JERICHO PROJECT

ENVIRONMENTAL CUMULATIVE EFFECTS ASSESSMENT

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EXECUTIVE SUMMARY

Cumulative impacts will occur at both site and regional scales. Site-related cumulative impacts will affect principally terrestrial and aquatic habitats with Project components altering different areas. On a site-specific basis impacts will be moderate, but on a sub-local level some impacts may be high, e.g. a 9 ha lake (Long Lake) will be completely removed as fish habitat; fish in the lake are limited to small populations of slimy sculpins and burbot.

With respect to regional cumulative impacts, only ecosystem components with large ranges or large areas of influence are likely to be affected by developments at the Jericho Diamond Project. The Jericho site and Lupin Mine are 27 kilometers apart by air. In fact, the separation on land is much greater, because Contwoyto Lake sits between the aforementioned locations. Any wildlife whose home range is greater than the land (air, in the case of birds) distance between sites could potentially experience a cumulative impact from the proposed development and the existing Lupin Mine. This would include at least the Bathurst caribou herd, grizzly bears, and Arctic wolves. However, it is expected that there will be no significant impact on wildlife and their use as an economic resource in the region.

The Jericho Diamond Project is one of several potential developments in the West Kitikmeot. Others include the existing Lupin Mine, proposed mines at Doris Hinge, Ulu, Izok Lake, George Lake, and Goose Lake, as well as continued mineral exploration throughout the area. Other than Doris Hinge, the proposed developments are contingent on commodity price increases and/or lowering of infrastructure and transportation costs; unnamed exploration activities are still in their early stages and therefore cumulative effects potential from these projects is uncertain.

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1.0 INTRODUCTION

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, combine with effects of other activities in a synergistic manner" (Canadian Assessment Research Council *in* Nunavut Planning Commission 1997) or

- "The effect on the environment that results from the incremental impact of proposed actions when added to other past, present and reasonably foreseeable future actions." (Environment Canada *in* Nunavut Planning Commission 1997).

- "…changes to the environment that are caused by an action in combination with other past, present and future human actions." (Cumulative Effects Assessment Practitioners Guide. Hegmann et al. 1999).

The Canadian Environmental Assessment Act requires that the environmental effects of projects that will proceed (already approved, or in an approval process) must be examined in combination with the environmental effects of the project being proposed (e.g. Tahera's Jericho Project). The environmental effects of uncertain or hypothetical projects or activities need not be considered. Cumulative effects from a project can be local (i.e. restricted to the site) or regional (the size of which depends on the biological or physical component of the environment under consideration). Local effects are the result of different Project activities having a combined effect on a particular component. The effects may act additively, synergistically, or subtractively (one effect may mitigate another effect). Regional effects are those that have the potential to combine with other human activities within the spatial boundaries considered for a particular environmental component to have an impact (negative or positive).

2.0 PROJECTS CONSIDERED

Guidelines established by some other agencies, subsequent to the Canadian Environmental Assessment Office policy, have broadened the scope of projects to be considered. The guidelines prepared for Tahera by the Nunavut Impact Review Board require consideration of the following:

- EKATI™;
- Diavik;
- potential future developments at the Jericho site;
- gold and other precious and base metal mines and deposits;
- the Echo Bay Mines winter road;
- the possible construction of an all-weather road from Yellowknife to Coppermine and a port and southern road network on the Arctic coast;
- hunting and guiding (no indication of what should be included or excluded);
- exploration by other companies;
- the likelihood of the NWT Power Corporation's developing some or all of the potential power sites that it has identified in the Region.

This list opens the assessment to considerable speculation; many activities are unknown, very transitory, variable from year to year, and of low to negligible local impact and no regional impact. This assessment is therefore limited to activities for which there is a project description in the public record, typically in support of exploration or development activities.

Figure 2.1 shows the location of power projects that have been considered by NWT Power. No projects are being actively considered at the time of writing of this report. Two proposed sites are on the lower Burnside River just upstream from its mouth on Bathurst Inlet: Burnalde Falls and Lower Burnside. There is no possibility the Jericho Project could have any impacts on the lower Burnside River either from normal operations or any possible accident that could occur. Based on the Project impact assessment, measurable impacts will be local and subregional (limited to a few km around the site at most). Other proposed projects are on drainages remote from the Jericho site, e.g. the lower Coppermine River. Given that off-site impacts to caribou migration have been assessed to be insignificant (Diavik 1998) and the ranges of other terrestrial fauna known to occur at hydro power sites would not overlap with Jericho, no cumulative effects would accrue to terrestrial fauna.

2.1 ALL-WEATHER ROADS

The only active all-weather road proposal for the West Kitikmeot at present is the Bathurst Inlet to Contwoyto road and this is the only all-weather road proposal that has therefore been considered. Other access road proposals have been proposed over the past 40 years with no concrete results (Diavik CSR, CEAA1999), and will not be considered for this project.

The Bathurst Inlet Port and Road Project would involve construction of a port on Bathurst Inlet, a 211 km road to Contwoyto Lake, and an all weather road to the Izok mineral deposit. Crossing of Contwoyto Lake would be via ice road in winter and barge in summer (Bathurst Inlet Port and Road Joint Venture 2002). The following brief summary is based on a draft project description submitted by the Joint Venture to the Nunavut Impact Review Board. The road would supply the existing Lupin and EKATI™ mines, the Diavik Mine under construction, and the proposed Izok Lake and Jericho mines. It would replace the current Lupin winter road, i.e., all the industrial traffic currently using the current road would switch to the Bathurst Road.

Road construction is scheduled from October 2004 from Bathurst Inlet and from February 2005 from Contwoyto Lake. The Lupin – Izok Lake leg will begin February 2006. Road construction is scheduled to be completed in October 2006. There will also be two barge terminals on Contwoyto Lake; the east terminal will include a 20-person camp, a small maintenance shop, and a truck parking area. During operation, an estimated 45,000 tonnes of fuel and supplies will be hauled west over the road to operating mines. From 300,000 to 470,000 tonnes per year of concentration will be hauled east from Izok Lake Mine. Summer barge operation will be from mid July to mid October.

No heavy hauling will occur in May and June, when the Bathurst caribou herd may be migrating across the road route north. To the extent that traffic switches from the Yellowknife-Lupin winter road to the Bathurst road, no incremental effects on caribou will occur, although the effects of road traffic may not be less. Caribou will have the right-of-way on the road and traffic will be halted for large groups of migrating caribou on the road.

From the perspective of cumulative effects arising from the Jericho Project, impacts would be similar, or less, than those that would occur from Jericho's use of the current Lupin winter road. Impacts on caribou from transportation activities could be lessened since the campaign hauling nature of the all weather road could be reduced, except for the Contwoyto Lake to Jericho leg. Further, the winter haul could largely take place in February and March, prior to the appearance of any caribou in the Jericho area, since lakes freeze sooner at this latitude than in the Yellowknife area.

2.2 HUNTING AND GUIDING

Hunting and guiding activities are moderate impact in a regional sense. The cumulative effect of all hunting activities on the Bathurst caribou herd is an estimated 14,500 to 18,500 animals harvested annually (WKSS 1999).

