 34 ha of Lichen-Rock – Bedrock and Lichen-Rock – Boulders, 28.3 ha of Sedge, 7.1 ha of Riparian Shrub, 3.8 ha of Snow Bank, and less than 1 ha of Moss.

Vegetation in the immediate vicinity of construction sites will receive deposition of fugitive dust, primarily in downwind areas. As the prevailing winds in the region are northwesterly, the major impacts of dust will generally be on plant communities to the southeast of the mine facilities or other source of dust disturbance (e.g., roadways). Results from modelling, air monitoring, and snow surveys indicated that most dust particles will settle out within 100 m of the source. With or without mitigation, the residual impacts on the productivity of vegetation communities of dust generated by construction activities are not expected to be significant. Spills of gasoline, diesel, hydraulic fluid, or other deleterious substances can cause degradation to surrounding vegetation communities, generally in a very localized area. Mitigation measures will ensure that spills are avoided or contained and will not result in significant impacts to vegetation cover.

Much of the anticipated loss of ELC vegetation communities at the main site will have already occurred before the **operation** phase begins. Further losses during operation will be associated with the Goose Island dikes and the expanding waste rock dumps. These losses will be somewhat offset

Table 4-21: Quantified Habitat Losses in the Meadowbank LSA

ELC Unit	Available in LSA (ha)	Lost in LSA (ha)	% Lost in LSA	% Lost in RSA
Avens	72	5.9	8.20	N/A
Birch Seep	622	50.6	8.10	0.09
Disturbed	10	6.1	61.01	N/A
Heath Tundra (Lichen Rock)	3,160	270.4	8.56	0.10
Lichen-Rock – Bedrock	337	29.5	8.77	0.02
Lichen-Rock – Boulder	601	91.5	15.23	0.03
Moss	1	0.0	2.84	N/A
Ridge Crest/Esker (Sand/Gravel)	1	0.0	0.00	0.00
Riparian Shrub – Birch	168	8.1	4.83	0.12
Sedge	585	53.0	9.06	0.18
Snowbank	95	5.9	6.21	N/A
Unmapped		1.5		N/A
Water (Deep & Shallow)	3,733	340.0	9.11	0.14
Total (ha)	**9,385**	**862.6**		**0.08**
	mine area / %	497.0	5.30	
	Vault area / %	365.8	3.90	
% Loss			9.19%	0.08%

Note: Discrepancies in total areas between the LSA and RSA are due to different methods used in categorizing ELC units.

by vegetation becoming established on exposed sediments from the Second Portage Lake drawdown, tailings beach, and waste rock piles. A total of 260 ha of terrestrial vegetation communities will be lost to all developments in the area of the Vault: 138.1 ha of Heath Tundra, 2.1 ha of Birch Seep, 86.9 ha of Lichen-Rock – Bedrock and Lichen-Rock – Boulders, 24.8 ha of Sedge, 1.0 ha of Riparian Shrub, 2.1 ha of Snow Bank, and 3.2 ha of Avens. Additionally, 1.5 ha of terrestrial habitat will be lost to dikes and the roads between the main and Vault sites.

Both exploration camps (north and south) will be removed and the habitats will be reclaimed, resulting in an increase of 2.5 ha of vegetated terrain. Dust and emissions from the mine plant and associated facilities, as well as from road traffic, will continue to cause minor vegetation degradation and possibly increased contaminant levels.

The **closure and post-closure** phase is the first significant opportunity to initiate major reclamation of areas lost during the construction and operations phases. Removal of project facilities, reclamation of tailings and waste rock facilities, and the deactivation of roads and associated reclamation activities will result in the natural revegetation of many previously impacted areas of the project. The removal and reclamation of the main site and associated facilities will result in increases of approximately 19 ha of ELC habitats. An even greater reclaimed area will be associated with the tailings deposition area and waste rock piles. The airstrip may be retained in a usable condition for long-term safety and future industrial activity. In the event the airstrip is decommissioned near the end of the closure phase, the disturbed area will be restored to its pre-development state and normal drainage patterns will be established to the extent practicable.

4.21.2.6 Wildlife

Appendix D contains a series of tables that summarize the high, moderate, and low suitability habitat loss during the growing season and winter in the LSA for each wildlife VEC below.

Caribou & Muskox (Construction, Operation, Closure)

A comprehensive analysis of the environmental effects of the proposed mine development on ungulates during the life of mine is provided in the impact matrices in Appendix B. In the growing season, an anticipated 112 ha (1.2% of total LSA area) or 8.2% of high suitability habitat is expected to be lost due to mine development activities. In the winter, an anticipated 392 ha (4.2% of total LSA area) or 9.6% of high suitability habitat is expected to be lost due to mine development activities. With overall losses less than 10% of the ungulate LSA, the overall magnitude of the impact is considered to be low and the unmitigated impact to be insignificant. When the ungulate-specific RSA is considered (i.e., mainland Nunavut), the impacts of habitat loss described above are very insignificant.

The primary potential effects of **construction and operation** activities on ungulates will be direct and indirect loss of habitat, avoidance of foraging habitat and areas of human activity (i.e., reduced habitat effectiveness), deflection from normal travel routes and energetic costs, health risk from drinking contaminated water from the tailings pond, reduced habitat effectiveness in areas close to noise and activity, possible injury or mortality from encounters with pits and other mine facilities, mortality due to collisions with vehicles or aircraft, contaminant loading from eating contaminated vegetation, and possible attraction of predators with increased local depredation rates.

The potential effects from noise will include avoidance of foraging habitat (reduced habitat effectiveness), deflection from normal travel routes, and energetic costs. Potential effects from roads, airstrip, and traffic will include mortality due to collisions with vehicles, reduced habitat effectiveness and habitat degradation due to dust and exhaust, and potential for increased contaminant loading in food sources.

Without mitigation, these impacts could have measurable impacts on ungulates utilizing the area. However, with mitigation (e.g., enforcing speed limits and giving caribou the right-of-way), residual impacts are anticipated to be of low significance.

Impacts to ungulates during the **closure and post-closure** phase will be reduced from impacts during the construction and operation phases. In general, a reduction in noise and activity and reclamation of waste rock piles, roads and other facilities will result in an improvement of habitat conditions.

Grizzly Bear, Wolves, Wolverines & Foxes (Construction, Operation, Closure)

A comprehensive analysis of the environmental effects of the proposed mine development on predatory mammals during the construction, operation and closure and post-closure phases is provided in the Terrestrial Ecosystem Impact Assessment and the matrices in Appendix B. Due to the relative rarity of bears and wolves in the area, however, hazards are deemed to be minor and the residual impacts will be of low magnitude and low significance.

In the growing season, an anticipated 59 ha (0.6% of total LSA area) or 9.0% of high suitability habitat is expected to be lost due to mine development activities. In the winter, an anticipated 276 ha (2.9% of total LSA area) or 8.5% of high suitability habitat is expected to be lost due to mine development activities. With overall losses less than 10% of the predatory mammal LSA, the overall magnitude of the impact is considered to be low and the unmitigated impact to be insignificant. When the predatory mammal-specific RSA is considered (i.e., 100 km radius or 3,140,000 ha), the impact of habitat loss described above is very insignificant.

The potential effects on predatory mammals from noise and activities related to **construction** will include avoidance of foraging habitat (reduced habitat effectiveness), deflection from normal travel routes, and energetic costs. Without mitigation, these impacts could have measurable impacts on predatory mammals utilizing the area. However, with mitigation (e.g., enforced speed limits, right-of-way to all predatory mammals), residual impacts are anticipated to be of low significance.

Potential effects from **operation** due to roads, airstrip, and traffic will include mortality due to collisions with vehicles, reduced habitat effectiveness and habitat degradation due to dust and exhaust, and potential for increased contaminant loading in food sources. With or without mitigation, these impacts are not expected to be significant.

The fuel storage and explosives facilities during operation have the potential to contaminate or degrade the surrounding environment and increase contaminant loading in prey through leaks, spills, fires and explosions. The main impact of the other facilities would be habitat loss, disturbance, and reduced habitat effectiveness. Bears and wolverines may also be attracted to certain kinds of aromatic compounds, including oil products, typically oily rags and grease tubes, as well as aerosol cans and batteries.

The domestic waste disposal facility during operations may attract predators if waste is not properly disposed. Food and other camp wastes attract scavengers including grizzly bear, Arctic fox and wolverine, increasing risk to human safety. Mortality of animals may occur if they are deemed to be problem.

Impacts to predatory mammals during the **closure and post-closure** phase will be reduced from impacts during construction and operation. In general, a reduction in noise and activity and reclamation of waste rock piles, roads and other facilities will result in an improvement during closure and post-closure. The domestic sewage and waste disposal facility, and kitchen and camp facilities may still have the potential to attract predators (especially grizzly bears and wolverines), with consequent threats to human safety, prey animals, and ultimately the predators themselves. Ongoing effort will be made in restricting hunting within the vicinity of the project site during closure and post-closure.

4.21.2.7 Birds

Raptors (Construction, Operation, Closure)

Due to the relative rarity of nesting raptors in the area, hazards are deemed to be minor and the residual impacts will be of low magnitude and low significance. In both the growing and winter seasons, an anticipated 391 ha (4.2% of total LSA area) or 9.5% of high suitability foraging habitat is expected to be lost due to mine development activities (see Appendix D). On a raptor-specific LSA basis (i.e., 1 km radius or 314 ha), the 391 ha of high suitability habitat lost due to mine development represents an impact of high magnitude and significance to local nesting populations of raptors. On a raptor-specific RSA basis (i.e., 50 km radius or 785,000 ha), the 391 ha of lost high suitability habitat represents approximately 0.1% of the raptor RSA, an impact considered to be of low magnitude and insignificant.

The densities of breeding pairs of birds preyed on by raptors observed during June 2003 breeding bird surveys indicate that the loss of 522 ha of ELC terrestrial vegetation communities at the Main and Vault sites may affect several species, in particular: Lapland longspurs, horned larks, American pipits, rock ptarmigan, semipalmated sandpipers, and other passerine species. Since the habitats for these prey species are widespread within the LSA and RSA, the effects on the total regional raptor populations are expected to be minimal. However, the local reduction in the prey base may have a moderate impact on nesting raptors in the vicinity. Habitat losses for birds and small mammals will be 9.2% of the LSA and 0.08% of the RSA. The overall residual impact of the decrease in prey base on raptor populations is not expected to be significant.

Based on survey information to date, no raptor nesting sites will be impacted due to **construction** activities. The nearest known raptor nest site (an inactive peregrine falcon nest) was 2.5 km from the field camp. Optimal nesting habitats for breeding raptors are limited in the Meadowbank area due to the almost complete absence of cliff topography.

During the nesting season, human activity and noise may cause some disturbance and displacement of nesting raptors, resulting in increased energy expenditures and stress levels, and possibly reduced reproductive success and subsequent survival of young. Susceptibility to disturbance can vary between individuals and between raptor species. When breeding, raptors tend to be quite tenacious about their chosen nest site and are reluctant to abandon it. Provided the disturbance is not too intense or prolonged, raptors will generally return to the nest once the disturbance has ceased.

Habitat degradation due to dust, exhaust, and fuel spills during project **operation** has the potential to increase contaminant loading in raptor prey. Aircraft traffic poses a collision hazard to raptors, particularly in the vicinity of the airstrip, and raptor mortality may occur due to vehicle/bird collisions on the roads or collision and electrocution with powerlines. However, due to the relative rarity of raptors in the area, these hazards are deemed to be minor and the residual impacts will be of low magnitude and low significance. Potential effects from roads, airstrip, and traffic will include mortality due to collisions with vehicles and potential for increased contaminant loading in food sources. With or without mitigation, these impacts are not expected to be significant.

During the **closure and post-closure phase**, the cessation of traffic and reclamation of roads will reduce the fragmentation of habitats, and increase the availability of habitats for small mammals and foraging and roosting habitats for other breeding birds. Passerines and ptarmigan may be attracted to reclaimed road bed areas for roosting, foraging, and possibly nesting (once vegetation has become reestablished). Raptors which prey on these species risk increased exposure to contaminant loading in birds from road materials. This risk is, however, expected to be minimal. Although aquatic habitats at Second Portage Lake (i.e., used for tailings impoundment) will be permanently lost to shorebirds and waterfowl, flooding of the Portage and Vault pits at closure will result in new aquatic habitats for these species.

Waterfowl (Construction, Operation, Closure)

An anticipated 393 ha (4.2% of total LSA area) or 9.1% of high suitability waterfowl habitat is expected to be lost due to mine development activities (see Appendix D). On an ELC unit basis, loss of high suitability habitats includes 340 ha of lakes or ponds and 53 ha of Sedge. On a waterfowl-specific LSA basis (i.e., 1 km radius or 314 ha), the 393 ha of high suitability habitat lost due to mine development represents an impact of high magnitude and significance to local nesting populations of waterfowl. Despite this loss of high suitability habitat, waterfowl nesting surveys have indicated that few waterfowl nest in the Meadowbank vicinity. On a waterfowl-specific RSA basis (i.e., 50 km radius or 785,000 ha), the 393 ha of lost high suitability habitat represents approximately 0.1% of the waterfowl RSA, an impact considered to be of low magnitude and significance.

Most of the direct habitat losses for waterfowl caused by the mine development will occur at the Main Site during the **construction** phase. Dewatering of portions of Second Portage and Third Portage lakes will likely have the greatest impact on waterfowl. However, the construction of the plant site (footprint), dikes, dewatering facilities, waste dump, airstrip, pits, and main roads will cause a loss and disturbance of terrestrial and aquatic roosting, foraging, and nesting habitats. Apart from the direct loss of habitats due to alteration of terrain and vegetation, noise and activity during construction will result in the displacement and disruption of waterfowl and will reduce the effectiveness of their habitats. Disturbance of nesting birds can result in increased energy expenditures and stress levels, and possibly reduced reproductive success and subsequent survival of young. Residual impacts from disturbance are not expected to be significant

Aircraft traffic during **construction and operation** poses a collision hazard to waterfowl and other bird species, particularly in the vicinity of the airstrip. However, the probability of this hazard to waterfowl is deemed to be relatively low, except perhaps during the migratory period when flocks of geese land to rest and forage. Aversion techniques will minimize potential interactions. Some waterfowl mortality may occur in summer through collisions with ground vehicles but such incidents are expected to be infrequent, involving few individual birds, and therefore of minor impact to local waterfowl populations.

Mine **construction and operation** can result in indirect impacts to waterfowl species. Plant health and bird forage can be affected by fugitive dust deposition associated with mining activities, road use, and maintenance. Fugitive dust deposition can also lead to early snowmelt and changes in plant phenology, resulting in early flowering in some plant species (Walker and Everett, 1987; Forbes, 1995). This may provide earlier foraging and nesting opportunities for waterfowl. The impacts of fugitive dust will mainly occur downwind of operations. As the prevailing winds in the region are northwesterly, the major impacts of dust deposition will generally be on plant communities to the southeast of the facilities or other source of dust disturbance.

By the **operation** phase, much of the anticipated habitat loss for waterfowl will have already occurred. There will continue to be a disruption of waterfowl and other wildlife occurring in the immediate vicinity of project facilities as a result of construction noises, blasting, operations, vehicle traffic, and machinery. There will also be minor losses and disturbance of potential roosting, foraging and nesting habitat where the Goose Island dikes key into the shore, and a disruption of natural movement patterns of waterfowl within the localized area of the Third Portage Arm dike.