The Jericho Project will not involve the harvesting of caribou, nor result in the death of caribou, except possibly by accident; accidents will be mitigated as described in the Environmental Management Plan (Appendix B.3.1). Therefore, no measurable cumulative effects are expected from mining at the Jericho site in combination with hunting and guiding activities. Cumulative effects of guiding and hunting activities are further considered in the wildlife effects report prepared by Hubert and Associates (Appendix B.2.2). The active Tahera mining project, with its no-hunting policy within property boundaries, will actually provide a safe haven for wildlife.

2.3 MINERAL EXPLORATION

Most mineral exploration is transitory, very localized, and very low impact. The vast majority of temporary camps are in place for a matter of one to a few years, the footprint of the camps is relatively small (a few ha. at most), and no heavy equipment or extensive land disturbance are involved. Disturbance is limited to the physical presence of the camp and the noise of human activities, both of which are very localized. While concentrated helicopter-supported exploration may lead to significant wildlife disturbance in an area, the Jericho Project would not contribute to this effect since:

- no mineral exploration close to the Jericho Project will occur, as Tahera Corporation holds the rights to explore for minerals around the Jericho Project (see Map G); and
- use of aircraft at Jericho will not result in significant impacts to wildlife.

Under current regulations, exploration disturbances must be fully reclaimed as part of close out of land use permits and water licences. Exploration activities are also so widely spread that only the Bathurst caribou herd and possibly grizzly bears are likely to be affected by more than one project that also includes the Jericho Project.

2.4 MINING PROJECTS

Advanced projects that are considered in this assessment include the following:

- Izok Lake;
- Ulu;
- Hope Bay (former BHP Doris and Boston);
- Snap Lake;
- George/Goose Lake.

Published records were relied upon for descriptions of current activities at the sites. Information provided by DIAND, and not readily available, is included in Attachment 2.1. Information on other mining projects is in the public record.

Existing (or approved) mines included in the evaluation are:

- Lupin;
- EKATI™;
- EKATI™ Sable expansion; and
- Diavik.

The proposed Sable expansion is judged not to add significantly to regional cumulative effects, although it may affect site cumulative effects at EKATI™ Mine. The principal reason for this conclusion is that winter road haulage (the only shared component between Jericho and the southern diamond mines) will not significantly affect caribou northward migration as explained in Section 1.15 of the Environmental Impact Assessment (EIA) (Appendix B.2.1).

As discussed in the Project Description (Appendix A.1), any expansion at Jericho would depend on finding further economic resources and would likely trigger a new environmental impact assessment.

3.0 CHOICE OF VECS TO CONSIDER

Valued Ecosystem Components (VECs) considered included all physical and biological components of the environment that have some potential to be affected by the Project. Valued Socio-economic Components (VSECs) are considered in the Socio-Economic Effects Assessment. In developing VECs, reference was made to community consultations where people identified issues of concern. Issues raised by communities were very limited and very consistent: water quality and caribou. Specifically the VEC list considered for environmental cumulative effects assessment for the Jericho Project includes:

- air quality;
- water quantity and quality;
- permafrost;
- terrestrial and aquatic habitats; and
- terrestrial and aquatic plants and animals;

Socio-economic Effects Assessment is presented in Appendix C.1.2. Impacts on heritage resources are discussed in Appendix C.3.3.

Elements of the Jericho Diamond Project, which have the potential to act cumulatively on VECs, are shown schematically in Figure 3.1. Cumulative effects at a local level are possible from both physical presence of facilities and activities carried on at Jericho in the course of construction, operation, and closure. Figure 3.1 summarizes significant linkages among facilities, activities, and the VECs they could potentially affect. Local effects are discussed in the following sections under site-specific effects with respect to the linkages shown in Figure 3.1. The potential for regional cumulative effects on the VECs chosen for assessment are more limited, because fewer of the potential impact sources are significant over a large enough area to be incremental to the same potential impacts at the other facilities considered.

4.0 BOUNDARIES

4.1 SPATIAL BOUNDARIES

Spatial boundaries for cumulative effects assessment vary with the component of the environment being considered. In Nunavut and Northwest Territories data are lacking from which to make a quantitative decision on spatial boundaries for many VECs. Hegmann, et al. (1999) suggest an adaptive approach be used in setting spatial boundaries and this is especially appropriate for the Jericho Project. Boundaries should be flexible so they can be moved, should the introduction of relevant new information suggest current boundaries are inappropriate for the VEC in question. Guides suggested by Hegmann, et al. in setting spatial boundaries include:

- establish a local study area in which the obvious and often mitigable effects may occur;
- establish a regional study area that includes the areas where there could be possible interactions with other human activities, considering the interests of other stakeholders;
- consider the use of several boundaries, one for each environmental component (dictated by the guide above);
- for terrestrial VECs, such as vegetation and wildlife, select ecologically defensible boundaries wherever possible;
- provide for expansion of boundaries sufficiently to address the cause-effect relationships between actions and VECs (if known or knowable);
- characterize the abundance and distribution of VECs at a local, regional, or larger scale if necessary, and ensure that the boundaries take this into account;
- determine if geographic constraints limit cumulative effects within a relatively confined area near the activity;
- characterize the nature of pathways that describe the cause-effect relationships (where known) to establish a "line-of-inquiry"; and
- set boundaries at the point at which cumulative effects become insignificant.

Because of the general lack of information, professional judgement is required to use most of these guides in Nunavut. Assessing the potential for cumulative impacts required collection of appropriate baseline data now, and will require a commitment to monitoring programs in the future. Tahera Corporation provided funding for regional studies carried out by WKSS. Monitoring programs associated with the Jericho Diamond Project are discussed in the Environmental Monitoring Plan (Appendix B.3.3) and will be negotiated in detail during the permitting process.

For the Jericho Project, in most cases, the local study area is the footprint of the Project plus a 100 to 2,000 m buffer (or the height of land if appropriate). Exceptions are water and air quality, where the nature of the VECs requires somewhat larger local study areas.

Spatial boundaries chosen and the rationale are discussed in each VEC section.

4.2 TEMPORAL BOUNDARIES

Temporal boundaries will be life of mine for effects that cease when the mine is closed. For some effects, such as changes in landform, the temporal boundary will be indefinite and for effects that last beyond life of mine, the temporal boundary will be the length of time the effect lasts. For instance, some habitat loss will continue until reclamation processes have returned the site to its former state.

5.0 VEC-SPECIFIC EFFECTS

5.1 AIR QUALITY

5.1.1 Site Specific

The spatial boundary considered for air quality is an area within 20 km radius of the Project site. The boundary was chosen based on air quality modelling results. The Industrial Source Complex (ISC3) model used for dispersion estimates treats sources cumulatively and thus, the assessment in the EIA, Section 1.12 (Appendix B.2.1) is essentially a site cumulative effects assessment.