Development of the tailings facilities (Second Portage Lake) may attract waterfowl to the tailings ponds with elevated levels of contaminated water. Ingestion of contaminants from water or fish may have adverse effects on the health and reproductive fitness of waterfowl, and in extreme cases may cause mortality of the birds. The health of waterfowl utilizing the mine site and environs will be difficult to determine directly because of their migratory and transient nature and the difficulty in obtaining samples for analysis. A proactive management strategy is the best approach for avoiding these potential problems. The residual impacts of contaminant ingestion from the tailings pond will not be significant due to mitigation measures that will be implemented to minimize waterfowl exposure to contaminants.

During **closure** when the dikes are breached in order to reflood Portage and Goose Island pits, inundation of the adjacent terrestrial habitats will result in a minor loss and disturbance of potential roosting, nesting, and foraging habitat for waterfowl. However, flooding of the pits will result in new aquatic habitats for these species. Aquatic habitats dewatered to create the tailing storage facility at Second Portage Lake will be permanently lost to waterfowl.

Other Breeding Birds (Construction, Operation, Closure)

An anticipated 382 ha (4.1% of total LSA area) or 8.4% of high suitability habitat is expected to be lost due to mine development activities (see Appendix D). On an ELC unit basis, loss of high suitability habitats includes 51 ha of Birch Seep, 270 ha of Heath Tundra, 8 ha of Riparian Shrub and 53 ha of Sedge. On an other-breeding-bird-specific LSA basis (i.e., 500 m radius or 78.5 ha), the 382 ha of high suitability habitat lost due to mine development represents an impact of high magnitude and significance to local nesting populations of breeding birds. On another-breeding-bird-specific RSA basis (i.e., 5 km radius or 7,850 ha), the 382 ha of lost high suitability habitat represents approximately 4.9% of the other-breeding-bird RSA, an impact considered to be of low magnitude and significance.

Most of the direct habitat losses for breeding birds caused by the mine development will occur during **construction and operation** of the plant site (footprint), dikes, dewatering facilities, waste dump, airstrip, pits, and main roads, causing a loss and disturbance of terrestrial and aquatic roosting, foraging, and nesting habitats. Densities of breeding bird species observed during the June 2003 breeding bird surveys indicate that the loss of a total of 522 ha of ELC vegetation communities will displace approximately 250 to 270 (1 pair per 2 ha) pairs of Lapland longspurs, 40 to 60 (1 pair per 10 ha) pairs of horned larks, 4 to 6 (1 pair per 104 ha) pairs of American pipits, 10 to 20 (1 pair per 35 ha) pairs of rock ptarmigan, 5 to 10 pairs of semipalmated sandpipers, and minor numbers of other passerine species. Since the habitats for these species are widespread within the LSA and RSA, the effects on the total regional populations can be expected to be minimal.

Apart from the direct loss of habitats due to alteration of terrain and vegetation, noise and activity during construction will result in the displacement and disruption of other breeding birds and will reduce the effectiveness of their habitats. Disturbance of nesting birds can result in increased energy expenditures and stress levels, and possibly reduced reproductive success and subsequent survival of young. Ptarmigan, however, are often quite tolerant of human presence and several pairs were observed in the vicinity of the Meadowbank Camp in June 2003. When sitting on a clutch of eggs, they can be very “broody,” often allowing humans to approach extremely close to the nest (pers. obs.). Nevertheless, they may exhibit startle and flight responses to sudden noises (e.g., from blasting or low-flying aircraft). They may also avoid areas of frequent, intense, or prolonged disturbances.

Aircraft traffic poses a collision hazard to all bird species, particularly in the vicinity of the airstrip. However, this hazard is deemed to be moderate, infrequent, of short duration, and of potentially minor impact to birds. Some bird mortality may occur in summer through collisions with ground vehicles but such incidents are expected to be infrequent, involving few individual birds, and therefore of minor impact to local bird populations.

Mine construction and operation can result in indirect impacts to breeding bird species. Plant health and bird forage can be affected by fugitive dust deposition associated with mining activities, road use, and maintenance. These activities can lead to reduced plant photosynthesis and reproduction, retarded growth, and altered respiration processes. Fugitive dust deposition can also lead to early snowmelt and changes in plant phenology, resulting in early flowering in some plant species. Although this may provide earlier foraging and nesting opportunities for breeding birds, dust deposition on vegetation may have a negative effect on the birds, in that berry-producing species may be reduced. Early green-up in the vicinity of roads may attract species such as ptarmigan, increasing the likelihood of collisions with vehicles. The impacts of fugitive dust will mainly occur downwind of operations. As the prevailing winds in the region are from the northwest, the major impacts of dust deposition will generally be on plant communities to the southeast of the facilities or other source of dust disturbance. The effects of mine-generated dust on the productivity of vegetation communities, and consequently bird populations, is not expected to be significant.

Much of the anticipated habitat loss for other breeding birds will have already occurred by the operation phase. There will continue to be a disruption of birds occurring in the immediate vicinity of project facilities as a result of construction noises, blasting, operations, vehicle traffic, and machinery. Both camps (north and south) will be removed and the habitats reclaimed. This will mean an increase in 2.5 ha of potential roosting, nesting, and foraging habitat.

During **closure and post-closure**, the cessation of traffic and reclamation of roads will increase the availability of foraging and roosting habitats. Passerines and ptarmigan may be attracted to reclaimed road bed areas for roosting, foraging, and possibly nesting (once vegetation has become reestablished). In doing so, they risk increased exposure to contaminants in road materials. This risk is, however, expected to be minimal but will be monitored. The removal and habitat reclamation of the fuel storage facilities at the plant site will reduce contaminant levels of the receiving environment in the vicinity of the discharge point.

4.21.2.8 Aquatic Organisms & Habitats

Construction & Operation

There are no rare or sensitive species within the project lakes that will be adversely affected by the proposed mine development. To protect fish populations during mine construction and operation, Cumberland is proposing a “No Fishing” policy for all non-resident workers. Based on sustainable harvest rates for the project lakes, fishing by aboriginal people will not result in a reduction in fish population status.

Potential impacts to aquatic organisms and habitats arise from changes to water quality, water quantity, and habitat loss. Project components and activities with the potential to have the greatest impact, as assessed in the impact matrices, are: (1) dikes, (2) loss of a channel connecting between the Portage lakes, (3) pit dewatering, (4) pit development, (5) noise and blasting, (6) effluent discharge, and (7) rock storage facilities. These are discussed below.

1. *Dikes* – Dikes considered include the East, Bay Zone, Goose Island, and Vault dikes. The cumulative direct loss of habitat as a result of dike footprints is 0.6% in Third Portage Lake, 1.9% in Second Portage Lake, and 0.1% in Wally Lake. The surface area of dike faces is very small relative to lake area and will have insignificant impact on lake productivity. Dike faces will be designed to provide high-value habitat for fish and will remain in place after mine closure as permanent features. Compensation of dike footprint areas is considered as part of the no-net-loss (NNL) habitat compensation plan. Residual impacts from dike construction and operation are low in magnitude, local in extent, of short duration, and infrequent. Residual adverse effects are not significant.
2. *Portage lakes connecting channel* – One of three channels connecting Third Portage and Second Portage lakes will be eliminated by dike construction and operation, impairing fish movements. An existing channel will be enhanced to facilitate water movement and to improve fish passage between the lakes. Residual impact on fish is low in magnitude, local in extent, of short duration, and frequent. Residual adverse effects are not significant.
3. *Pit dewatering* – Dewatering of Second Portage pit will result in a loss of fish habitat within Second Portage Lake that is addressed as part of the NNL plan for the project. Discharge of water into Third Portage Lake north basin may cause a temporary increase in lake elevation of 20 to 30 cm and will increase flow from Third Portage Lake to Second Portage Lake via the remediated

channel. Because water levels are being increased and not decreased, no adverse impacts on fish habitat or fish populations are anticipated. Fish will be salvaged prior to dewatering.

Residual impacts to fish habitat and fish populations from dewatering of Portage, Bay Zone, Goose Island and Vault pits is low in magnitude, local in extent, of short duration, and infrequent. Residual adverse effects are not significant.

4. *Pit Development* – Operation of the Portage and Vault pits will result in the loss of productive habitat in Second Portage and Vault lakes during the life of the mine. The tailings storage area will be a permanent feature of Second Portage Lake. Although loss of habitat and fish biomass can be compensated through onsite (at post-closure) the temporary residual magnitude of impact to habitat and fish populations in Second Portage and Vault lakes during mine operation is high. The spatial extent of impacts on fish habitat and fish population in Second Portage Lake is local, of medium- (fish populations) to long-term (habitat) in duration, and will occur frequently. The residual effect is of local, but not regional, significance; and is short-term, because upon closure fish will be introduced into the new habitat. Spatial extent of habitat loss in Third Portage Lake is small relative to lake area and residual adverse effects are not significant. More detail about habitat loss in Third Portage Lake is considered within NNL habitat compensation.
5. *Noise & Blasting* – Analysis of the construction and operation blast design indicated that impacts to fish from excessive peak particle velocity (13 mm/s PPV) and overpressure (100 kPa) will not occur and will meet the FAO Canada guidelines. Therefore, residual effects related to blasting will be low in magnitude, local in extent, of medium duration, and will occur frequently. Residual effects are not significant.
6. *Effluent Discharge* – No treatment is required for effluent discharged from Vault Lake attenuation pond to Wally/Drilltrail lakes since water quality is not predicted to exceed CCME (2001) criteria. Environmental Effects Monitoring under MMER will be implemented in Wally/Drilltrail lakes to ensure that adverse impacts are detected and mitigation undertaken if necessary. During operation, the quality of effluent discharged from Second Portage attenuation pond to Third Portage Lake is predicted to be well within MMER concentrations for conventional parameters, metals, and cyanide. An EEM program will be implemented in Third Portage Lake as part of a larger, more comprehensive program to monitor water quality, plankton, benthos, and fish populations (see Aquatic Effects Monitoring Plan). Until more accurate modelling of receiving environment water quality is conducted, there is a moderate potential for exceedances of CCME guidelines for aquatic life protection in Third Portage Lake and possibly Second Portage Lake during latter stages of mine life.
7. *Rock Storage Facilities* – Storage of waste rock on largely upland, terrestrial habitat will result in the elimination of several small fishless ponds and a small pond (9.5 ha) that contains lake trout.

The impact assessment considers fish habitat loss as well as possible impacts from runoff of low pH, metals-contaminated water. All contact water will be captured and directed to the reclaim pond prior to treatment.

Residual impacts of generic activities (for which there are proven mitigation and engineered solutions) include water intake, haulage route operation, marine barge landing and marine traffic, Turn Lake road crossing, and mine site infrastructure. These are not considered significant.

Closure & Post-Closure

Several mine components, such as dikes, pits, and tailings / rock storage facilities, could have impacts on the aquatic environment during the closure and post-closure phase. These are described below.

Dikes – Dike design takes into consideration the possible locations and types of flood control structures that may be required to ensure long-term stability. Dewatering dikes will remain intact during the controlled flooding of both Portage and Vault pit areas in order to isolate flooded pit waters from surrounding lakes. Oxidation of exposed dike (pit) walls over a period of several years during gradual filling will allow oxidized rock to come in contact with pit waters and cause an increase in dissolved metals concentrations and lower pH within the pit waters. It is expected that the initial water will exceeded CCME guidelines, but will improve over time. Thus, dikes and pit walls will be a potential source of acid and metals to local waters at post-closure.

The Second Portage East dike will remain, preserving the 1 m difference in elevation between Third Portage and Second Portage lakes and creating habitat on the interior of the East dike. Similarly, the Portage Tailings dike will remain to contain the stored mine tailings and will be enhanced to provide fish habitat along its outer slope. The remaining portions of Bay Zone and Goose Island dikes will provide fish habitat along both interior and exterior walls.

The new habitat created along dike walls will be of greater surface area and equal or greater quality (coarse substrate providing shelter, and varying depth available along wall from pit ledges) relative to current pre-mine conditions; however, in the short-term, this will be offset by elevated concentrations of dissolved metals and low pH that could impair colonization by periphyton and benthos and incubation survival of fish eggs. Adverse effects would be expected to be limited to the initial period of pit/lake mixing, as oxidized materials will gradually be diluted, with no new oxidation because of flooded conditions. Metals toxicity will diminish rapidly over time, probably within a few years, resulting in no net loss of productivity over the long term. Given the absence of food resources within the newly flooded pits, fish would initially avoid the dike/pit areas, preferring to stay in Wally or Third Portage lakes. Colonization of dike walls by periphyton and benthos may be impaired for several years following flooding. Also, because of their depth, the flooded pits will not provide productive habitat for fish over the long term, except for overwintering.

Residual effects related to dikes during post-closure are of low magnitude, are local in extent, of permanent duration, and occur frequently. Residual effects are not significant in either case and certainty of this prediction is high. The net change in habitat quantity and quality relative to pre-mining conditions in Third Portage Lake is negligible. The net increase in surface area and volume of the lake and habitat conditions created along the dike walls is partly offset by the deep, unproductive habitat of the flooded pits.

Pits – There are two issues considered in the post-closure environment: impacts to fish habitat and fish populations as a result of flooding and mixing of pit waters with waters in adjacent lakes, and changes to fish habitat in Second and Third Portage lakes and Vault Lake relative to pre-mine conditions.

Instantaneous breaching of the dike would cause significant drawdown of Third Portage Lake, which would have an unacceptable effect on fish habitat. Therefore, flooding will be accomplished through a combination of seepage, precipitation, and some re-direction of spring freshet flows from Third Portage Lake. The rate of flooding will be controlled by engineered structures incorporated into the detailed design of the dikes that may include spillway structures or side decant structures.

The Vault pit will be flooded during the closure period over a period of about six years, and will become part of Vault Lake. The dike between Vault Lake and Wally Lake will be removed. In the same manner as for the Portage open pits, the dike will only be removed when it is acceptable for water in Vault Lake to mix with Wally Lake.

As discussed previously, oxidation of rock walls over several years could lead to possible acidification and elevated dissolved metals concentrations in pit waters immediately after flooding. The dikes will not be breached until the water quality meets MMER guidelines. Given that there are no fish present, and periphyton and benthos have not recolonized the flooded pits, no impacts to fish or fish habitat within the pits will occur. Monitoring will be undertaken to determine water quality in the pits prior to decommissioning.

The residual impacts to fish and habitat in the Portage and Vault pits in the post-closure environment are of low magnitude, local extent, of short (fish) to medium (habitat) duration, and may occur frequently. Pit water quality is expected to improve relatively quickly, given the low oxidation potential post-flooding, and should not pose significant risks in the medium-term. Algae, periphyton, benthos, zooplankton, and communities of fish will recolonize pit areas over time. Residual effects are not significant and certainty of this prediction is medium.

With respect to change in fish habitat in project lakes, there will be a net gain in habitat in Third Portage Lake and a net loss in Second Portage Lake, partly as a result of the exchange of lake areas between the two lakes, and because of habitat loss as a result of tailings disposal.

After flooding of pits and decommissioning of the southern end of Goose Island dike, 92 ha, or 2.5% of lake area impounded by the Goose Island dike will be returned to Third Portage Lake. With the exception of shorelines and dike surface area, much of this habitat will be of low quality because of the great depth of the Goose pit. Additional area will be gained from the peninsula of land that used to separate Second Portage Lake from Third Portage Lake, which will have become part of the Portage pit. Finally, 41.5 ha of lake area between the tailings dike and the East dike, formerly part of Second Portage Lake, will become part of Third Portage Lake, plus an additional 10 to 15 ha north of the original lake boundary that is part of the North Portage pit. The incremental gain in surface area of Third Portage Lake, relative to pre-mine conditions is approximately 120 ha, which is more than 3% of the original lake area; however, given the deep depth of the pits, the gain in area is offset by the relatively poor-quality habitat of the lake bottom and lack of littoral zone habitat. The additional volume (combined volume of North Portage, Portage and Goose pits) gained is approximately 35.9 Mm^3;

minus the original dewatering volume within Goose Island (2.6 Mm^3), this represents a 14.6% increase in volume relative to the pre-mine lake volume estimate (228 Mm^3).

The total area of moderate and high value habitat created on site during mine operation is 15.6 ha; this does not account for possible benefits to Arctic char by facilitating access between Second and Third Portage lakes. At post-closure, a considerable amount of habitat can be recovered within Third Portage Lake from the original lake area impounded as well as former land area between the Portage and Goose Island pits. With the exception of the pits, creating reef, shoal, and platform habitat of ideal substrate type, slope, complexity, and depth to provide spawning/nursery, rearing, and feeding habitat for fish can enhance this habitat.

Total moderate and high-value habitat created at post-closure is approximately 197.9 ha. Combined with operational habitat area, which will continue through post-closure, the total amount of residual moderate and high-value habitat created is 213.5 ha, which exceeds the total habitat areas lost (175.4 ha) from development of the Second Portage pit and tailings disposal facility (39.4 ha), Goose Island pit (62.0 ha) and the Vault pit (74 ha). The main reason for the overall gain in habitat value is that formerly low value habitat in Second Portage and Third Portage lakes and terrestrial areas (Goose Island, other small islands, peninsula separating the Portage lakes) will become high value aquatic habitat.

Although there will be an outstanding habitat deficit during operation, a net gain in habitat at post-closure will, over time, offset the net loss during mine operation. Re-flooding of Vault Lake and pit will significantly increase the area and volume of this lake. Pit walls and former shorelines will be contoured and designed to provide high value habitat for fish to several meters depth. There is currently very little deep, overwintering habitat in Vault and Wally lakes, so creation of deep water habitat may be viewed as positive.

Residual impacts on fish habitat and populations in the Portage lakes and Vault Lake are low in magnitude, local in extent, and permanent in duration. More habitat will be gained in Third Portage Lake than is lost within Second Portage Lake. Residual, long-term (i.e., post-closure) impacts are not significant and certainty of this is high.

Second Portage tailings facility – All mine tailings will be stored at this facility permanently, representing a loss of fish habitat equivalent to the area of the tailings pond (93 ha), or 24% of the area and 46% of the volume of Second Portage Lake. Implications of this habitat loss are described in the subsection above. During the latter half of mine operation, closing of the tailings storage pond starting at the east end will be done using waste rock materials covered by a minimum of 2 m (thermal active layer of permafrost) of ultramafic rock, which generates only small amounts of acid and has low potential for metal leaching. Capping is expected to be completed by 2017. This action is necessary to ensure that all tailings materials eventually become frozen as part of the permafrost layer and are isolated from groundwater and from surface waters.

Notwithstanding habitat loss, the potential for leaching of dissolved metals and acids into Third Portage Lake from the tailings facility is low in magnitude, local in extent, of permanent duration, and occurs infrequently. Residual effects are not significant for either fish or habitat. Capping using non-metal leaching ultramafic rock and freezing by permafrost should result in complete mitigation. Certainty of this prediction is moderate.

Vault & Portage rock storage facilities – By post-closure, Vault rock storage facility will cover an area of 191 ha, and will be composed of 28 Mm^3 of non-PAG intermediate volcanic rock. It is expected that permafrost will gradually creep into the rock storage facility and reduce infiltration and oxidation of rock. Leachate will be monitored during post-closure to ensure that water quality of surface waters of Vault and Phaser lakes are not impaired. It is anticipated that capping of the Vault rock storage facility will not require capping with non-PAG ultramafic rock.

Residual effects on fish and habitat related to leaching of contaminants from Vault rock storage facility are of low magnitude, local in extent, of permanent duration, and occur infrequently. Residual effects are not significant in either case and certainty of this prediction is moderate.

4.21.3 Biological Diversity

Although the project will have localized effects on vegetation communities and associated wildlife species, the population viability of all species currently located in the LSA is not expected to be impaired. No local extirpations or local changes in biodiversity are expected because: (1) the project footprint is relatively small; (2) all species found within the LSA that may be impacted by the project are also widespread in the RSA; (3) no critical habitat for rare and endangered species or species of management concern has been documented; and (4) a comprehensive management plan will ensure that any impacts to local plant and animal species are minimized. Biodiversity and richness of local and regional flora and fauna will be maintained.

4.21.4 Social, Economic & Cultural Components

Baker Lake is the primary area of positive impacts. It is the closest community to the project site, and will receive preference for employment and business opportunities. Some benefits will also accrue to individuals and business elsewhere in Kivalliq Region and Nunavut.

4.21.4.1 Identification of Valued Socioeconomic Components (VSECs)

With the identification of key issues by the community of Baker Lake and other project stakeholders, and with understanding of socioeconomic status from baseline studies, it is possible to derive project-specific VSECs, as follows: employment, training, and business opportunities; traditional ways of life; individual and community wellness; infrastructure and social services; and sites of heritage significance. In addition, it is possible to identify two VSECs at the regional/territorial level: employment, training, and business opportunities; and fiscal benefits to the territorial government

4.21.4.2 Socioeconomic Impact Assessment Methodology

The methodology to determine socioeconomic impacts largely drew from the wealth of traditional knowledge available to Cumberland through public meetings, workshops, discussions with Elders, site visits, interviews, and the community liaison office established in Baker Lake. While determination of socioeconomic impact significance broadly follows the methodology used for environmental impacts, there are important differences that are more fully described in the Socioeconomic Impact Assessment. These differences are summarized briefly below:

- direction (positive or negative) is an important attribute to include, as many socioeconomic impacts are in fact benefits

- reversibility does not often apply—there are few means to reverse social change that occurs as a result of a project
- socioeconomic impacts do not occur in a vacuum, but interact with an already evolving social context, thus can be unpredictable even in their direction—thus are often discussed in terms of potential rather than probability
- unpredictability often forces a more qualitative approach to assessing the significance of socioeconomic impacts
- regardless of measures that may be put in place to create conditions and opportunities for benefit, individuals and communities remain free to make choices. Poor choices can be made, people may choose not to participate, and/or other realities may intrude such that outcomes are not as foreseen.

Before construction of the proposed mine begins, an Inuit Impact Benefits Agreement (IIBA) will be negotiated with the Kivalliq Inuit Association (KIA) because the proposed mine project is on Inuit-owned Lands. Currently, Cumberland has a benefit agreement to accompany the exploration land lease. This agreement focuses on jobs, training, local hiring programs, and community liaison.

4.21.4.3 Impacts on Employment, Training & Business

Cumberland intends to extend employment and business opportunities to the Hamlet of Baker Lake, and secondarily to other communities in Kivalliq Region, consistent with principles of cost effective, efficient, and safe operations. Cumberland will also assist the Hamlet and other communities in taking advantage of these opportunities. Finally, Cumberland will take into consideration the extent to which its suppliers and subcontractors employ and contract Kivalliq Region labour and businesses. These measures are more fully described in the Socioeconomic Impact Assessment.

Project Expenditures

Eventual employment and business impacts will depend on the success of these measures. Previous experience, through the exploration and feasibility phases of the project from 1995 to 2003, saw 23% of total expenditures spent within Nunavut (see Table 4-22). Most hiring was in Baker Lake, but business benefits were widely spread in Kivalliq Region.

Table 4-22: Meadowbank Gold Project, Cumulative Local Expenditures

Activity	*2003*	*1995 - 2002*
Local Persons Employed	*33*	*3 - 30*
Wages	$ 262,000	$650,633
Expediting and Transport	$ 693,663	$1,573,502
Fuel	$ 372,593	$1,139,191
Equipment	$85,087	$252,476
Food and Accommodation	$ 275,572	$785,263
Construction		$22,500
Drilling	$ 286,675	$27,108
Aircraft		$152,483
Community		$ -
Environment	$ 250,000	$227,743
Other	$73,384	$53,130
Total (Kivalliq)	$2,298,974	$4,884,019
Total (Program)	$7,650,000	$22,877,372
Cumulative(Kivalliq)	$7,182,993	
Cumulative(Program)	$30,527,372	

If a similar trend were met over the lifetime of the project, there would be a total expenditure in Nunavut of over $300 M. This figure is made up of about $76 M during the 18 month construction phase, $23 M per year over a ten year operation phase, and a further $3 M over the closure phase. Such numbers should be interpreted with caution. For example, there is some possibility that during the construction phase—with large capital expenditures outside the territory—that a 25% target for local expenditures may not be achieved. On the other hand, over time, as a result of increasing experience of labour and business with the project, Cumberland should be able to significantly exceed a 25% target.

As project expenditures are comparatively large relative to the size of the regional and territorial economies, the impact is considered of medium magnitude, positive, long term and of moderate significance.

Employment

Over the construction period, labour force requirements will vary but peak at 350. It is conditionally estimated that in the order of 15% to 20% of these jobs will require unspecialized skills (representing up to 90 jobs at peak). The workforce requirement for the operation phase is estimated at 250, and the demand for less skilled people will likely peak at about 60. Semi-skilled and skilled workers would also of course be offered employment. Taking into consideration that labour force participation rates are likely to rise in the event of improved employment opportunities, Baker Lake should be able to supply the largest fraction of these jobs.

The potential impacts of employment are likely to take some time to gain full momentum, and overall are considered of high magnitude, positive, long term and of high significance, specifically to those individuals and their families who are able to benefit.

Business Opportunities

The Conference Board of Canada (CBoC, 2001) and the territorial government (SEDS Group, 2003) have noted at length the challenges to businesses in Nunavut. The overall result is that there are not many businesses, they tend to be small and have high costs, and most are essentially catering to consumption needs of residents. Cumberland has worked with businesses in Baker Lake and elsewhere in Kivalliq Region over the exploration phase of the project, with some success. With continuing preferential contracting, local business participation in the project is expected to grow with time.

In addition to direct employment and business opportunities; however, indirect employment benefits and induced employment and business should also be considered. Businesses contracted to supply the project will require new employees. As well, with increasing direct and indirect local economic activity, individuals and businesses will be spending increasing incomes on local goods and services. This in turn will induce more employment, and perhaps more small businesses, as people in the community organize to provide additional goods and services demanded by others with new disposable income.

The potential impacts of business expansion and creation are likely to take some time to gain momentum, but overall are considered as of high magnitude, positive, long term and of high significance, particularly to those individuals and their families who are able to benefit. The

impacts at the community level, of moderate significance, are most likely to be seen in Baker Lake and Rankin Inlet, but some stimulus to business will be felt across the region.

Job Training

It is Cumberland's policy, as exemplified to date over the exploration and feasibility phases of the project, to provide on-the-job training to employees. Such training is intended both to improve skills towards improved job performance and promotion and towards broadening the skill base of employees such that new or strengthened skills can be applied elsewhere in the economy. Beyond on-the-job training, however, the IIBA negotiations between Cumberland and KIA will address the need for a broader based project education and training strategy to provide assistance to those who wish to develop skills that will position them for project employment. This education and training strategy will also include an element to address motivational issues around getting children through high school. Such measures would be intended to contribute to encouraging a commitment to education on the part of youth.

The potential impacts of education and training to the labour force are considered of medium magnitude, positive, long term and of high significance, specifically to those individuals and their families who are able to benefit.

Increased Income

With the potential to employ 60 to 90 individuals directly over the construction and operation phases, the direct project wages paid to people in Kivalliq Region, primarily Baker Lake, could exceed $3 M annually. With additional induced employment creation, the expectation is that the increase in total wages paid in the community will be greater.

Increased income is associated with increased individual and household wellness. There is thus potential for improved quality of life for the individuals and their families who are able to find employment with the project or with businesses that supply the project or elsewhere in the growing local economy.

The potential impacts of increased income are considered of high magnitude, positive, long term and of high significance, particularly to those individuals and their families who are able to benefit. It is expected that overall community effects, moderate in significance, are likely to be most experienced in Baker Lake, as most direct employment will occur here.

Project Closure

The closure phase of the project is projected to last over a two year period, and the post-closure phase for up to 25 years. Expenditures during closure for labour, goods, and services will be much reduced as compared to the operation phase, although reclamation activities can be more labour intensive. Further, at the end of the two-year closure phase, all expenditures, with the possible exception of very limited employment related to environmental monitoring during post-closure, will come to an end. It is also to be noted that project viability depends most importantly on the price of gold. Should this price drop significantly over the life of the project, or should other unforeseen events happen, temporary or long-term closure could occur.

Closure is the economic bust that is inherent in non-renewable resource extraction and can produce a reversal of positive economic and social benefits. This is considered a negative impact, of high magnitude particularly in Baker Lake, long term and of high significance.

4.21.4.4 Impacts on Traditional Ways of Life

The social, cultural, and economic importance of traditional ways of life to overall quality of life is fundamental and as such guides not only the content of government policy, planning, and service delivery, but also the mechanisms for developing and implementing policy.

The project has both positive and negative potential to change the patterns of traditional ways of life. The project will not significantly restrict access to or productivity of lands used for traditional activity. More indirect effects, however, are possible. There is concern that wage employment is a disincentive to traditional activity and that on-the-job cross-cultural contact may result in undervaluing of traditional ways of life. Cumberland’s human resource policies, training programs, and codes of conduct for workers emphasize cross-cultural mutual respect, understanding, and trust, and provide incentive and opportunity for Inuit employees to engage in traditional ways of life.

At the community level, the mine site is located far from Baker Lake, and its out-of-area workers will be housed in workers' camps, rotated out to their own (northern and non-northern) communities on various schedules. Keeping out-of-area employees away from local communities minimizes cross-cultural contact, but there will nevertheless be an increase in contact in Baker Lake, largely associated with transportation activities.

There is potential for both negative and positive impacts, of any magnitude, on traditional ways of life, which could be of high significance. Any net impact, since it would be an impact of cultural change, would be long term and continue beyond the life of the project. The impact would be experienced primarily in Baker Lake.

4.21.4.5 Impacts on Individual & Community Wellness

Potential impacts on individual and community wellness are complex, far reaching, and given human nature, difficult to predict with certainty. Individual and community wellness is intimately associated with potential impacts on traditional ways of life as discussed above. In addition, however, individual decisions on the use of increased income, household management in relation to rotational employment, migration, public health and safety, disturbance particularly during the construction phase, and Cumberland's support for community initiatives as will be negotiated in the IIBA are the other drivers that have the potential to effect individual and community wellness.