5.1.2 Regional

If the potential for long-distance transport of air contaminants such as metals, which arrive in the Canadian Arctic predominantly from industrial areas in Russia (Diavik 1998), persistent organic chemicals (e.g. pesticides), and greenhouse gas effects are considered, there are no boundaries that can be set for Project effects. However, measurable Project effects on a regional scale cover a much smaller area. As discussed in the EIA, Section 1.12, the Project will make a comparatively insignificant contribution to green house gas emissions; the contribution to greenhouse gases by inactive projects is zero. As well, persistent organic chemicals are not used or generated by gold or diamond mines and thus cumulative effects on concentrations of these chemicals would be zero. The ISC3 model is not designed to assess effects on a regional scale. De Beers (2002) used an air quality model capable of providing regional air quality impact estimates. Their studies concluded that, other than greenhouse gases, no regional cumulative effects would accrue from operation of the existing and planned mines in the Slave Geologic Province, including Snap Lake, EKATI™, Diavik, Lupin, and Jericho.

Estimates have been developed by Diavik and EKATI™, which show their contributions to greenhouse gases will be low compared to total NWT or Canadian contributions (see BHP 1995 and Diavik 1998). The total estimated contribution of CO_2 (worst case operating year – Year 3) from the Jericho Project is estimated to be 48,582 tonnes/year, based on the conservative and probably unrealistic assumption that all sources are operating at steady full power. This emission constitutes 0.0097% of the total Canadian production of CO_2 for 1995 of 500,000,000 tonnes; the Jericho estimate does not include aircraft or winter haul sources of CO_2, but still accounts for more than 90% of total CO_2 emissions. Estimates have not been developed by Lupin Mine, but would be a fraction of those estimated for EKATI™, Diavik, and Jericho, principally because the mine's operations are underground.

For Jericho, air contaminants, including dust, have been conservatively predicted to be at the CCME criterion within 8 km of the open pit centre. In terms of significant air quality effects then, the site-specific and regional boundaries are the same. No other industrial activity exists, or is planned, within this area. Therefore no cumulative effects in combination with other human activities will accrue from operation of the Jericho Project, unless additional activities that affect air quality commence within the life span of the mine. The qualitative cumulative effects assessment for the Snap Lake project indicated negligible cumulative effects on Bathurst caribou, grizzly bears,

wolves, and wolverines (De Beers 2002). Given that the Snap Lake project will be approximately three times the size of Jericho (based on production, 3,000 tpd vs. 800 tpd, and area of disturbance, 650 ha vs. 222 ha), it is unlikely dust deposition from the Jericho Project will have measurable cumulative effects at a regional scale.

5.2 NOISE

5.2.1 Site Specific

The average ambient noise level at the Jericho site will be 35 to 40 dBA, based on the analysis done for Diavik (1998). Blasting noise at 600 m from source will be about 115 dB (peak). Blasting will only add cumulatively to the ambient noise at the site once per day and for approximately one second. Therefore it can be discounted as a contributor to cumulative ambient noise at the site.

The principal sources of noise will be mobile equipment, during open pit mining, centred at the open pit. Table 3.1 of the Project Description (Appendix A.1) provides a list of mobile equipment that will be operated at the Jericho site by mine function (excluding aircraft). Noise generators will be limited to the site, except for:

- up to three times weekly aircraft flights to and from Jericho airstrip;
- periodic helicopter activity in the summer by exploration crews based at Jericho;
- winter supply haul.

These off-site noise sources will not act cumulatively, other than the occasional overlap of helicopter and fixed wing aircraft activities during summer months. Aircraft flight paths will be arranged so that raptors, the principal wildlife of concern, will not be harassed by overflights. Ungulates, including caribou are not a significant concern (see Environmental Effects Assessment on Wildlife, Appendix B.2.2).

Other than blast noise, the average ambient noise at the Jericho site will drop off to near background close to the site (sound drops off as the square root of the distance from the source). No significant effects to wildlife from the cumulative noise sources from the Project site are likely to occur off the site proper.

The main concerns will be cumulative effects of site noise on occupational health and safety, and to that end, hearing protection will be provided and mandated for job sites where the noise is approaching, or above, WCB guidelines. The accommodation building will be placed as far as possible from the open pit, consistent with the requirement for a compact mine design. Buildings will be insulated against the cold and windows fitted with double panes which will also serve to deaden noise. The principal noise source that will be audible throughout the plant complex will be back up horns from mobile equipment. This noise will be momentary (typically less than one minute per incident). If backup horn noise becomes problematic, alternates acceptable to WCB, e.g. strobe lights, could be investigated. Tahera is not aware of any mine where backup horns are an issue with employees.

5.2.2 Regional

The only existing industrial operation in the region is the Lupin Mine, which is 27 air km distant. It is unlikely that either operation will be audible from the other even under the most favourable sound propagation conditions, thus no cumulative impacts from multiple noise sources are likely to occur.

5.3 WATER QUANTITY/HYDROLOGY

5.3.1 Site Specific

The water balance information provided in Section 1.9 of the EIA (Appendix B.2.1) lists all sources of water "use" for the Project, including runoff (the largest collective source of "use"). Actual water use, meaning draw of water from Carat Lake, will be just less than 180,000 m^3 per year. The Project facilities using water will be:

- open pit (very limited amount for drilling);
- process plant (majority of water required – less than 30 m^3/hour);
- potable use (1.25 m^3/ hr or 30 m^3/day).

Water for dust control will be drawn from sediment control ponds or the pit sump, where possible. Some water may need to be drawn from Carat Lake during extended dry periods. This will constitute a small part of the daily water requirement for process water. The majority of the water used (less about 10% by weight remaining with coarse PK – 37,668 m^3/yr) will be cycled through the PKCA and back to Carat Lake through Stream C3 and Lake C3. Thus, the site-specific impact on the water balance of Carat Lake and Lake C3 will be very small. Other water "use" as defined in the Project water licence is in fact potential change or contamination of water quality, and will not affect quantity, i.e. runoff may contain sediments or other contaminants from crossing the Project site, which by definition of a water licence is “use”. Should spray irrigation of some mine water be instituted, there would be a short-term water loss from this treatment of water (see the EIA report, Appendix B.2.1). The magnitude of the effect would depend on the amount of water spray irrigated.

5.3.2 Regional

The regional boundary for cumulative impacts can be taken to be the Carat Lake watershed, which was calculated by SRK (1998) to be 227 km^2,i.e. from headwaters of streams flowing into Carat Lake to the Burnside River. Total runoff for the basin, assuming an MAR of 190 mm would be over 43 million m^3. The total estimated Project actual use of water (i.e., the amount the Project would remove from the basin) would be 37,668 m^3, plus an additional amount due to evaporation from ponds (the PKCA, or Long Lake, excepted since evaporation currently occurs from the surface), and a small amount due to miscellaneous absorption. This amounts to less than 0.1% of the total basin annual drainage, which is negligible. Lupin Mine, the closest industrial operation to Jericho, draws water from Contwoyto Lake. Contwoyto Lake discharges to the Burnside River, which joins the drainage basin (where Jericho is located) downstream of Kathawachaga Lake. The mean annual volume of water draining the Burnside has not been calculated, but it is well in excess of the mean annual volume from the drainage basin on which the Jericho

Project is located. Thus, it can be concluded that no measurable cumulative effects will accrue to the water balance of the Burnside system from operation of both Lupin and Jericho mines.