Increased Income

In addition to the expected positive benefits of increasing income, as this is related to improvements in a range of socioeconomic parameters, there are also potential downsides, experienced at the individual, household, and community levels. Essential to realizing the positive benefits of increased income is the capacity to manage that income in the interests of the household. Income that is not spent wisely does not generate the hoped for quality of life improvements.

There are concerns about the association between increased disposable income and poor choices, such as increased use of drugs and alcohol, or inappropriate sexual activity. It is possible not only to spend income unwisely such that potential benefits are not achieved, but to spend it in ways that cause actual disbenefit. Such disbenefits harm individuals and their families, and are a source of negative behaviour that harms the community as a whole.

A further concern is that steady employment and wages for some but not others in the community will contribute to income inequity, which in turn may contribute to social problems such as increases in crime and social conflict. The erosion of traditional values, such as cooperation and sharing, can also at least theoretically be linked to increasing inequity.

To better manage the effects of increased income and ensure that benefits are maximized and negative impacts minimized, Cumberland will put in place an employee assistance program to provide the full range of services to its employees and their families. Careful management of its workforce, specifically zero tolerance for drugs and alcohol and measures to support traditional ways, will also mitigate potential negative impacts of increased income.

Potential for Contamination in Traditional Food

Based on information gathered through traditional knowledge and baseline studies, the Meadowbank area is not often for hunting and fishing. The potential for mine activities to contaminate the food chain—specifically fish and caribou—is minimal. However, because of importance of the *precautionary principle* and a commitment to protecting human health, in addition to mitigation activities, vegetation, water quality and fish health will also be monitored to ensure that fish, caribou, and other traditional foods are not affected by mining activities.

Rotational Employment

Much has been written on the potential impacts of rotational employment on the families and communities of employees. The positive impacts include reduced cross-cultural contact within communities, time and resources for traditional ways of life, and workforce discipline while on-the-job contributing to long-term capacity building. Negative impacts can include family stress, family conflict between generations and spouses, breakdown of traditional values of sharing and mutual support, undervaluing of traditional ways of life, and increased substance abuse. Baker Lake residents are also concerned that housing workers at a camp, especially female workers, can create opportunities for sexual abuse.

Many of these negative impacts are similar in nature to those generated by increased income, and depend not only on project organization but also on individual decisions and choices. They are therefore also influenced by mitigation measures described above. As well, much has been learned about best practice for workers' camps and rotational employment over the last twenty years in the north. Cumberland will apply this best practice, including protection for female workers, short rotational schedules, and transportation arrangements that return employees directly to the point of hire communities.

The impacts of rotational employment at the individual, household and community level are unpredictable, and of unknown magnitude, but potentially both positive and negative, medium term and could be of high significance, particularly at the individual level.

Migration

The mine site is remote from the community of Baker Lake, and will provide all workers at site with accommodation, meals, recreational facilities, social services, and transport in and out of their point of hire communities. The project will thus not involve the migration or movement into Baker Lake of workers themselves, with the possible exception of a very few out-of-area employees engaged at transport and storage facilities in the town.

Migration has some potential to occur as a result of members of Baker Lake resident families returning in the hope of employment at home and/or as a result of the economic pull such a project exerts as people try to move to the area to take advantage of indirect and induced economic benefits of the project. The return of family members, particularly those who are individuals who left only to find employment elsewhere, can be of great benefit to family welfare. They may, however, compete for and get jobs that would therefore be denied to present residents, place additional demands on social service delivery, and put pressure on local supplies of goods and services (particularly housing).

The potential impacts of migration are complex, and are likely to have both positive and negative components, but of low magnitude. Any effects of migration are long term but are likely to be low significance. It is not likely that migration to any other community than Baker Lake would be significant.

Health & Safety

It is of concern to the people of Baker Lake that out-of-area workers may pose a threat to public health and safety. There is an association between mining camps largely filled with men on single status and/or with increased income and such public health concerns as increased rates of sexual abuse, teenage pregnancy, single parenthood, sexually transmitted disease, substance abuse and crime. It is this association that guides best practices in managing the behaviour of workers living in camps in proximity to small communities.

Health and safety of workers and the population at large is subject to legislation and perhaps more importantly to best practices. Health and safety training also has applications in personal life – workers often not only use new health and safety training on-the-job, but also at home in the course of daily tasks.

The potential public health and safety potential impacts of the project, of unknown magnitude, are negative, and, because there is such high impact at the individual level in the event that a risk is realized, the effects must be considered long term and of high significance.

Community Wellness

There is an expectation that, particularly since the largest part of mining project royalties are paid to the federal government rather than the territory directly, that a project such as this one provide benefits to most directly affected populations in addition to job creation and business opportunities. The NLCA and Terms of Reference for the Meadowbank EIS suggest expectations that project proponents work with local communities to identify contributions to community wellness. An additional factor to consider is that there are potential negative impacts on individuals and communities that can neither be clearly identified nor directly mitigated, for example: effects on traditional ways of life or effects of poor choices with respect to increased individual income, as discussed above. Support for community initiatives is therefore considered to be the means through which to enhance the net local benefit of the project.

To the extent that during IIBA negotiations Cumberland and the KIA agree on a program for Cumberland contributions to community initiatives, there will be positive impacts on community wellness, probably of medium magnitude, but potentially long term and of high significance.

4.21.4.6 Impacts on Infrastructure & Social Services

Negative infrastructure effects are largely related to any project demands on physical infrastructure such as roads, other transportation facilities, telecommunications, and utilities. Social services effects can result from increased demands on health, policing, education and housing services by new populations (workers and migrants) or on health and policing services particularly as a consequence of effects on individual and community wellness. Recent rapid population growth has had particularly negative effects on the availability of housing, with consequent negative impacts on wellness. The concern with respect to such impacts is social service delivery to the local community will suffer in response to an increase demand that cannot be met, contributing to a vicious circle of more social problems and yet further increased demand. This in turn can imply that government will incur additional costs in increasing infrastructure and social services.

Meeting the operational needs of the project and the needs of large out-of-area workforces is part of the response to limiting pressures on the delivery of goods and services. Cumberland will ensure that its power, communications, transport and other operational needs do not depend on local facilities to the extent that this is possible, and that such local facilities that are used, for example local roads and the airport, are paid for and/or maintained as will be agreed in the IIBA. Food and accommodation, recreation facilities, physical and mental health services and other goods and services as may be identified as necessary will be provided to the mining operation independently of what is now available in Baker Lake, which is in any case too far away to be accessed regularly by the mine workforce.

However, there are also potential positive effects on infrastructure and social services. The construction of the haulage route between Baker Lake and the mine site will increase ease of travel to lands north of the mine site used for traditional activity. Long-term benefits may be realized to the tourist industry through project infrastructure left behind after closure. Increased employment and business opportunities will result in increased income, a measure of economic security, capacity building that will contribute to employability over the long term, and improved self-image of employees and their families. This could result in reducing dependence on government social services.

The balance between negative and positive impacts on social services delivery is difficult to predict, although the expectation is that positive impacts will gain momentum over the project life. There is potential for undoing some of this positive impact at the time of closure.

The impacts on social services and infrastructure, of low to medium magnitude, are considered largely positive in the medium term and of moderate significance. There is some potential for closure to have a negative impact on social service delivery.

4.21.4.7 Impacts on Sites of Heritage Significance

Project design was adjusted to the extent practicable to ensure that heritage resources sites are away from planned infrastructure. There are still a few recent use sites that fall within the boundaries of the project zone. In these cases, steps for further investigation, protecting, and/or mitigating the sites will be discussed and agreed with the community of Baker Lake, the chief archaeologist for Nunavut, and the Department of Culture, Language, Education, and Youth (CLEY).

Should additional sites be identified during construction, construction will be stopped and CLEY and the Hamlet of Baker Lake will be advised. Until such time as an evaluation of the site can be completed by a qualified archaeologist and the appropriate decisions (e.g., avoidance of the site or mitigation) discussed and implemented, restarting construction in the immediate area of the heritage resource would be postponed.

The impacts on heritage resources, of low magnitude, are negative except insofar as the identification and description of sites contributes to knowledge of heritage resources in Nunavut. The impacts are considered to be of low significance.

4.21.4.8 Impacts on the Economies of Nunavut & Canada

To estimate the economic impacts of the project on Nunavut and Canada as a whole, an input-output simulation was run by Statistics Canada. Summary results for Nunavut and for Canada are presented in Table 4-23.

For the construction phase, the increase to Nunavut GDP, prorated to one year from 18 months, is in the order of 7% to 8%. Total employment created in Nunavut represents approximately two jobs for every directly employed construction worker; however, it must be remembered the largest fraction of these would be out-of-area workers rather than permanent residents of Nunavut. Fiscal benefits to the Government of Nunavut are also large relative to its tax base.

Table 4-23: Input-Output Interprovincial Model Summary Results

Parameter	Construction $303 M/18 months		Operations $92 M/year	
	Nunavut	Canada	Nunavut	Canada
Impact on GDP (market prices, $000)	120,333	233,813	35,451	63,780
Total Labour Income ($000)	76,651	149,584	27,010	43,745
Total Employment (person years)	1,008	2,584	303	700
Indirect Taxes on Production & Products (minus subsidies, $000)	2,088	5,688	1,168	2,331
Total Output ($000)	349,377	585,208	102,745	167,635
Output Multiplier	1.15	1.93	1.12	1.82

Source: Statistics Canada.

Regarding job creation, 80% of the over 1,000 person-years of employment the model predicts for Nunavut during the construction phase would be in the mining and construction sectors. However, the model also predicts job creation in the following sectors in order of magnitude: (i) finance, insurance, real estate, and renting and leasing; (ii) scientific and technical services; (iii) government sector; (iv) wholesale trade; and (v) transportation and warehousing.

Operation phase economic impacts are lower on an annual basis, but would accumulate over a ten year period. The most significant difference is that whereas construction creates much indirect employment, operation does not. The total increase in employment of 303 represents only about 0.2 jobs created for each directly employed operations worker.

The economic impacts on the economy of Nunavut, of high magnitude, are positive over the medium term and of high significance, particularly during the construction phase. The economic impacts on the economy of Canada, primarily centered in Alberta, Ontario, and Quebec, are of low magnitude relative to the size of the Canadian economy, medium term and of low significance.

4.21.5 Impacts of the Environment on the Project

4.21.5.1 Seismicity

No impacts. See Section 4.20.2.1 for details.

4.21.5.2 Terrain Stability Summary

No impacts. See Section 4.20.2.1 for details.

4.21.5.3 Climate Change (Global Warming)

A report entitled, “Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure” (BGC, 2003) suggests that globally the average temperature may increase by about 2°C by 2100 due to global warming. The increase may be double the global average for sites located at 50°N, and may be 3.5 times greater for sites located at 80°N. These estimates suggest that the average annual temperature for the Meadowbank property, located at around 65°N, may increase by approximately 5.5°C by 2100.

Studies indicate that the boundaries of discontinuous and continuous permafrost are expected to move northward due to global warming (Woo et. al., 1992). Predictions based on a warming of 4°C to 5°C over the next 50 years suggest that the Meadowbank property would remain within the zone of continuous permafrost, but the active layer thickness would increase and the total thickness of permafrost may slowly reduce in time. **These changes will not compromise permafrost encapsulation of the rock storage and tailings facilities.**

4.22 CUMULATIVE EFFECTS ASSESSMENT

Cumulative environmental effects are defined as: “impacts on the natural and social environments which occur so frequently in time or so densely in space that they cannot be ‘assimilated’ or combined with effects of other activities in a synergistic manner” (CARC in NPC, 1997). A cumulative effects assessment (CEA) was conducted to assess any cumulative environmental effects over a regional area that are likely to result from the project in combination with other projects or activities that have been or will be carried out. This assessment took into consideration the following factors:

- valued ecosystem components (VECs)
- significance of the cumulative environmental effects
- comments from the public that are received in accordance with the CEAA regulations
- measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project
- any other matter relevant to the assessment.

This CEA is limited to those residual effects (post-mitigation) on VECs resulting from past, present, or reasonably foreseeable actions that occur within the area where a linkage between the residual effects of the Meadowbank Gold project and the residual effects of other actions occurs.

Below is an explanation of the approach to, and elements of, the cumulative effects assessment.

Methodology – The methodology used during this CEA follows the guidelines provided by the Environmental Impact Screening Committee (EISC) and the Environmental Impact Review Board (EIRB) in their October 2001 guide entitled, “Cumulative Effects Assessment in the Inuvialuit Settlement Region,” and CEAA’s guide entitled, “Cumulative Effects Assessment Practitioners Guide” (February 1999). In addition, guidelines, comments, and recommendations from NIRB, KIA, DSD, and other federal agencies were considered.

Regional Environmental Issues of Concern – The issues central to this assessment were derived from concerns of the NPC in their Keewatin Regional Land Use Plan (approved by INAC and DSD in 2000); from public consultation sessions; and from similar studies that have been conducted for mining developments in the central mainland tundra over the past ten years

See Section 4.18.2 for a definition of VECs and explanation of how they were selected.

Temporal & Spatial Boundaries – Spatial boundaries for the cumulative effects assessment were established on a VEC-specific basis. RSAs for each VEC are discussed in Sections 4.15 and 4.16.

Mitigation of Potential Environmental Effects – Specific mitigation for each component can be found in the respective EIA sections for each VEC identified.

Mining Projects with Possible Linkages – No other mining project located within the Western Churchill Geological Province (see Figure 2-1) is currently operating or at some stage in the project permitting process. Closed mines include the Cullaton Lake / Shear Lake property and Nanisivik mine. A spatial and temporal overlap exists between the closure and decommissioning activities of the Cullaton Lake / Shear Lake property, Nanisivik mine, Baker Lake, and the Meadowbank Gold project.

Cumulative Effects Assessment Summary – There are no measurable cumulative effects expected to occur on VECs from actions related to project development, as shown in Table 4-24.

Table 4-24: Measurable Regional Cumulative Effects Potential

VEC	Measurable Regional Cumulative Effects Potential
Air Quality	None
Noise	None
Water Quality	None
Water Quantity	None
Permafrost	None
Vegetation Cover (Habitat)	None
Wildlife	None
Aquatic Habitat	None
Fish/Aquatic Organisms	None

4.23 SUMMARY OF IMPACTS BEFORE MITIGATION

Table 4-25: Summary of Project Impacts before Mitigation

VEC	Description of Potential Significant Impacts during Construction/Operation
Fish habitat	Reduction of fish habitat in Second Portage, Third Portage and Vault lakes due to pit development. Permanent reduction in western portion of Second Portage Lake. Runoff from waste rock pile at Vault Lake will introduce high pH and metal contamination to Wally Lake. Permanent loss of fish habitat in NP-2, a small pond within the Portage Waster Rock facility. Increased TSS due to dike construction. Introduction of sediments and porewater metals due to dewatering.
Fish population	Reduction of fish productivity in Second Portage, Third Portage and Vault lakes and possibly into the main basin of Tehek Lake. Bioaccumulation of elevated metals due to potential elevated levels of metals in water. Increased pressure on fish populations from increases in fishing activity. Dispersion of fish away from disturbed areas (e.g., dike construction area).
Air quality	Degradation of air quality due to emissions resulting from combustion of diesel fuel in the power plant and vehicles including nitrogen oxides, carbon monoxide, sulphur dioxide and particulate matter (PM10 and PM2.5). Fugitive dust emissions from tailings, overburden and waste disposal, process operations including ore hauling, road use, and fine sediments exposed on lake bottoms after drawdown.
Noise	Increased noise levels from blasting, drilling, materials handling and aircraft.
Water quality	Degradation of water quality due to effluent discharges, emission fallout, sediment releases, and dewatering resulting in increases in metals, nutrients, and/ or hydrocarbon concentrations.
Surface water quantity & distribution	Reductions in lake area and water volume at Second Portage and Vault lakes. Elimination of westernmost connecting channel between Third Portage and Second Portage lakes. Increases in Third Portage Lake water levels due to dewatering of Second Portage Lake. Change in water circulation patterns.
Permafrost	Increase of active layer thickness, melting of ground ice, thaw subsidence and sediment loss, particularly in wetland areas.
Vegetation Cover	Wind erosion of tailings resulting in contamination of vegetation in fall-out (downwind) areas.
Predatory mammals	Attraction to mine wastes (e.g., garbage) resulting in animal mortality. Increased hunting pressure and mortality. Avoidance of foraging habitats and deflection from normal travel routes due to activity and noise.
Small mammals	Loss of local habitat. Avoidance of foraging habitats and deflection from normal travel routes due to activity and noise. Food wastes attract small mammals leading to dependency and mortality.
Raptors	Avoidance of foraging habitats due to activity and noise. Disruption of nesting birds.
Waterfowl	Loss of wetland nesting, foraging and roosting habitat. Avoidance of nesting, foraging and roosting habitats due to activity and noise. Attraction to contaminated wetland facilities (e.g., tailings pond) leading to contamination.
Other breeding birds	Loss of local habitat. Avoidance of foraging habitats and deflection from normal travel routes due to activity and noise.
Ungulates (caribou & muskoxen)	Increased hunting pressure and mortality. Avoidance of foraging habitats and deflection from normal travel routes due to activity and noise.

4.24 ENVIRONMENTAL MANAGEMENT & MITIGATION

4.24.1 Overview

A project Environmental Management System (EMS) 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.

The EMS 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.

4.24.2 Management of Impacts on Physical Environment

A large number of mitigative measures will be implemented to avoid or minimize any impact on the physical environment. To this end, Cumberland has written several draft management plans, as listed below:

- Aquatic Ecosystem Management (AEMP)
- Terrestrial Ecosystem Management
- Emergency Response
- Reclamation & Closure
- Emergency Response
- Air Quality & Noise Management
- Access & Air Traffic Management
- Mine Waste & Water Management
- Hazardous Materials Management
- Closure & Reclamation
- Spill Contingency
- No-Net-Loss (NNL)
- MMER

These plans set out detailed site-specific protection measures and procedures that serve to protect the VECs identified for this project during all phases of project development. A summary of management and mitigation measures for each VEC is provided in the subsections below.

4.24.2.1 Vegetation Cover

Mitigation measures for vegetation are documented in the Terrestrial Ecosystem Management Plan. Mitigation to be implemented for vegetation communities during the construction and operation phases will include: (1) clearly delineating mine footprint in order to reduce habitat degradation in surrounding areas; (2) adhering to emissions and dust control protocols (see the Air Quality & Noise Management Plan) to avoid vegetation degradation; (3) constructing containment berms around fuel storage areas, and following the Hazardous Materials Management and Spill Contingency plans; (4) maximizing the use of stripped materials and suitable waste rock for road, airstrip, and dike construction; and (5) facilitating progressive reclamation and revegetation by scarifying and/or re-contouring surfaces, stabilizing slopes, and restoring natural drainage patterns (see the Closure and Reclamation Plan, and the Terrestrial Ecosystem Management Plan).

4.24.2.2 Wildlife

Mitigation measures for wildlife are documented in the Terrestrial Ecosystem Management Plan. Important mitigation measures for wildlife include minimizing blast noises, engine noises, maintaining and ensuring vehicles are properly muffled, establishing speed limits, giving right-of-way on all roads, minimizing the number of take-offs and landings, dust suppression, proper containment of fuel storage areas and explosives, contingency plans (for fires, spills and explosions), complying with hazardous materials guidelines, environmental awareness programs, incineration of all garbage and foods (domestic waste), restrictions on hunting, and establishing blasting windows if possible.

Upon closure, tailings impoundments will be capped, reclaimed, and made accessible or inaccessible as necessary. Waste rock piles will be capped with non-PAG material and contoured to allow passage of wildlife such as caribou through the site.

Caribou & Muskox

In the event that ungulates venture near the tailings impoundment and risk drinking contaminated water or becoming embedded in tailings the will be moved away.

Predatory Mammals

To avoid "problem" animals, all domestic waste and garbage will be incinerated, such that no residue attractive to wildlife remains. Domestic waste facilities have been designed to be tightly sealed, and to trap all odours. Care will be taken that aromatic substances such as oil (such as grease, oily rags and paint), and other products (such as aerosol cans and batteries) are stored in sealed, bear-proof containers and eventually removed offsite. A safety education program for all personnel on procedures for dealing with bear-human interactions, and avoiding interactions with wildlife in general will be implemented.

Small Mammals

Small mammals may inhabit roadsides, which would make them particularly vulnerable to collisions with vehicles. Speed restrictions will be implemented, roads will be watered as necessary to reduce dust, emissions and dust control protocols will be followed, and vehicles will be maintained in good condition to minimize contaminant loading of roadside and downwind vegetation. To avoid dependence of small mammals (e.g., Arctic ground squirrel) on human foods, feeding will be prohibited, food will be properly and securely stored, and all food wastes will be incinerated. Whenever possible throughout the life of the mine, an attempt will be made to create habitat for microtine rodents on the slopes of waste rock dumps.

Birds

Specific mitigation measures for birds include minimizing noise levels around active nests, using aversive methods to discourage birds from roosting on the runway and on road edges; deterring shorebirds and waterfowl from utilizing potentially contaminated areas such as reclaim ponds by using aversive techniques including bangers, pumping potentially contaminated water ponds out of pits to a settling area, creating habitat for shorebirds in shoreline and shallow water areas of flooded pits and for ptarmigan, passerines, and small mammals on slopes and possibly capped top of waste dump if substrates are not toxic, ensuring that new lake waters do not contain unacceptable levels of contaminants, and treating contaminated water inputs prior to discharge.

4.24.2.1 Fish

The NNL framework document presents a range of possible options to mitigate and compensate, to the extent possible, impacts to fish habitat in the project lakes with a combination of onsite and off-site measures. Greater emphasis is placed on compensation of medium and high value habitat such as spawning shoals, shelter, and feeding habitat and less on low value (e.g., deep water, low complexity) habitat. Efforts to avoid or mitigate impacts to fish include winter culvert installation; sediment control; use of properly sized intake screens; use of riprap to stabilize shorelines and anchor pipes; modification of the external surface of containment dikes; enhancement and improvement of connecting channels between lakes to enhance fish movement; treatment of effluent discharge; and discharge only during open water, not under ice.

At closure, there is expected to be a net gain (~38 ha) in productive habitat capacity in the project lakes. Enhancement of dike interiors, creation of shallow reefs and other habitat features within former lake habitat areas and creation of new lake habitat as a result of flooding of former terrestrial habitat are mitigation measures.

Fish Salvage

Baker Lake community members and the HTO will harvest fish from the Portage (135 ha), Bay Zone and Goose Island (73 ha), and Vault (98 ha) impoundment areas prior to dewatering. A research initiative will be undertaken to quantify fish biomass per hectare from Arctic oligotrophic headwater lakes to gain empirical data on lake productivity and sustainable biomass to quantify actual impacts to fish populations as a result of lake impoundment and dewatering of Nunavut lakes. Collaboration with Canada Fisheries and Oceans (FAO) will be sought prior to undertaking this initiative.

Once fish have been salvaged, a portion of fish can be placed into an adjacent lake system, and/or sacrificed and provided to Baker Lake residents for domestic consumption and for dog food. Whether fish are transferred to adjacent lakes or used as food is ultimately the decision of Baker Lake residents in consultation with FAO.

4.24.2.2 Air Quality & Noise

Cumberland's Air Quality & Noise Management Plan will be in compliance with all relevant environmental regulations during construction and operation of the project. The air quality management plan will include the following components:

- identification of the operations at the site including emission sources
- description of the air emission limits for the overall project (including plant) and for major sources and stacks (including pertinent operational parameters)
- identification of permissible sound levels
- description of air basin and baseline noise
- emission inventory and emission forecasts
- dispersion modelling
- commitment to report greenhouse gas (GHG) emissions in support of Canada's Voluntary Challenge and Registry
- development of a baseline and a monitoring system for GHG emissions to evaluate and report on progress in improving efficiency and reductions in GHG emissions
- report of particulate matter emissions to National Pollutant Release Inventory (NPRI)
- promotion of cleaner technology to improve performance
- consideration of fuel economy as an important criterion when purchasing, upgrading, or maintaining the haul truck fleet
- search for a market-based solution to ensure cost-effective emission reductions
- implementation of air quality and noise mitigation measures as presented in the following sections
- development and implementation of air quality and noise monitoring plan to verify compliance with relevant regulations
- employee training awareness
- continuous improvement program.

4.24.2.3 Permafrost

Most heavy structures (e.g., mine buildings) will be supported on concrete foundations extending to bedrock. To avoid permafrost degradation, foundations will either be built at a suitable elevation to prevent frost damage or will be built where ground ice is not present in subgrade materials. Specific options include: buildings elevated on piles or sills leaving a dead air space between the floor slab and the subgrade; slab-on-grade placed on a well-compacted structural fill with ventilation pipes in the fill (the ventilation pipes, which are operated in the winter to super chill the ground, may be forced air or non-assisted convective air flow); or slab-on-grade placed on a well-compacted structural fill with thermo siphons used to chill the fill year-round.

Permafrost will aggrade through the cover, tailings, and into the talik beneath, thereby encapsulating all contaminants and resulting in low rates of ARD generation in the long term. This permafrost will develop and be preserved even under the worst climate warming forecasts. Aggradation into and preservation of permafrost in the core and upstream (tailings) side of the tailings dike is a key aspect of the design concept. Both steady-state and transient thermal modeling for the post-closure indicate that the dike will become frozen during operation and remain frozen after closure, even with Third Portage Lake waters lapping against the downstream side, and even when climate change warming is considered. At waste rock disposal facilities, waste rock will be placed on thaw-sensitive polygons during winter months, possibly in conjunction with proactive measures to enhance ground chilling prior to placement (e.g., snow removal and/or compaction). Potential permafrost degradation associated with the discharge pipeline will be avoided by using an insulated pipe with heat tracing, and by elevating the pipeline across thaw-sensitive terrain.

For contact ditches, mitigation may simply involve placement of a stabilizing apron comprising granular fill, possibly in conjunction with geotextile, although such mitigation is considered unlikely given appropriate design precautions. Where thaw-related impacts affect non-contact ditches, impacts may be somewhat higher because placement of a stabilizing fill is not consistent with the “non-contact” designation. In these cases, special care will be taken to ensure aprons comprise non-acid-generating and non-metal-leaching granular materials.

4.24.2.4 Water Quality & Quantity

Water quality and quantity will be managed and protected through a comprehensive Mine Waste and Water Management Plan. This plan is described below and shown on Figures 4-9 to 4-16.

Mine Waste Rock Management Plan

The proposed mine will generate approximately 160 Mt of mine rock and 20 Mt of tailings. Mine rock includes iron formation, intermediate volcanic, ultramafic rocks, and overburden. Mine rock will be classified as:

- mine rock for general construction
- mine rock for dike construction
- mine rock for capping
- mine rock to waste rock storage areas
- tailings.

The overburden and ultramafic rocks are not expected to be acid generating. All other waste rock types and the tailings are potentially acid generating. Mine rock that is not used for construction will be trucked to mine waste rock storage areas. The quantities of waste rock to be excavated are summarized in Table 4-26.

Table 4-26: Quantities of Waste Rock Types

Rock Storage Facility	Rock Type	Quantity
Portage	Ultramafic & Mafic Volcanic	35 Mt
	Intermediate Volcanics	27 Mt
	Iron Formation	33 Mt
	Quartzite	2 Mt
	Overburden	7 Mt
Vault	Intermediate Volcanics	54 Mt

Portage rock storage facility – Waste rock from the North Portage, Third Portage, and Goose Island open pits will be stored in an area to the north of Second Portage Arm and to the west of the Vault haul road. The storage area will be constructed to minimize the disturbed area and capped with a layer of non-acid generating rock at closure to constrain the active layer within relatively inert materials. The potentially acid generating waste rock below the capping layer will freeze, resulting in low rates of ARD generation in the long term. Water from the waste pile will be collected by perimeter ditches and directed to the reclaim pond.

Vault rock storage facility – Waste rock from the Vault open pit will be stored in an area to the north and west of the Vault open pit. The rock storage facility will be graded at closure to encourage run-off and to provide a final shape consistent with the surrounding topography. The water seepage from the Vault waste rock storage area is expected to be of suitable quality to allow discharge to the environment without treatment and capping of this facility is therefore not proposed.

Tailings storage facility – The following site selection criteria were used for the tailings storage facility:

- sufficient volume to store the planned volume of tailings over the mine life
- potential to store some increased volume of tailings
- location must accommodate the potential for future mine expansion
- must be within a catchment draining toward the open pits
- must allow collection and control of supernatant

A slurry disposal in Second Portage Arm was selected as the preferred option based on the decision matrix. The main advantages of this location include:

- reduced potential for ARD/metal leaching
- ease of operation in the harsh arctic climate
- lowest relative capital cost.

Tailings will be stored in Second Portage Arm, which is currently underlain by a talik that extends through the permafrost to the underlying groundwater. Tailings will be placed as thickened slurry, initially by subaqueous deposition and later subaerially. A reclaim pond will be operated within the tailings impoundment.

A dry cover of non-acid generating ultramafic rockfill will be placed over the tailings at closure to confine the active layer within relatively inert materials. Thermal modelling indicates that the tailings will freeze in the long term, and that the talik that currently exists below Second Portage Arm will freeze before seepage from the tailings impoundment reaches the groundwater below the permafrost. Therefore, the potential for groundwater contamination to occur as a result of seepage from the tailings impoundment is considered to be low. This tailings deposition strategy will result in the Second Portage Arm being filled with tailings at the end of the mine life.

Water Management Plan

A water management plan has been developed to minimize the impact of the proposed project on the quantity of surface water, and on the quality of surface water and groundwater. Specific mitigation strategies include:

- reducing the intake of fresh water from the neighbouring lakes by recycling and reusing water where practicable
- implementing measures to avoid the contact of clean runoff water with areas affected by the mine or mining activities
- collecting, transporting, and treating mine water, camp sewage, and runoff water that comes into contact with project activities, as necessary
- managing potentially acid-generating or metal-leaching materials
- monitoring quality of discharges
- adjusting management practices if monitoring results indicate discharge quality does not meet discharge criteria.

The following are the minimum standards that were incorporated into water management planning activities:

- Establish compliance with all applicable federal and territorial environmental legislation (including *Canadian Environmental Protection Act*, *Fisheries Act*, Freshwater Intake End-of-pipe Fish Screen Guidelines (DFO, 1995), Canadian Environment Quality Guidelines, and Metal Mining Effluent Regulations.

- Cross reference existing guidelines relevant to water management, such as the Guidelines for the Discharge of Domestic Wastewater in Nunavut by the Nunavut Water Board.