5.4 WATER QUALITY

5.4.1 Site Specific

The spatial boundaries for the local study area for water quality were set as the outlet to Jericho Lake rather than a fixed distance from Project activities. This boundary is taken to be the point where water quality effects of the Project will be unmeasurable and is, of course, downstream of the Project. The Ash, Key, and Lynne lakes drainage system, which empties into Contwoyto Lake, should not be affected measurably by the Project. No water quality effects are possible above the main inlet to Lake C3, since this is upstream of any Project-related discharge and too distance for fallout from airborne contaminants (i.e. nitrogen from explosives) to be measurable in the water column.

Without mitigation a number of sources of water discharge from the Project could act cumulatively to add both suspended sediment and nitrogen compounds to Carat Lake, Lake C1, and Lake C3, all of which are fish-bearing. The parameters of concern, as discussed in Section 1.11 of the EIA (Appendix B.2.1) are suspended sediments, nitrogen (especially ammonia), and possibly copper, aluminum, and chromium. All other parameters regulated or of concern for the protection of aquatic life will be within receiving environment guidelines. Metals are well within concentrations normally set for mine effluent discharge under the Metal Mines Effluent Regulation of the Fisheries Act. Any mitigative actions taken to address ammonia concerns will also address metals issues. Suspended sediment will be brought to Water Licence concentrations prior to discharge by the use of settling ponds and flocculents (if necessary). That leaves nitrogen (i.e. ammonia) as a potential concern. While nitrate will be elevated, it is not forecast to reach receiving environment levels (CCME generation of nuisance algae), because phosphorus will be limiting and thus prevent algal blooms. Phosphorus will be generated by sewage, but sewage will be directed to the PKCA where phosphorus will be absorbed.

The areas where nitrogen will be discharged in water will depend on the levels of ammonia found in runoff and the PKCA supernatant water. If runoff and supernatant water meet receiving environment guidelines, no negative impacts are expected; aquatic monitoring will be employed to verify this prediction. Most site runoff will be to Carat Lake, if Project Water Licence criteria are met. Runoff from the south side of the plant and stockpile area and the PKCA discharge will be to Lake C3, which is immediately upstream of Carat Lake. Alternate discharge schemes will be employed, should water not be acceptable for direct discharge.

Total loading of nitrogen from all sources predicted by the nitrogen model to Carat Lake and Lake C3 are provided in Table 5.1. Nitrate, nitrite, and ammonia loadings can be derived from nitrogen by using the ratios provided by the nitrogen model. Ratios were derived by the model authors (Ferguson and Leask 1988) from empirical data.

The nitrogen loading can be put in perspective by comparing the loading with the amount of water available in the receiving water bodies and the annual flow through those water bodies. This information was derived from water balances calculated using mean annual runoff (MAR). A conservatively low MAR (130 mm) was used. The discussions on water balance in the Environmental Management Plan (Appendix B.3.1) provide the reader with additional information. Lake volume and annual flow through are listed in Table 1.5 of the EIA (Appendix B.2.1). From Table 1.10 of the EIA, the year with maximum nitrogen loading is Year 6 and this year was used for the analysis as a worst-case estimator. Predicted flow through in Lake C3 is several times per year and thus no build up of nitrogen will occur in this lake. Predicted flow through in Carat Lake is from less than once per year to 1.4 times per year (depending on the mean annual runoff estimation). Average discharge on an annual basis is 0.9 m^3/s, which results in 28.4 million m^3 exchange. Since mean annual basin runoff (above Carat Lake) is 28.12 million m^3, on average, the lake water is completely exchanged annually. The conclusion of this analysis is that no build up of nitrogen will occur in the Lake C3-Carat Lake system as a result of the combined inflows of water from the Project site. Complete mixing can be expected over time in both lakes, due to wind (see dilution report of URS, Appendix D.1.2). Nitrogen loading will constitute an extremely small fraction of the water volume and, if the predictions in Table 5.1 are correct, will not be measurable.

From the above analysis and the fact that algal growth will be limited by phosphorus, it can be concluded that no significant cumulative effects will result from the combined discharges of nitrogen-bearing water from the Project site.

The level of confidence in this estimate is moderate, because it is based on model results and, to a lesser extent, the experience of EKATI™ Mine (which was used as a check on model results).

Nitrogen loading to Carat Lake will last life of mine. Once the open pit and underground phases of mining have ceased, water that flows north will be directed to the open pit, which will slowly fill (over a period of a century or more). By the time the pit has filled, no more nitrogen will be available to leach. Some loading from the PKCA discharge and from water directed to the PKCA will continue beyond the life of mine for a few years. The extent of this post mining time period cannot be predicted with any confidence prior to mining, but will be predictable with a moderately high level of accuracy prior to closure because mine monitoring will have provided eight years of data on which to draw conclusions about leaching rates.

5.4.2 Regional

Regional boundaries for water quality could be taken to be the entire watershed on which the Project is located, i.e., the Burnside River system. However, this becomes meaningless in terms of measuring effects.

The closest mine to the Jericho Project is Lupin, which discharges effluent to Contwoyto Lake from both the tailings containment area and (in a separate stream) secondarily treated domestic sewage. Lupin Mine has demonstrated from their monitoring that discharges are not affecting water quality in Contwoyto Lake, 25 km from the nearest

point where any runoff from the Jericho Project could physically affect Contwoyto Lake. Since no persistent xenobiotic organic chemicals are used at either Lupin or Jericho, no measurable cumulative effects on the water quality of Contwoyto Lake are possible from the two operations. Further, as the Jericho Project will not have any significant, measurable effects on water quantity beyond the local study area, no regional cumulative effects are possible.

5.5 PERMAFROST

5.5.1 Site Specific

No component of the Project will have a significant, unmitigatable effect on permafrost. Further the Project does not require permafrost for either operation or environmental control. Therefore cumulative effects will either be negligible, or not significant, for Project operation and environmental control.

5.5.2 Regional

No regional effects on permafrost are possible from any phase of the Jericho Project.

5.6 VEGETATION AND WILDLIFE HABITAT

5.6.1 Site Specific

Developing a mine and related infrastructure will require terrain disturbance and limited habitat destruction. Overall areas required for site development and ecological zones affected by site development are summarized in Table 5.2. The plant communities in the Project area are representative of the surrounding tundra biome. Terrain disturbance caused by the Project will result in terrain alteration and disturb areas of plant cover but will not diminish the overall biodiversity of the local tundra biome. Local terrain disturbance at the Jericho site on the plant communities and associated wildlife habitats will all be the direct result of activities and facilities required for the Jericho Diamond Project; there will be no contribution to local terrain disturbance from non-Project sources.

5.6.2 Regional

The Comprehensive Study Review (CSR) of the Diavik Project considered the combined effects of the EKATI™ and Diavik projects and found that there would be "., no effects from changes to vegetation/terrain from winter projects and activities. Non-winter projects and activities (may contribute to) insignificant residual effects,"; Table 5.3; CSR, CEAA 1999). Adding Snap Lake would not significantly change this assessment. Non-winter activities effects from Snap Lake, as for EKATI™ and Diavik, are likely to be limited to the immediate area of the mine site.