A site water balance model (see Tables 4-9 and 4-10) was prepared to identify the water sources and their relative contribution and to evaluate proposed water management infrastructure. Surface water was grouped into two categories, contact and non-contact water. Contact water originating from affected areas will be intercepted, collected, and conveyed to central storage facilities, where it will be decanted to treatment, if needed, or directed to receiving lakes. Portions of the dewatered Vault Lake and Second Portage Arm will serve as the central water attenuation storage facilities. Second Portage Arm will have two segregated water storage facilities for the storage of process reclaim water (main basin) and the Portage area mine site runoff (northwest basin) until approximately Year 5. From Year 6 of the mine life onward, the reclaim and runoff attenuation pond will be combined and will be operated at the western end of Second Portage Arm.

The various components of the water management system will be designed to meet the following criteria:

- Water management infrastructure along the perimeter of the developed areas must be able to intercept and convey to proper handling facilities contact water from a 1:100-year/24-hour precipitation event.
- Water management infrastructure located within mining affected areas where water has no chance of overflow outside of developed areas, should be able to handle the runoff from a 1:10 year / 24-hour precipitation event.
- Water management infrastructure along the perimeter of the developed areas must be able to divert non-contact water from a 1:100 year / 24-hour precipitation event.
- Dewatering capacities for contact water sumps and ponds should be selected to handle the greater of:
  - the average year freshet volume in a 30-day period; or
  - the 1:100 year freshet volume in a 90-day period.
- Attenuation ponds should be sized to accommodate the runoff from a 1:100-year / 24-hour precipitation event in excess of their maximum operating storage volume (average year climate conditions) while maintaining a 1 m freeboard before the possibility of a spill to the receiving environment.
- All contact water will be intercepted, contained, analyzed, treated, if required, and discharged to the receiving environment when water quality meets the discharge criteria. Non-contact water is limited to runoff originating from areas unaffected by mining activity and that does not come into contact with developed areas. Non-contact water will be intercepted and directed away from developed areas by means of natural or man-made diversion channels and allowed to flow to the neighbouring lakes untreated.

4.24.3 Management of Impacts on Socioeconomic Environment

This section describes the proposed measures that will be undertaken by Cumberland to mitigate the socioeconomic impacts of the project and enhance the benefits to the Baker Lake community and the Kivalliq region in general. These measures have the potential to increase the overall net socioeconomic benefit of the project.

4.24.3.1 Human Resources

Cumberland is currently drafting a Human Resources plan, which focuses on many issues, including the following:

- training at all levels
- Inuit training and hiring
- employment rotation
- labour relations
- housing, accommodation, and recreation
- safety, health, and hygiene
- policies and procedures (i.e., that address matters such as firearms usage or discrimination, etc.)
- coordination with other developments
- arbitration and amendment provisions.

4.24.3.2 Occupational Health & Safety

An Occupational Health and Safety Plan (OHSP) has been prepared to address the requirements under the *Northwest Territories Mine Health and Safety Act and Regulations* and the Canadian Labour Code (both of which apply to mining developments in Nunavut). The OHSP covers gold mining, processing, and related activities at the Meadowbank site and is guided by the following principles:

- a clear chain of command for safety and health activities
- accountability for safety and health performance
- well-defined corporate expectations regarding safety and health
- well-defined task and operational hazards/risks

- comprehensive hazard prevention and control methods
- record keeping requirements to track program progress.

For more information, see the Occupational Health and Safety Plan, included in this EIA submission.

4.24.3.3 Nunavummiut Involvement

To ensure Nunavummiut involvement, Cumberland will consider hiring local Inuit to be responsible for some or all of the following:

- monitoring certain project activities
- organizing and participating in liaison committees to facilitate communications, consultation, and the resolution of environmental matters
- compiling and reviewing the use of Nunavummiut place names and other Traditional Knowledge.

4.24.3.4 Public Involvement

Since initial exploration activities began, Cumberland record of public consultation has been comprehensive and varied (see Table 4-3 in Section 4.5, "Public Consultation" for a list). In early 2004, Cumberland opened a liaison office in Baker Lake to ensure the public has a forum in which to discuss any questions and concerns. A local Inuit man, Peter Haqpi, has been hired to communicate with local residents in their own language on Cumberland's behalf.

Cumberland is committed to furthering public knowledge and education about the Meadowbank project and mining in general through some or all of the methods listed below:

- holding communication sessions to explain the results of the EIS
- organizing information sessions on specific subjects
- establishing corporate public offices in the Region or in Nunavut
- holding open houses and workshops on project development
- meeting with government officials, interest groups, and other parties
- delivering presentations to interest groups and the public
- holding community forums
- encouraging site visits by Elders and others
- producing a company newsletter

- annual environmental reporting
- releasing project documents to the public
- establishing local monitoring committees
- providing media releases.

4.24.3.5 Impact & Benefits Agreements

An Inuit Impact Benefit Agreement (IIBA) has been successfully negotiated between Cumberland and the KIA for the land use lease. This agreement lays the foundation for establishing the terms and conditions for the project-supplied benefits to the Kivalliq Region and the Hamlet of Baker Lake, as defined by the NLCA (1993). The final IIBA will be a key factor in the mitigation of potential negative socioeconomic effects of the project.

4.24.3.6 Pollution Prevention

Pollution prevention is defined by the Federal Government in the document *Pollution Prevention: A Strategy for Action* (Environment Canada, June 1995), which links the concept of pollution prevention with sustainable development. Cumberland's focus will be on preventing pollution from occurring rather than managing it. For more information, see Sections 4.1.2 and 4.2 of this document as well as Cumberland's environmental management plans included as part of this EIA submission.

Hazardous Materials

The Hazardous Materials Management Plan (HMMP) provides a consolidated source of information on the safe and environmentally sound transportation, storage, and handling of the major hazardous products to be used at the Meadowbank Gold project. In combination with Cumberland Resources' Emergency Response Plan, and Spill Contingency Plan, the HMMP provides instruction on the prevention, detection, containment, response, and mitigation of accidents that could result from handling hazardous materials.

The plan is based on the following principles for best practice management of hazardous materials:

- identify and prepare materials and waste inventories
- characterize potential environmental hazards posed by those materials
- allocate clear responsibility for managing hazardous materials
- describe methods for transport, storage, handling, and use
- identify means of long-term storage and disposal
- prepare contingency and emergency response plans
- ensure training for management, workers, and contractors whose responsibilities include handling hazardous materials
- maintain and review records of hazardous material consumption and incidents in order to anticipate and avoid impacts on personal health and the environment.

Cumberland recognizes that incorporating proper hazardous material management into other environmental management plans and systems leads to risk reduction, improved process control, and cost savings.

All hazardous materials to be used at the Meadowbank operation will be manufactured, delivered, stored, and handled in compliance with all applicable federal and territorial regulations, as well as ISO 14001 environmental management standards. Cumberland will institute programs for employee training, facility inspection, periodic drills to test systems, and procedural review to address deficiencies, accountability, and continuous improvement objectives.

Spill Contingency

The Spill Contingency Plan provides a practical source of information required to assess spill risks, develop an effective countermeasures program, and respond in a safe and effective manner to spill incidents. More specifically, the plan:

- complies with Cumberland's environmental policy
- identifies the organization, responsibilities, and reporting procedures of the Meadowbank emergency response team in the event of an emergency or spill
- provides readily accessible emergency information to the cleanup crews, management, and government agencies in the event of a spill
- complies with federal and territorial regulations and guidelines pertaining to the preparation of contingency plans and notification requirements

- promotes the safe and effective recovery of spilled materials
- minimizes the environmental impacts of spills to water or land
- provides site information on the facilities and contingencies in place if a spill or malfunction should occur.

4.24.3.7 Socioeconomic Management Plan

The primary vehicle for impact mitigation and benefit enhancement will be the IIBA to be negotiated between Cumberland and the KIA. Cumberland has negotiated a land use lease IIBA with the KIA, but a final IIBA agreement has not been completed. The main objectives of the IIBA are as follows:

- mitigating the impacts and enhancing the benefits of project development
- creating opportunities for the people of Baker Lake specifically and the Kivalliq Region generally to participate in the project, thereby enhancing self-determination
- establishing Cumberland's role as an active member of the community and participant in the sustainable development of Baker Lake
- maintaining goodwill and good relations with communities and their governments.

The following principles will guide IIBA negotiations:

- Consultation and participation will be practiced throughout the process to define priorities, needs, and preferences and to decide how mitigation and enhancement measures will be implemented.
- The development and implementation of mitigation and enhancement measures will be undertaken in partnership not only with communities but also with a range of organizations from government and civil society that are able to bring culturally appropriate experience and knowledge to maximizing net socioeconomic benefit.
- Implementation of both the terms of the IIBA and project operations will be conducted in an environment of accountability and transparency.
- Sustainability criteria will be incorporated by emphasizing the need to enable local and territorial participation in employment and business opportunities, training, and partnerships with government and community.

4.25 RESIDUAL

The only significant residual impacts determined to result from project activities throughout the life of the mine were at a local level, and were specifically related to the loss of a large portion of Second

Portage Lake. Minor residual effects of the project (i.e., the effects that remain after all efforts to reduce impacts have been carried out) include: (1) change in water movement and surface area of Second Portage Lake because of the tailings deposits and Portage pit; (2) local changes in small mammals, bird, and fish populations due temporary habitat loss; (3) possible short-term increase in metal concentrations in Third Portage Lake; and (4) an increase in fish habitat at the mine site at closure (positive effect).

4.26 MONITORING & FOLLOW-UP

Monitoring is a way of identifying the source of physical and chemical stressors to the environment, pathways of potential exposure, the ecological receptors at potential risk, mitigation measures, and the specific parameters to be monitored, their frequency, geographic location, and duration. Cumberland's monitoring plan takes an integrated, ecosystem-based approach that links mitigation and monitoring of physical/chemical effects on key ecological receptors. Mitigation is incorporated into mine design from the beginning, but can be improved upon based on information gathering and the results of monitoring. Monitoring is applied continuously throughout the life of the mine and will support adaptive management of effects to VECs.

4.26.1.1 Environmental Management & Monitoring Activities

An ongoing environmental monitoring program will be integrated into the EMS to demonstrate the safe performance of the mine facilities. Monitoring will identify non-compliant conditions if any, allow maintenance and planning for corrective measures to be completed in a timely manner, and enable successful completion of the abandonment and restoration plan (see Section 4.22.2 for a list of plans).

Cumberland will work with the regulatory agencies and Inuit 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 4-27. A more detailed discussion of monitoring activities for each VEC follows the table.

Table 4-27: 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;
	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.
Aquatic Monitoring	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 (AEMP) prior to project construction to acquire baseline information
	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
	The federal MMER will be implemented or part of the more comprehensive AEMP to specifically target effluent quality and toxicity and receiving environment effects
	Streams would be monitored during periods of flow (typically June through September)
	No-Net-Loss (NNL) of fish habitat program will be implemented to determine success of various habitat enhancement / replacement features in project lakes and off site
Terrestrial Monitoring	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
Air Quality Monitoring	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

	Function/Key Elements
QA/QC Program	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 banks and analytical control standards The QA/QC program will include protocols for sampling, handling and shipping of samples and for data management and reporting.

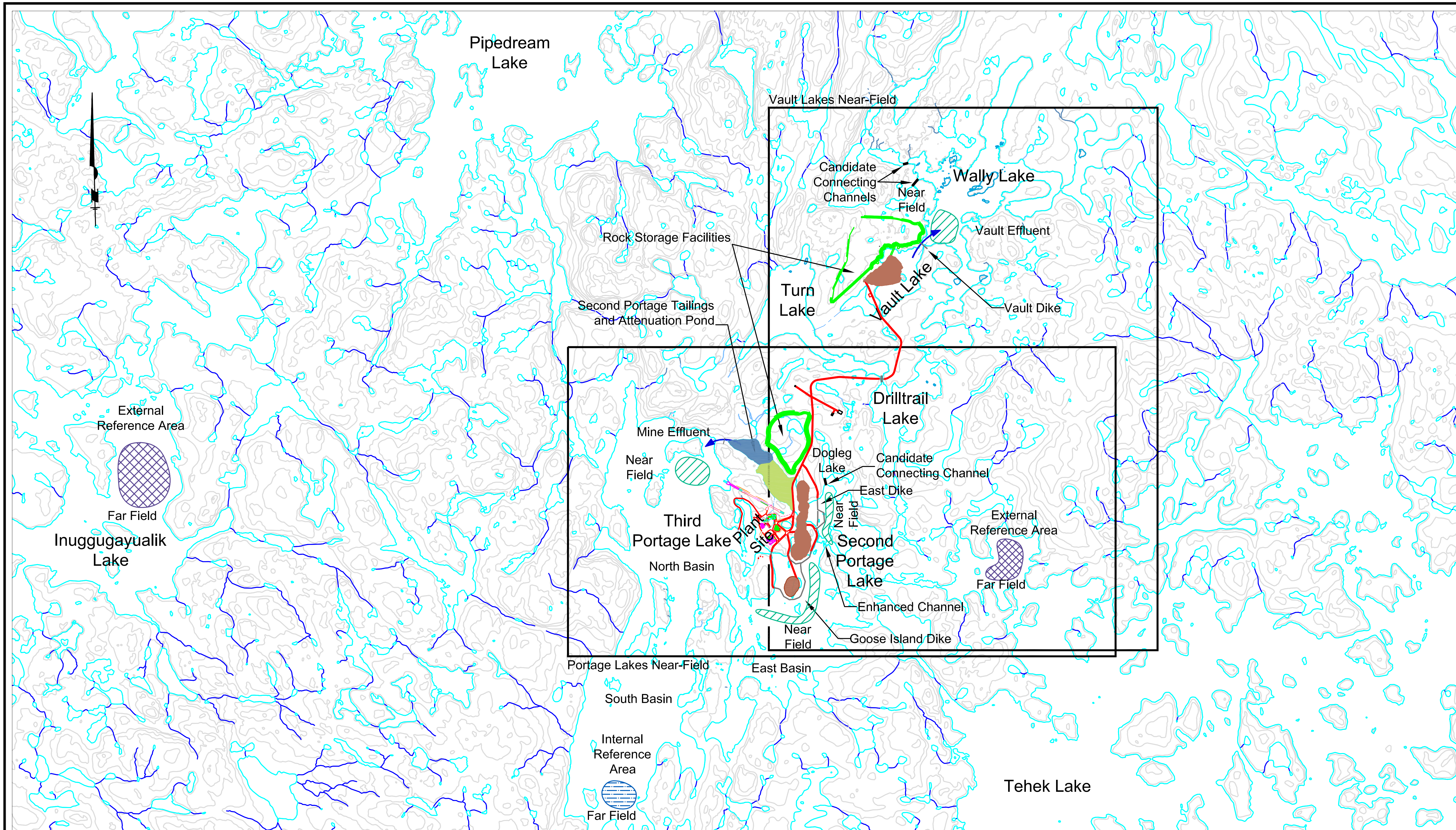
4.26.1.2 Aquatic Monitoring

Listed below are three discrete monitoring programs that have been designed and will be implemented upon initiation of the Meadowbank project that are specific to fish habitat and populations.

The *Aquatic Environment Management Plan* (AEMP) describes the rationale, framework, strategy, and scope of management plans to be implemented during all project phases in the Meadowbank area receiving environment lakes and streams. The AEMP monitoring strategy has two primary components: core monitoring and targeted studies. The core program is a general strategy to monitor water and sediment quality, periphyton, benthic invertebrates and fish that is tailored based on our understanding of mine construction, operation, and infrastructure (e.g., dikes, effluents, stream crossings, roads, etc.). Requirements under MMER are considered part of the foundation to core studies pertaining specifically to mine effluent sources.

Targeted studies are specific studies that typically have narrower temporal or spatial bounds or are designed to address specific questions related to particular components of mine development during construction or operation. These are integrated with, and complementary, to the core monitoring design.

A detailed framework document for the application of the federal Metal Mining Effluent Regulations (MMER) including Environmental Effects Monitoring (EEM) has been proposed. This document provides a description of required environmental monitoring for effluent and receiving environment chemistry, toxicity testing, benthic community, and fisheries surveys. Figure 4-42 shows the location of water quality monitoring stations as part of the AEMP and MMER program. Permafrost and hydrology monitoring stations are shown in Figure 4-43.



Legend

External Reference Area
Pit
Near Field Monitoring Area
Internal Reference Area
Road

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Figure 4.42
Project Lakes Monitoring Areas

Source: Azimuth Consulting Group drawing

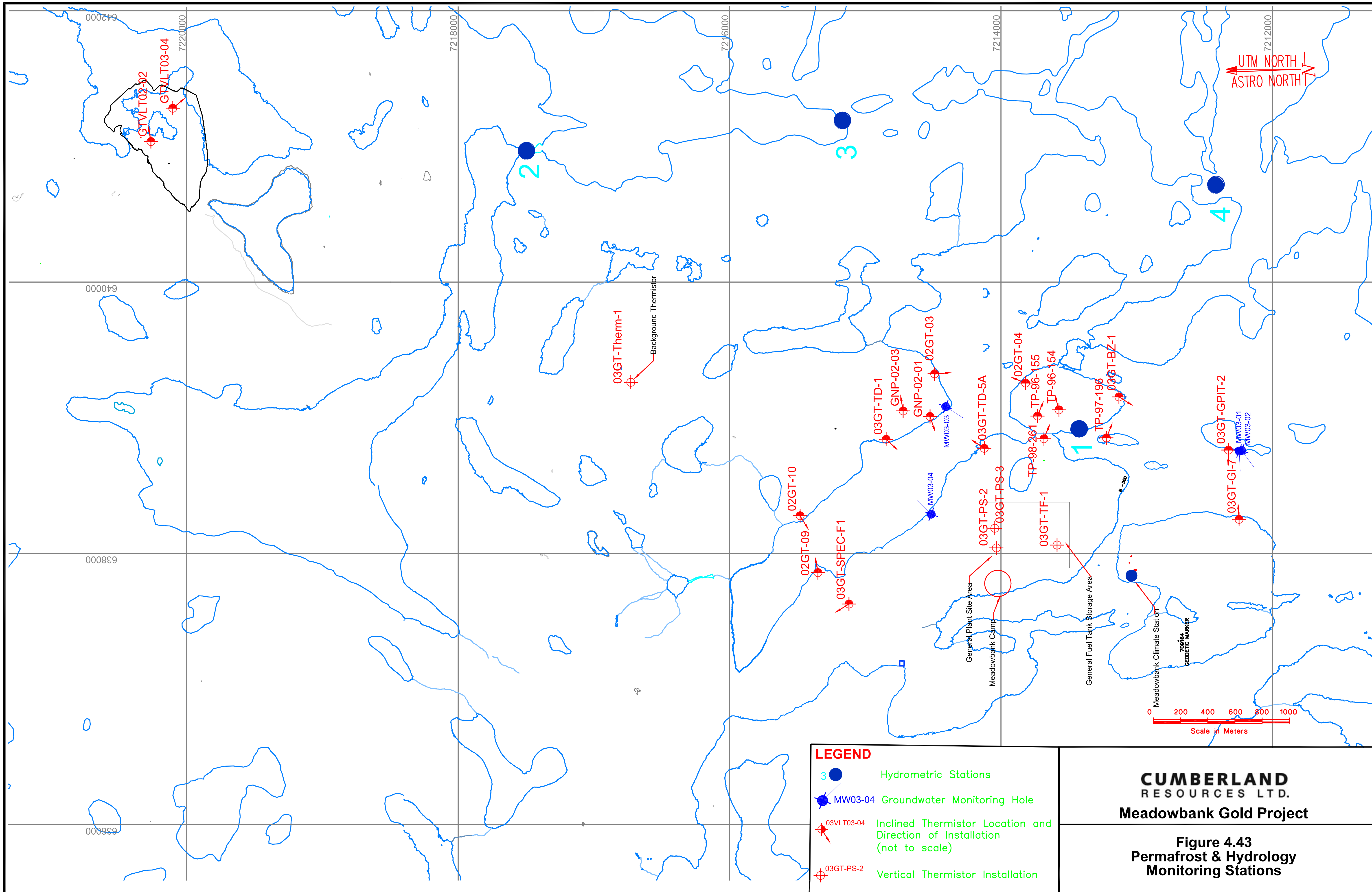

Figure 4.43
Permafrost & Hydrology Monitoring Stations

The EEM program is comprised of two parts: (1) Effluent and water quality monitoring studies intended to provide background, supporting information for the assessment and interpretation of biological monitoring. This component includes effluent characterization, sublethal toxicity testing, and water quality monitoring. (2) Biological monitoring studies, including a site characterization, a fish survey (using indicators of fish population health and fish tissue analysis), and a benthic invertebrate community survey.

As is the case for the routine MMER program, EEM program will also apply to both discharges. The MMER framework document describes how the MMER and EEM programs will be specifically applied at Meadowbank.

A No Net Loss (NNL) of fish habitat framework document that describes and quantifies the area and quality of receiving environment habitat harmfully altered, disrupted, or destroyed (HADD) as a result of mine development and proposes mitigation and/or compensation to ensure no not loss. The NNL Framework document provides a quantitative assessment of all major project activities that have the potential to cause a HADD of fish habitat and adheres to the DFO (1986) principle of no net loss. A range of possible options to mitigate and compensate, to the extent possible, impacts to fish habitat in the project lakes is proposed using a combination of onsite and off-site measures. Off-site measures are required because of the large area of lake habitat adversely affected during mine operation. Ultimately however, a gain in habitat will be realized after closure because of new habitat created from former terrestrial environments. The NNL Framework document also describes what monitoring and assessment may be required to demonstrate the performance and efficacy of the enhancement structures during and beyond mine life.

4.26.1.3 Terrestrial Monitoring

Wildlife monitoring is an important tool in protecting wildlife resources at the Meadowbank Gold project. Because of uncertainties in impact prediction and the effectiveness of mitigation, monitoring will allow for verification of conclusions of the impact assessment, fine-tuning, and refinement of mitigation measures, and documentation of significant impacts on abundance and distribution of wildlife populations. Several variables that define the well-being of wildlife populations will be monitored. A summary of the general approach is provided below.

Habitat distribution – Habitat, including vegetation, rocks, rock crevices, eskers etc., is required by all wildlife species. Each wildlife species or wildlife VEC has varying needs for habitat units classified under the Ecological Land Classification. As a result, the availability (i.e., % cover within the LSA; habitat loss relative to availability in the LSA) of all ELC habitat units will be assessed on an annual basis during the life of the mine. Extent of habitat loss will be determined and mapped from ground investigations and aerial surveys. Newly disturbed areas will be delineated using GPS and mapping capabilities. Where unnecessary and unplanned habitat degradation is documented, measures will be taken to reclaim these areas.

Wildlife distribution – Various monitoring programs will be in place to assess the distribution of wildlife within the LSA and RSA. Ongoing ground surveys of the LSA will also provide information on the distribution of larger species, as well as small mammals such as Arctic hare. Since many species utilizing the area are migratory and/or transient, changes in distribution will not necessarily be an accurate indicator of population changes resulting from mine-related activities. Details on monitoring programs designed for particular VECs are described in separate sections below.

Wildlife abundance – Wildlife abundance is likely a better indicator than distribution of the potential effects of mine activities on wildlife utilizing the area. Both increases and decreases in populations may be observed. For example, caribou may be attracted to the mine site because of the safety from predators that the mine and its human inhabitants afford. Increased numbers of caribou in the LSA may be documented by ongoing LSA ground surveys.

Wildlife health – The health of wildlife utilizing the mine site and environs will be difficult to determine directly because of the migratory and transient nature of all larger, long-living animals and the difficulty in obtaining samples for analysis. The approach Meadowbank will take is to sample soil and vegetation such as lichens, which are known to assimilate metals and other substances in their environment, and are basic foods for herbivores such as caribou, particularly in winter.

Plants (e.g., sedge, grass and willow) and soil samples may also be collected from potential foraging sites (e.g., near fuel storage areas, ammonium nitrate / explosives storage/ fuel plant, roads and airstrip) of ungulates, waterfowl, small mammals and certain passerines, and be analyzed for inorganic elements, petroleum hydrocarbon constituents, and other contaminants. The results will be compared to data for vegetation collected pre-development and in control areas.

Adaptive management – Within each wildlife management approach or method there is a certain level of uncertainty or unpredictability. The general purpose of monitoring is to determine if mitigation measures have been successful. For example, it may be determined that waste management practices are not effective in keeping predatory mammals away from the mine site. The residual effect would be that predatory mammals continue to return to the mine site, increasing the risk that animals will need to be destroyed. Adaptive management measures would be implemented, such as recommendations to reduce the availability of animal attractants at the landfills, protecting effluent lines with metal sheathing, and placing metal skirting around the base of buildings, to reduce potentially unacceptable impacts.

Caribou & Muskox

Caribou play a vital role in the subsistence economy in the Baker Lake area and are an important food source for carnivores. 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. Ongoing collaboration with government researchers and review of government radio-collaring programs will provide further information on the movement patterns and herd origins of caribou found in the Meadowbank area.

Monitoring will also include maintaining daily logs of ungulates, locations, numbers, sex, direction of travel, and any long-term population indicators. Pilots would be required to report all ungulate / plane collisions and near misses as well as any caribou or muskox sighted in the area, and maintain a wildlife sighting log book. All operators of vehicles would be required to report any collisions with ungulates.

Predatory Mammals

Wildlife logs, of both sightings and interactions, will be kept on an ongoing basis to document the sightings of large predators in the vicinity of the mine facilities. These records will be one of the core elements for the site-specific monitoring plan and will provide support for actions required to prevent critical situations. Regular analyses of these data may provide solutions by way of adaptive management.

Cooperative programs will be discussed with the NWMB and representatives from Baker Lake to devise means to develop population estimates for grizzly bears, wolverines, and wolves. If applicable, potential or existing den sites will also be identified and monitored for use throughout the life of the mine.

Birds

Maintenance of a wildlife sighting and activity log for the project site and continued annual monitoring of raptor, waterfowl, and other breeding bird nesting patterns and numbers in relation to the proximity of mining activities will be undertaken. For waterfowl, the focus will be on wetlands and lake islands located in close proximity to mine facilities that are considered suitable for nesting. Where active nests are located, nest-specific management plans will be developed. Mitigation measures to prevent birds from flying into power lines such as tying brightly-coloured ‘banners’ onto the lines will also be monitored for their success.

Vegetation Cover

Phenology studies were initiated in 2003 and will be ongoing through the life of the mine to determine potential changes in phenology due to mine activities. Results will be compared to control sites.

Vegetation (e.g., lichens) will be sampled for contaminants on a regular basis within the study area (i.e., areas potentially affected by mine activities), and outside the area (i.e., control where project effects are unlikely to occur) both prior to and during the life of the mine. Pre-development sampling will be undertaken to gather information on baseline conditions on the site.

If progressive revegetation is attempted at the tailings impoundment and waste rock storage facilities, these sites will be monitored for success throughout the life of the mine, including closure and post-closure. Roads will be scarified and recontoured, with thought given to creating esker-like habit. Trails, however, will be prepared for regrowth and revegetated artificially. These sites will be monitored for revegetation as possible foraging habitat for herbivores, burrowing rodents, and foraging habitats for predators.

4.26.1.4 Air Quality & Noise Monitoring

The objective of air quality monitoring is to provide data to determine the environmental effect of project activities upon air quality. Air Quality monitoring will address the most prominent issues for mining projects: the concentration of suspended particle matter in the air surrounding the major areas of activity (dynamic monitoring), and the deposition rate of particles (static monitoring).

Dynamic monitoring will be based on high volume air sampling for particulate matter of diameter equal or less than 10 µm (PM_{10}) or total suspended particulate. The most suitable HV sampler available on the market today is Staplex Model TFIA shown in picture to the left. The instrument's flow rate is 0 to 70 ft^3/min with the low range flow of 0 to 2 ft^3/min. It is suitable for both spot or continuous monitoring.

Alternatively, lower volume sampler might be adopted for monitoring during construction and operation of the project. There are several PM_{10} samplers available on the market that can be used either as a stand-alone module or in combination with up to three satellite units. Combination of TSP, PM_{10} and $PM_{2.5}$ Mini-Partisol Model 2100 units powered by solar panels operating at Northwest Territories at the proposed diamond mine project is shown in picture below.

The monitoring sampler will be deployed at the plant boundary in the direction of prevailing wind away from any taller structures or hills. Results will be extracted in a monthly basis and compared with relevant ambient air quality standards to find facility compliance status.

Static monitoring of dust deposition will follow D1739-98 "Standard Test Method for Collection and Measurement of Dustfall" (Settleable Particulate Matter). It involves installation of a dust canister to measure the amount of dust that settles out of the atmosphere by the effect of gravity deposited on a unit area over a certain length of time. It is proposed to deploy three static samples: near the dynamic sampler and by two open pits areas on the ground level to monitor the rate of PM deposition near the mining sites. The samplers should be replaced every month and gravitational analyses performed at the plant's laboratory. The ambient air "trigger levels" for dust fallout is a mining-standard 4 g/(m^2 month) averaged over one month.

The ambient air "trigger levels" specified in the Air Quality Management Plan are:

- suspended particulate, 45 μg/m^3, averaged over seven days.
- deposited particulate, 4 g/m^2/month, averaged over one month.

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

The purpose of ambient air quality monitoring is not only to check degree of compliance but also to:

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

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

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

- the fallout guidelines and dust concentration standards for the facility
- the type of monitoring test conducted (that is, the concentration or fallout measurements)
- the monitoring locations
- the instrumentation used

- the weather conditions during ambient quality survey (monthly weather report)
- the time and duration of monitoring, including dates
- the results of monitoring at each monitoring location (daily for concentrations in $\mu g\ m^{-3}$, monthly for fallout in $g\ m^{-2}\ month^{-1}$)
- measurement error analysis (statistical and systematic errors)
- Partisol sampler audit report
- quality assurance/quality control (QA/QC) data
- a statement outlining the development's compliance or non-compliance with the limit
- where concentrations or dust fall exceedances are found; the reason for non-compliance should be discussed
- the strategies to be used to manage air quality exceedance
- annual report should summarized monthly report and give annual arithmetic mean as well as statistical analysis; graphs would add to transparency of the results.

A concurrent equipment maintenance program and good operating practice will further control undesirable air emissions.