Wildlife habitat in the region will be reduced by 221.8 ha. The environmental effect of this on the sustainable harvests of wildlife populations will be minor. The sustainability of harvests on populations presently being harvested should not change as a consequence of the overall environmental effects from the Jericho Diamond Project. These findings are consistent with those of the environmental effects assessment of the Diavik Project,

which is approximately 170 km south of Jericho, proposed to operate for 23 years, and expected to disturb an active footprint more than five times greater than that of the Jericho Project (CEAA, 1999).

5.7 AQUATIC HABITATS

5.7.1 Site Specific

Table 5.3 indicates Project facilities and activities that may measurably affect aquatic habitats. Impact ratings in the table are relative to other impacts listed. Refer to the Aquatic Impact Assessment (Appendix B.2.3) for a full discussion of site-specific impacts.

Examination of effects listed in Table 5.3 shows that sedimentation of water bodies from the site is the only cumulative effect that is likely. All drainage from controlled areas will be to sedimentation ponds or the PKCA. No water will be released to the environment that does not meet Project Water Licence criteria. Proposed water management practices are detailed in the Project Description (Appendix A.1) and the Environmental Management Plan (Appendix B.3.1). Given these practices, the potential for effects on aquatic habitats, other than loss of habitat from Project development previously discussed, is predicted to be low. Furthermore, the greatest potential for sedimentation is to areas of streams that are not inhabited by fish; corrective action will be possible prior to sediment entering fish-bearing waters. The level of confidence in these predictions is high, because of redundancy built into management systems.

5.7.2 Regional

The loss of fish habitat on a regional (watershed) scale, while measurable, will be insignificant (<<1% of total available habitat for any fish species). Effects that could potentially degrade fish habitat at the Jericho site will not extend beyond the site, i.e. beyond Carat Lake or the bay in Contwoyto Lake, where the winter road leaves the lake.

A statistically measurable cumulative effect on habitat is the increased potential for spills of materials carried on the Lupin winter road. These could be spills that enter water bodies due to incomplete clean up, or spills due to a truck going through a break in the ice. As discussed in Section 1.17, the potential for spills from the Jericho Project winter resupply is very small. Second, the material with the greatest potential to affect aquatic habitats is petroleum, and because petroleum products are lighter than water, tanker trucks that might break through the ice float (Nuna Logistics, pers. comm. 2000). The tanker truck would be winched out of the lake (by a crawler tractor or similar) as quickly as possible. Thus very little, if any, product would be lost due to such an accident. A spill on ice would be completely cleaned up except under unusual circumstances. Therefore, the potential for contamination of aquatic habitat is much lower than indicated by the frequency of spill statistic. The cumulative effects from accidental spills that impact aquatic habitat are therefore negligible.

5.8 WILDLIFE

5.8.1 Site Specific

5.8.1.1 Raptors

The Project area includes or is adjacent to breeding territories of golden eagles, rough-legged hawks, peregrine falcons, and gyrfalcons. Jericho Project construction and operation will include seasonal mining operations beginning in April and continuing into December. These activities will occur for the entire raptor breeding, nesting, and fledging period for the life of the Project. Surveys and observation of raptors over the period since 1995 at Jericho indicate the following:

- None of the golden eagle nests in the area occur within 2 km of the Project's proposed facilities. Nests were occupied during a period of intense exploration activity with constant helicopter support in the area.

- One rough-legged hawk nest is less than 2 km from the Project site and mining activities may displace birds from this nest. Seven rough-leg territories were active in 1996, the highest of any of the five years surveyed; a year in which Carat Camp supported a large exploration program with up to three drills operating. Supporting these drills required steady helicopter traffic, sometimes with two helicopters. There were also frequent, sometimes daily, resupply flights landing at the airstrip upon its completion in early July, 1996. Winter road use will be completed by the time that rough-legged hawks arrive in spring.

- One peregrine falcon nest is about 0.5 km from the Project site and mining activities may also displace these birds from this nest. It was occupied by peregrines in 1995 and 1999. Peregrines tolerate intense interactions with man, including capture and detainment on occupied breeding territories with successful return to the territory and breeding on release.

- Gyrfalcons have not been a regular feature in the raptor surveys of the Project area and no confirmed nest sites have been observed.

The foregoing indicates only minor environmental effects of the Jericho Project on local raptors over the life of the Project. Effects will be direct and no other environmental effects by human sources in the Project area are expected.

5.8.1.2 Migratory Birds

Migratory bird species are represented in the local fauna by individual breeding pairs of species that are generally distributed throughout the continental tundra biome and, for some species, beyond. None of the species known to breed in the Project area have been observed in large concentrations. Large concentrations of waterfowl have not been observed at either Carat Lake or nearby Contwoyto Lake (5 km). In 1999 a pair of loons and an oldsquaw nested in the outflow to Carat Lake; a pair of Arctic terns nested nearby. The loons were noted there again in 2000 and a pair of parasitic jaegers nested on the adjacent lowland. No nesting waterfowl were noted on the shores of Long Lake (proposed tailings containment) in either 1999 or 2000 during searches of the entire shoreline.

Interactions with migratory birds during construction, operations, and related support activities will be of a passive nature. Direct interactions that could cause displacement of individual pairs of loons or oldsquaw nesting in the area on Carat Lake and its outflow are not required for any aspect of the Project.

The minor environmental effects of Project activities on local migratory birds over the life of the Project will be direct and no other environmental effects from local human sources on migratory birds in the Project area are expected.

5.8.1.3 Small Mammals – Herbivores

Microtine rodents, hare, and ground squirrels occupy the Project area and are found throughout the tundra of Nunavut and beyond. They are local residents throughout the year, but ground squirrels hibernate. The Jericho Project will have a direct effect on small mammal habitat. Beyond that, the effects from Project activities on cyclic microtine populations will be direct, but undetectable. Direct effects on ground squirrels will be those associated with ground squirrels' habituation to camp facilities as shelter and a source of scraps, including food and nesting materials. Arctic hare will use the facilities sites as shelter from the elements in winter, and as shelter from predators in summer and winter. The Project's environmental management plan (Appendix B.3.1) provides for wildlife to have the right of way which is designed to minimize road kills. Hunting or trapping on the Project site will be prohibited, leading to only minor residual impacts. These minor environmental effects of Project activities on local small mammal populations over the life of the Project will be direct and no other environmental effects from local human sources on small herbivore mammal populations in the Project area are foreseen.

5.8.1.4 Muskox

Muskox are resident in the Project area and are found in low densities throughout most of the mainland tundra of Nunavut. Muskox in low numbers were observed in the Project area during aerial surveys in 1999 and other overflights of the Project area since 1995. No observations of muskox were recorded for the area immediately adjacent Carat Lake or the airstrip. Summer observations of individuals and small herds in the highlands east of Carat Lake were common during flights between Carat Camp and Lupin in the summer of 1999. Winter herds of up to 25 animals were observed on the northern flank of the Willingham Hills in the spring of 2000. No muskox fecal pellets (winter form) or fecal chips (summer form) were recorded during habitat survey transects through the three dominant ecological zones in the area reported by Canamera (1996a). These transects included examination of the areas adjacent to the proposed waste rock piles, the diamond processing plant site, and adjacent to the airstrip. Muskox are resident in the region, but their use of the grounds in the immediate vicinity of the Jericho pipe, Carat Camp, and airstrip seems to be infrequent. Notwithstanding their infrequent use, muskox show great tolerance to benign and passive interactions with human activity as has been demonstrated by years of observations at Lupin Mine. Also, no road accident involving muskox at Lupin has been reported (Hohnstein, 1996).

The minor environmental effects of Project activities on local muskox and muskox herds over the life of the Project will be direct and no other environmental effects from local human sources on muskox in the Project area are foreseen. Unlike caribou, muskox are not migratory, and so are considered only in the local context for assessing cumulative effects.

5.8.1.5 Caribou

The Jericho Diamond Project is located on the Bathurst caribou herd summer range. Large concentrations of caribou with and without calves have been observed passing through the Project area travelling both north and south in summer months. The Project is located near the apex of a very large lake (Contwoyto) and the movement of caribou through the Project area may be in part concentrations of caribou passing around the lake, rather than selecting the Willingham Hills for a specific summer destination. On only one occasion during the exploration phase of the Jericho Project was a large concentration of caribou observed to interrupt a summer migration to feed and rest in the Project area. This occurred June 26/27 1996 when a post-calving concentration estimated at 50,000 (+/-14% of the herd) spent 12 - 18 hours in the immediate Project area. Similar observations have been made at Lupin. In June 1999 herds of 1,000+ caribou passed between Lupin and Contwoyto Lake more or less continuously June 27, 28, 29 and 30. These observations show that physical infrastructure like Lupin Mine and heavy construction equipment operations (Jericho airstrip construction) are not barriers to large aggregations of migrating caribou. These observations also show that large aggregations of caribou must be expected in the Project area during seasonal mining operations. The Project's site configuration, operations plan, and environmental management plans have been developed to accommodate an instantaneous influx of several thousand caribou.

Movement of caribou through the area during spring migration is significant. The observations made (Appendix B.1.3) suggest that spring migration through the Project area is characterized by a steady stream of smaller herds (100's), in contrast to summer observations of either small numbers (<10) moving very little, or very large herds (>1,000) moving quickly. This information shows that it is possible to develop a cost effective Project site configuration plan that will not unduly hinder the movement of large numbers of caribou during the post-calving through late summer period. The most common interaction with caribou in the Project area will likely be road traffic. Caribou will always have the right of way. The foregoing indicates minor local effects are likely to occur from Jericho Project activities. These minor environmental effects on the Bathurst caribou herd over the life of the Project will be direct and no other environmental effects from local human sources on caribou in the Project area can be foreseen from local mining and related activities in the Project area.

5.8.1.6 Carnivores

Fox

Arctic fox and red fox have both been observed in the Project area, but only red fox have been found to occupy nearby dens. Red fox have been observed in the area and a den, active in 1999 and 2000, is located in a sand ridge in the lowland approximately 0.5 km east of the airstrip. As with rough-legged hawks, the most common prey for

foxes in the Project area are microtine rodents, whose population cycles will not be affected by the Project's operations. Interactions between Project operations and fox should be minimal. Proposed Project operations have no need to disturb the area of the fox den, nor is there a need for Project personnel to visit it.

Care will be taken not to make any of the mine area attractive to foxes by making food available, leaving road kills to be scavenged, or hand-feeding foxes. The minor environmental effects of Project activities on red and Arctic fox populations over the Project life will be direct; no other environmental effects from local human sources on fox in the Project area can be foreseen.

Wolf

Three wolf dens are known for the Project area. One den, approximately 6 km north of the airstrip, was active in 1999. The other two are closer to the Jericho site; one 0.5 km northeast of the airstrip and another near Contwoyto Lake, east of the proposed pit. Neither den has been confirmed as being active in the course of the Project since 1995, but an obviously nursing female was observed on several occasions by the airstrip construction crew in 1996 (Tobias Vlasblom in Jericho daily engineering report, Canamera, 1996b unpublished). None of the dens are within the active footprint of the mine and related facilities and infrastructure. As with fox, interactions with the Project should be passive, with no activity requiring direct exposure to any of the wolf dens in the area.

Wolves are also known to scavenge and so the same Project mitigation measures for foxes apply equally to wolves. As well, road kills will be disposed of promptly. Hunting or trapping of wolves by Project personnel in the area of the Jericho Project site will be prohibited. The minor environmental effects of seasonal mining activities on the wolf population over the Project life will be direct and no other environmental effects from local human sources on wolves in the Project area can be foreseen.

Wolverine

Wolverines are solitary carnivores, expert scavengers, and successful predators (Wilson in Chapman and Feldhammer, 1982). Wolverines have occasionally been observed on the Project site (Wildlife Report, Appendix B.1.3); no dens have been located. Management measures to prevent scavenging by other carnivores will also serve to discourage wolverines. The minor environmental effects of Project activities on the wolverine population over the Project life will be direct and no other environmental effects from local human sources on wolverine in the Project area can be foreseen.

Grizzly Bear

The large esker complex running northwest from the airstrip shows the remains of four grizzly dens. Grizzlies den for the winter in October. In the area of the Project it is expected that well drained soils including esker habitat will be the preferred denning habitat. Bear and the sign of bear have been observed at the Carat Lake camp; no direct interactions with grizzly have occurred since the camp was established in 1996. Camp management has always been diligent in incinerating kitchen garbage and an electric perimeter fence was erected around the camp in the

summer of 1996. The experience and record at Lupin Mine shows that mining within the range of grizzly can proceed with little direct impact on the grizzly population in the region (Metall, 1993). In the matter of denning habitat, there is no need or intention of taking granular material from the northwest esker complex where evidence of past grizzly denning has been observed.

The record of grizzly presence, but absence of direct interactions with man at the Carat Lake camp, is evidence of the effectiveness of the current practice of incineration and electric fencing. The minor environmental effects of Project activities on the grizzly population over the life of the Project will be direct and no other environmental effects from local human sources on grizzly in the Project area can be foreseen.

5.8.2 Regional

Regional cumulative impacts will be derived from two principal sources: transportation activities directly associated with the Jericho Project and regionally significant environmental effects from the Jericho Project in combination with other regionally significant environmental effects. For wildlife, the spatial boundaries for consideration of wildlife effects range from the Project footprint (for small mammals) to the entire winter road from Tibbitt Lake to Lupin Mine and Jericho (for caribou).

5.8.2.1 Transportation

The Jericho Diamond Project will be served by the Lupin winter road for its annual resupply. The ice road serving the Jericho Project will be a 28 km extension on Contwoyto Lake and continue 3 km over the tundra to the Project site. In the event that the Ulu Project were to proceed, the winter road serving Ulu would continue north from the Jericho turn-off to the northern tip of Contwoyto Lake. The Ulu Project winter road resupply schedule would be similar to the winter road operations serving Jericho. At present the winter road serving Lupin Mine originates at Tibbit Lake, 60 km east of Yellowknife. A Project Description to build and operate a port on Bathurst Inlet for resupplying bulk materials to Lupin Mine has been developed and submitted with a request for a review by the Nunavut Impact Review Board.