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

The following items are to be included in a noise monitoring report:

- the type of monitoring test conducted (that is, the construction stage or operation)
- the noise limits (daytime and nighttime) for the facility
- description of the nearest affected receivers
- the monitoring locations
- the noise instrumentation used

- the weather conditions during noise survey
- the time and duration of monitoring, including dates
- the results of noise monitoring at each monitoring location
- a statement outlining the development's compliance or non-compliance with the limit
- where noise exceedances are found; the reason for non-compliance should be stated
- the strategies to be used to manage the noise exceedance.

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

4.26.1.5 Permafrost Monitoring

Several of the Meadowbank project components benefit from, or require, freezing conditions. During construction, operation, and closure of these facilities, thermistor strings will be installed and ground temperatures monitored to ensure predicted geothermal performance is in accord with actual performance.

4.26.1.6 Socioeconomic Monitoring

The imperative of the project to deliver concrete economic benefits suggests that a priority for monitoring activity be the measurement of those benefits. In addition however, monitoring is necessary to establish trends in community wellness, such that problems, that may be related to the project or that the project can effectively address, can be identified. The primary objectives of socioeconomic monitoring are thus to:

- record the uptake of employment, business and workplace training opportunities over time and analyze the trends in this uptake in relation to expectations and targets
- monitor the implementation and effectiveness of education, training and other community support initiatives
- evaluate the trends in community wellness and the relationship between these and project operations.

Operations Monitoring

Cumberland undertakes to:

- maintain full human resource records in a form that will permit an annual roll-up of selection, employment, promotion, training and exit statistics on the workforce by residence, ethnicity, gender, level and field as a percentage of the total workforce
- maintain procurement records in a form that will permit an annual roll-up of the number, value and general content of contracts for goods and services by supplier location and ownership, as a percentage of total procurement
- require of all contractors and subcontractors annual reporting employment and businesses that provides the same information
- maintain health and safety, accident, workforce behaviour and other relevant records pertaining to events that occur in direct relation to Cumberland operations
- at least on an annual basis undertake a formal review of the results of the above to determine the success and trends over time of initiatives to enhance participation of Inuit people and businesses, to accommodate concerns of the local population, and to identify any specific obstacles or problem areas
- maintain records on all formal consultations, meetings and grievance and dispute events with the public, leadership, partner organizations, the project workforce, contractors and advisory bodies to the project, noting attendance, issues raised and resolutions
- undertake, at least on an annual basis, a formal review of the results of the above to identify any systematic successes or failures.

Cumberland will communicate the results of the above monitoring internally to management and the workforce as appropriate, such that the information can be used to adjust policies, procedures, mitigation and enhancement measures and behaviours where adjustments are identified to be necessary. The results will also be annually reported in an appropriate form and discussed with Baker Lake and the KIA as part of ongoing consultation, information exchange, and monitoring on the project.

Education & Training Strategy

Cumberland has undertaken to work with the KIA to put in place an education and training strategy. The strategy will identify the objectives and the content of the community based education and training component of socioeconomic mitigation. With the articulation of these objectives and content, indicators can be developed to monitor implementation and responsibilities can be assigned for collection of data on these indicators. Generally, there are likely to be four elements of a complete monitoring program (likely responsibility for data collection is referenced in brackets):

1. number and brief description of programs, including contributions of human resources or funds from Cumberland
2. levels of participation and completion rates relative to programs (partners implementing programs)
3. educational performance and employment indicators over time, such as rates of high school completion, labour force participation rates and unemployment rates (routinely collected Government of Nunavut statistics)
4. follow-up studies on program effectiveness; for example, on how participants are using knowledge that may have been gained in a particular program (to be determined on the basis of the study parameters).

It is to be noted that whereas the first three types of monitoring data are fairly straightforward to collect and report, they are unlikely to provide the kind of information necessary to adaptively manage education and training initiatives. The first two simply provide information on inputs and outputs. Interpretation of the third relative to success of any particular education and training strategy is confounded given the number of other factors that will influence the data. Therefore, it is the fourth kind of investigation that is required to fully monitor. Given the potential sensitivity of follow-up work on beneficiaries of education and training, this type of monitoring will largely be the responsibility of the CLC, with financial support of Cumberland if agreed. Methodologies and results would be discussed with Cumberland such that the company has the information it needs for its human resource planning and decision making, as well as for adjusting its support for education and training initiatives.

Community Wellness

Potential socioeconomic impacts to Baker Lake, such as the effects on individual, family and community wellness, also require formal monitoring. This is problematical because, whereas there is much experience in identifying indicators of community wellness, it has proved extremely difficult to disentangle cause and effect. The project will not be the only force of change in the area.

Nevertheless, irrespective of directly attributable cause and effect, it is in the interests of Cumberland to understand socioeconomic trends such that where the project is able to intervene effectively, it has the information to do so. The baseline study has collected some data against which to measure trends in such areas as population, educational achievement, average household size, participation and employment rates and average income. These data are periodically publicly reported by government, on the basis of household surveys or other sources of information, and are thus are fairly straightforward to collect over time.

In addition, local education, health, and the police services keep detailed data on their operations. Such data include rates of teen-age pregnancy, attempted and actual suicides, incidents of domestic violence, mental health breakdown, and arrests for various types of crime for example. Much of this community level social service data are confidential, but are often more pertinent to monitoring wellness than household survey data. These data, in appropriate aggregated form, could be provided by the agencies collecting them to the Community Liaison Committees (CLC).

Monitoring perceptions, through ongoing consultation with affected populations, is also important. The extent of sharing and cooperation, the degree to which the project workplace accommodates Inuit culture, the levels of disturbance as a result of increased traffic, and the legal but disruptive behaviour of out-of area workforces, for example, are subjectively experienced. Cumberland's ongoing consultations with its workforce and the people of Baker Lake will provide some such information, and it may be that additional consultations would be organized by the CLC specific to specific data needs.

As data from the above activities become available, there will be a requirement to interpret any resulting evidence of socioeconomic trends and their relation to the project. It is to be noted that the type of investigations that may be necessary to unravel project impacts from overall social change can be particularly invasive. The CLC may choose to undertake special purpose studies as deemed valuable.

In addition, fish tissue and vegetation will be monitored as part of the AEMP and EEM programs to ensure that contaminants are not present and posing a threat to human health.

Finally, monitoring and analysis of the impacts of resource development projects on communities across the north is ongoing, by governments, special purpose agencies, academics, and resource extraction companies. Insights from such studies can inform the interpretation of data collected in Baker Lake as described above. The CLC could review such studies in deliberations on the cause and effect relationships between Cumberland activity and community wellness indicators.

4.26.2 Community Liaison Committees

Cumberland will participate with the people of Baker Lake, the KIA, and the Government of Nunavut to develop a framework for collaborative monitoring of community and ecosystem wellness. The vehicle for such monitoring is likely to be a CLC. The details of this framework will be negotiated as part of the final IIBA.

4.27 AUDITING & CONTINUAL IMPROVEMENT SYSTEM

Despite careful planning, it is probable that certain components of the environmental management system proposed in this document will need to be modified. It will therefore be necessary to audit or review the plan to pinpoint components that need correction, adjustment, or upgrading. Not only the operational aspects of the plan, but any paperwork that deals with the plan, will be reviewed. Cumberland's goal will be to continuously audit all aspects of the plan, in accordance with ISO-14001 protocols, for effectiveness.

Throughout the mine life, as policies and regulations change and technology advances, the EMP will be modified to address changes and to benefit from technological advances. The primary objective will be continued compliance with regulations governing the project.

Formal evaluations of the EMP will be documented, deficiencies noted in the report, and progress in addressing deficiencies tracked in writing. Responsibilities to address deficiencies and accountabilities will be assigned and deadlines for addressing required changes will be set. The Meadowbank mine site supervisor will assume overall responsibility for the process; authorization for expenditures may be required from other management personnel.

Mining is a capital-intensive industry and major facilities will not be changed during the life of the mine, considering its eight-year life span. Technological change will, however, be monitored through regular information exchanges with operating mines, especially gold mines in the Arctic. Mine personnel will also monitor relevant technical literature for process changes that may be practically implemented.

4.28 CLOSURE & RECLAMATION

Mine closure activities represent dismantling and removing all buildings (offices, mills, rock processing areas, and storage facilities), fuel, explosives, supplies, crushers, treatment plant, sewage treatment plant, camps, equipment (pipelines, extraction machines, and rock processing and ore smelting machinery), decommissioning of roadways and the airstrip, as well as drainage ditches.

Mine closure and reclamation will utilize best management practices and appropriate mine closure techniques that will comply with accepted protocols and standards. Figure 4-44 shows the closure concept for the Meadowbank mine. Closure will be based on project design and operation to minimize the area of surface disturbance, stabilize disturbed land surfaces and permafrost against erosion and return the land to post-mining uses for traditional pursuits and as appropriate wildlife habitat.

The waste storage facilities will be progressively closed during mine operations. A dry cover of non-acid-generating ultramafic rock will be placed over potentially acid-generating waste rock piles and tailings impoundment to confine the permafrost active layer within relatively inert materials. Monitoring, inspection, and maintenance activities will be carried out during mine operations to progressively modify the abandonment and restoration plan according to the monitoring and assessment results.

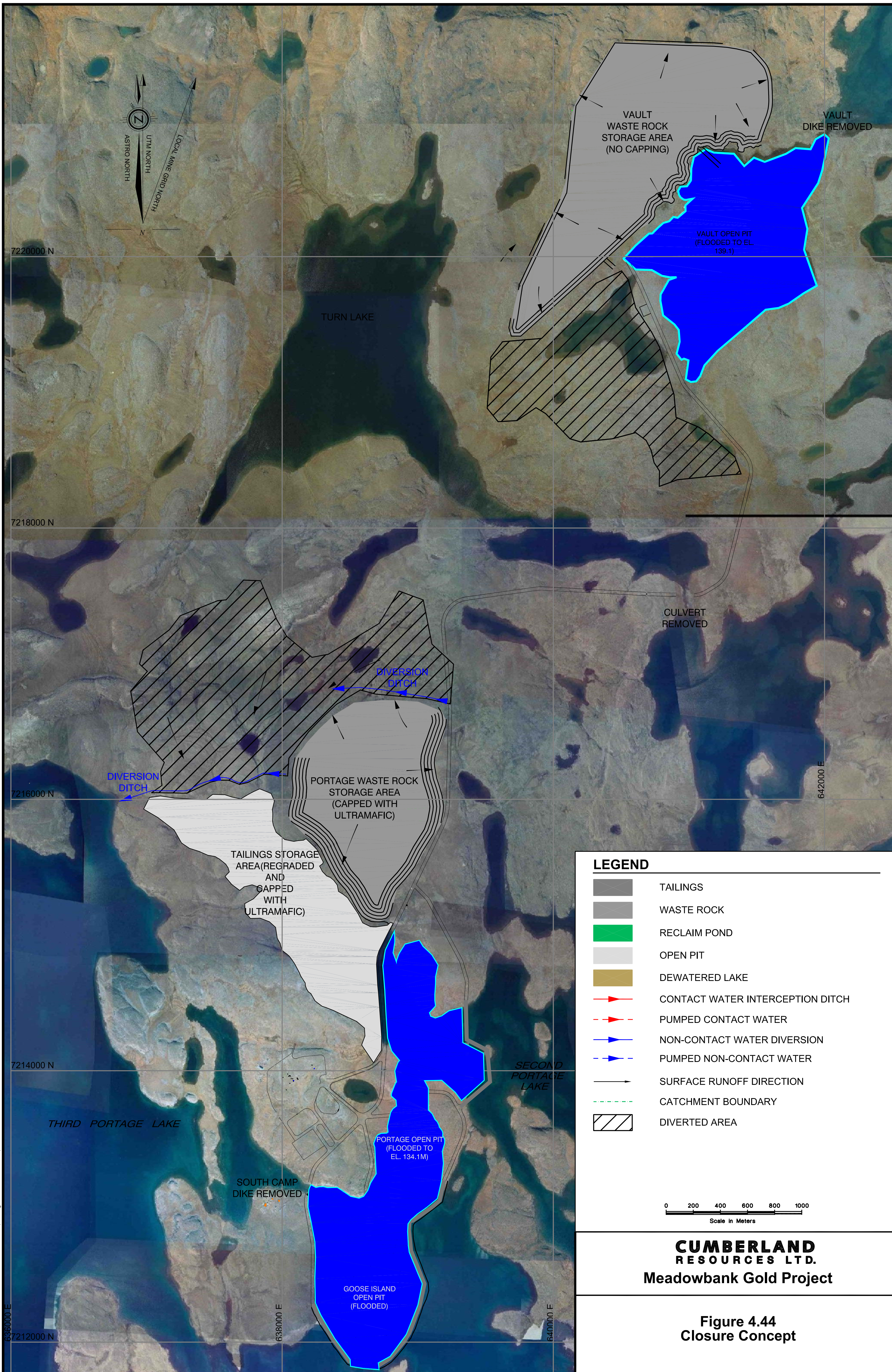

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Figure 4.44 Closure Concept

All surface buildings and infrastructure will require reclamation and closure measures upon completion of mine operations. The mill complex, site services, and power plant will be dismantled and removed off site as salvage materials, or deposited in the open pits or waste storage areas. Other surface facilities (camp complex, ancillary shop, warehousing and office facilities, mine site tank farm, and a number of dry storage facilities) will be dismantled and buried on site. All infrastructure that may be required for mine operations including the airstrip, roads, plant site, storage pads, quarries, and granular borrow areas (if present) will be re-contoured and/or surface treated according to site specific conditions to minimize erosion from surface runoff and wind blown dust, and enhance the development site area for revegetation and wildlife habitat.

The water management facilities (see Section 4.24.2.3), including the dewatering dikes, attenuation ponds, collection ditches, sumps and treatment plants, will be required to remain in place until mine closure activities are completed and monitoring results demonstrate that the water quality conditions are acceptable for discharge of all contact water to the environment without treatment.

Access to open pits will be secured by placement of rock berms around the pit perimeters prior to flooding to minimize hazards to human and wildlife. The pit walls will be contoured (upper 8 m) to provide optimal habitat for fish. The tailings attenuation pond and sumps will be drained and surface treatment will be provided to minimize erosion from surface runoff and wind-blown dust. The dewatering dikes will be breached after pit flooding is successfully completed and water quality has improved to the point where mixing will not cause exceedances above CWQG for aquatic life. The abandonment and restoration plan will be developed in conjunction with the mine plan so that abandonment considerations can be incorporated into the mine design.

Monitoring and maintenance will be carried out during all stages of the mine life. Monitoring will be essential to demonstrate the safe performance of the mine facilities, and will assist in identifying non-compliant conditions, allow maintenance and planning for corrective measures to be completed in a timely manner, and enable successful completion of the Reclamation and Closure Plan.

4.29 OUTSTANDING ISSUES

There are no major outstanding environmental issues associated with the construction, operation, reclamation, or closure of the Meadowbank Gold project that are not addressed in this Environmental Impact Statement.

Ongoing negotiations and a signed IIBA agreement will allow the potential socioeconomic impacts of the project discussed in this document to be more thoroughly evaluated.

4.30 LIST OF CONSULTANTS

See Appendix A.

4.31 LIST OF ORGANIZATIONS

See Appendix A.