Winter road support for the Project, regardless of route, will produce local and regional interactions with VECs. The annual resupply for the Jericho Diamond Project by winter road will operate for as short a period as possibly late January through early April every year. Loads required for construction, operation, and closure of the Jericho mine are detailed in Section 8 of the Project Description (Appendix A.1). Incrementally, these loads will represent a small fraction of the total traffic on the Lupin winter road (approximately 6% of the 2001 total, i.e. pre-Snap Lake total). Winter transportation activities have the potential to cause cumulative impacts on some animals, because of their large ranges (some carnivores) or migratory behaviour (Bathurst caribou herd).

Caribou

The mines on the caribou range operate year round. The winter road is in use from January through mid-April every year; and the outfitters' hunting camps operate from mid-August through early October. The total allowable kill for 1999 by hunters served by outfitter camps based in the NWT was 1,077 with 889 taken (GNWT data, unpublished).

The interactions between Jericho Project surface transportation activities and caribou will occur during late winter and spring migration; interactions with Project aircraft activities could occur anytime between April and September. It is impossible to determine if any of the caribou involved in these interactions will also have interactions with other existing human land use activities on the Bathurst range.

"During spring migration caribou cows are strongly motivated to reach the calving ground and, apparently, as they pass Lupin, they do not linger there" (Mueller and Gunn, 1996). They also presumably take the most energy efficient route to get to the calving ground. It is unlikely that caribou cows passing Lupin/Jericho on spring migration would also have passed through the EKATI™ and/or Diavik diamond projects. However it may be that cows, passing through the vicinity of the Jericho Project, also pass near to the Ulu Project site. Snap Lake is on the margins of the winter range and Hope Bay is outside the recent range of the Bathurst herd, as defined by recent telemetry data from Bathurst caribou cows. Cumulative effects of successive and sequential interactions for a significant portion of the calving herd are not expected during spring migration. Similarly, it is unlikely that individual caribou cows will pass both Lupin and Jericho sites in a single spring migration period.

During the remainder of the year however, it is possible and perhaps probable that individual caribou will interact with multiple mine sites and outfitter camps combined. Considering the daily movements of the animals during the summer period (13.52 and 5.32 km/day for post-calving and late summer seasons, respectively), it is unlikely that interactions with mine activities at this time of year would persist for an extended period, resulting in significant cumulative effects.

Future developments on the Bathurst herd's range during the life of the Jericho Diamond Project could include:

- a diamond mine at Snap Lake, near treeline south of Lac de Gras;
- the Ulu gold mine, 100 km north of Jericho;
- the Hope Bay gold mine, northeast of Bathurst Inlet;
- the Izok Lake Project, approximately 50 km west of Jericho; and
- the Bathurst Inlet Port and Road Project, spanning 211 km between Bathurst Inlet and the eastern shore of Contwoyto Lake.

Caribou interacting with the Snap Lake Project on their winter range could also pass near EKATI™ and Diavik during the spring, but that would reduce the probability of the same caribou also passing Jericho/Lupin. The Hope Bay gold mine is located outside of the herd's current range, but within 100 km of the margins of calving grounds used by the herd for a few years during the period from the mid-1960's to the early 1990's (Sutherland and Gunn, 1996). The future Izok Project is located in the path of spring migration from the western portion of the Bathurst herd's winter range, in/near the area used during post calving in recent years, and also on the herd's summer range. The proposed road route from the future port on Bathurst Inlet crosses the spring migration corridor used by the Bathurst herd in recent years and is located on the herd's post calving and summer range.

It is unlikely that individual caribou will interact with both the Jericho Project and the Port and Road Project in the same season. The same holds for same season interactions with the Jericho and Hope Bay Projects and the Jericho and Snap Lake Projects. It is possible, however, that individual caribou could have same season interactions with the Jericho, Izok, Ulu, Lupin, EKATI™, and Diavik Projects in the course of the summer and fall. Examining the season by season movements of individual caribou cows providing telemetry data provides some insight into the frequency of same season interactions with more than one mining location on the Bathurst caribou range. The telemetry maps of 21 caribou were reviewed for the overall geographic and seasonal distribution of the individual caribou cows as shown by their collar locations for the 1996 – 2000 period (Figures 7.1 – 7.11 in Hubert and Associates Ltd. Wildlife Report, Appendix B.1.3). The maps show that same season interactions at more than one location may have occurred:

- at Lupin and Lac de Gras in 1997 on spring migration;
- at Jericho and Ulu in 1999 during late summer;
- at Jericho, Lupin, and Lac de Gras during post-calving in 1999; and
- at Lupin, Jericho, and Ulu on spring migration in 2000.

It appears that the probability of multiple same season interactions by individual caribou with human activities on the Bathurst range will be relatively low.

It is difficult to envision the direct effects of caribou interactions with Jericho Project activities acting alone or in concert with interactions at other mines that could have a direct effect on the Bathurst caribou herd to the extent that it could affect the total annual harvest from the herd. It is, however, very important that the herd be closely monitored so that any indirect effects of mining, in concert with other activities, are understood and measured in order to ensure the ongoing sustainability of the annual harvest.

While cumulative effects on the Bathurst Herd are not foreseen, the sustainable harvest from this resource is crucial to the well-being of many Nunavut and NWT communities. Tahera will investigate participation with the Government of Nunavut and other governments and industrial interests in monitoring the seasonal distribution,

productivity, and sustainability of the herd, in relation to all human activities on the herd's annual range. The value of such collaboration is demonstrated by the caribou telemetry data reported above. Tahera Corporation has been an active co-sponsor of the West Kitikmeot/Slave Study (WKSS), which coordinated the funding for telemetry collar deployment and data recovery. Continued cooperation and collaboration, such as that demonstrated by the WKSS, can produce more, and perhaps more useful, results for monies spent than can parties working in isolation.

Carnivores

The winter hauling season will be over by the time grizzlies emerge from their winter quarters. The minor environmental effects of seasonal transportation activities on carnivores will be local to the Project site over the life of the Project and will be direct. No other environmental effects from human sources elsewhere in the region can be foreseen.

5.8.2.2 Other Regional Activities

Cumulative effects from the Jericho Diamond Project are discussed in the context of other human activities in the local Project area within the region. Figure 5.1 shows the locations of the commercial activities and known hunting camps that occur within the "region", as it is defined for this assessment.

The kimberlite pipe to be mined at the Jericho Diamond Project and Lupin are separated by 27 air km. In fact the separation on land is much greater, because Contwoyto Lake sits between the aforementioned locations. However, any wildlife whose home range is greater than the land distance between sites could potentially experience a cumulative impact from the proposed development. This would include at least the Bathurst caribou herd, grizzly bears, and Arctic wolves. There is little information on foraging ranges of raptors in tundra environments. Some information from the Rankin Inlet area suggests ranges may be approximately 25 km^2 (Hubert, pers. comm. 1999) in which case, raptors could also be subject to cumulative effects from mine development (Lupin and Jericho).

Caribou

Because of the distance between the NWT diamond mines (EKATI™, Diavik, and Snap Lake) and the Jericho Project (the closest mine, EKATI™, is 135 km south), the only cumulative effect that requires consideration is the winter road previously discussed. Mines will, or are predicted to, have negligible effect on caribou mortality. Any local effects on energy utilization at the NWT diamond mines will be compensated for by the caribou long before they reach Jericho.

With respect to energy utilization, one modelling study on the Bathurst caribou herd has been completed (Diavik 1998). This discussion is drawn from the results of that study. The Diavik study predicted some increase in energy required by caribou to divert around the mine, but negligible increase of energy requirements in a regional sense. The same effect can be expected for Jericho. Based on Diavik's (1998) energy modelling results, no cumulative effects on energy utilization would be expected to occur between Lupin and Jericho.

There are certain areas of the mine that caribou will avoid (either by choice or by management), which results in the necessity for animals to divert around these facilities. Included are the airstrip, waste rock dumps, and open pit. However, at Lupin caribou move freely through the mine area and thus diversion is not an issue for that mine in contrast to Jericho. Thus no regional-level cumulative effects on energy utilization are likely to result from operation of the Jericho Mine in the same region as the Lupin Mine. The level of confidence for this prediction is moderately high, since it is based on nearly two decades of observations at Lupin Mine.

5.8.3 Summary of Wildlife Cumulative Effects

Cumulative effects are predicted to be non-existent or minor on a regional basis for all VEC's examined. On a local scale cumulative effects are predicted to be minor with adequate management for all VECs, including animals whose habitat is completely within the Project footprint (small mammals and some birds) and larger mammals (carnivores and ungulates).

5.9 AQUATIC PLANTS AND ANIMALS

5.9.1 Site Specific

Tables 5.3 and 5.4 summarize site-specific potential cumulative impacts on aquatic habitat and organisms.

Examination of Tables 5.3 and 5.4 indicates that there may be some reduction in affected fish populations, due to loss of habitat or reduction in quality of habitat combined with some potential for killing of fish or fish eggs from blasting activities. The fish species most at risk is the slimy sculpin. Because of the wide availability of suitable habitat in the Project area the cumulative effects will be low to moderate. Confidence in these predictions is high, because of the extensive database on fish populations and habitat at the Jericho site and because of the proposed redundancy in environmental control at Jericho.

5.9.2 Regional

Some local reduction in population sizes of especially slimy sculpins can be expected from loss of habitat and degradation of some shallow water habitat that is not completely eliminated. This will be offset by gain in habitat in the diversion channel and possibly enhancement of flows in Stream C3. Because of the relatively small numbers of fish potentially affected at Jericho, the effects on the regional populations will be negligible.

6.0 SUMMARY OF CUMULATIVE ENVIRONMENTAL EFFECTS

Elements of the Jericho Diamond Project that have the potential to act cumulatively on VECs are shown schematically in Figure 3.1. Table 6.1 summarizes the cumulative effects potential by multiple Project facilities and activities at the Jericho Project site.

Table 6.2 lists regional potential cumulative effects from existing and potential projects considered for cumulative effects assessments. Also noted are which VECs might be affected by cumulative effects from a combination of the Jericho Project and other projects. The rationale for the list in Table 6.2 is based on the known project description of the activity in question, the potential area where a measurable effect could occur, and the nature of the VEC, particularly over what area it is found. Where all three have an area of overlap an effect could occur.

Overall, cumulative effects from the Jericho Project on a local scale will be minor. On a regional scale, cumulative effects will be negligible to minor.

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TABLES

TABLE 5.1
NITROGEN LOADING AND WATER BALANCE MINE WATER RECEIVING BODIES

Lake	Nitrate t/yr	Nitrite t/yr	Ammonia t/yr	Volume m^3	Lower Bound Lake Water Exchange[a]		Loading as % of Lake Vol	
					m^3/yr	%	Carat	Lk C3
Total N Loading	2.086							
% to Carat	86%							
% to Lake C3	14%							
% Nitrate	73%						0.000005%	0.000051%
% Nitrite	2%						0.0000001%	0.0000002%
% Ammonia	25%						0.000002%	0.000003%
Carat	1.310	0.036	0.448	27,203,110	19,376,900	71%		
Lake C3	0.213	0.006	0.073	2,584,978	17,323,965	670%		

[a] Based on mean annual runoff of 130 mm

TABLE 5.2

APPROXIMATE AREAS OF SURFACE DISTURBANCE BY ECOLOGICAL ZONE[1]

Component	Ecological Zones and Areas Affected (ha)[2]							
	WGBM	**MBM**	**DBT**	**DRT**	**LK**	**CRH**	**EKD**	**Total**
Mine								
Open Pit	2.7		3.7	3.7				10
Waste Rock Dumps	17.5		22	13				52.5
Overburden Stockpile		5.07	3	4.2				12.3
Low Grade Ore Stockpile		5.3	2.7	5.07				13.1
Coarse Kimberlite Stockpile	1.85		5.95	6.7	2.14			16.6
Roads								
Haul (22 m width)	0.7	0.4	0.9	0.9			1.1	4
Access (13 m width)	1.4		3.2	4.7		1.1		10.4
Airport (10 m width)							1.5	1.5
Airstrip							2.4	2.4
Plant-Related + Ore Stockpiles				22.7				22.7
PKCA	2.07	0.9	9.6	10.9	11	0.14		34.6
Expl Camp, Truck Wash, Explosives		0.3	0.2	2			3	5.5
Sediment Collection Ponds	0.5	0.6		1.1				2.2
Borrow Areas							34	34
Subtotal Disturbance	**26.72**	**12.57**	**51.25**	**74.97**	**13.14**	**1.24**	**42**	**221.8**
% of Total	**12.05%**	**5.67%**	**23.11%**	**33.80%**	**5.92%**	**0.56%**	**18.94%**	**100%**

Notes

[1] Based on maximum areal extent of surface disturbance

[2] WGBM = Wet grass/birch meadow, MBM = Moist birch meadow, DBT = Dry barrenground tundra DRT = Dry rocky tundra, LK = Lake, CRH = Cliffs/rocky hills, EKD = Cliffs/rocky hills, Kame deltas

TABLE 5.3
SUMMARY OF SITE-SPECIFIC AQUATIC HABITAT CUMULATIVE EFFECTS

Project Activity	Effect	Relative Significance
Water intake	Loss of shallow water habitat	Low because of small area
Roads	Sedimentation Flow reduction Spills degrade habitat with contaminants	Low; no fish bearing habitat crossed Low, no fish bearing habitat crossed Low because of frequency of occurrence
Runoff from disturbed areas	Sedimentation	Low with water management
C1 Diversion	Sedimentation Loss of habitat in original stream Gain in habitat in diversion	Low with water management Low because unused Moderate, if used
Fuel Farm	Escaped spills of petroleum to water bodies	Low because of frequency of occurrence
Ore and Waste Handling Stockpiles	Sedimentation from dust	Low because of the coarse nature of stockpiled materials
Discharge of PK Effluent to Stream C3	Loss of habitat due to dewatered during post construction and closure; improved habitat through augmented flows during operation	Low as stream is used opportunistically by small numbers of fish

TABLE 5.4
SUMMARY OF SITE-SPECIFIC POTENTIAL CUMULATIVE IMPACTS ON AQUATIC ORGANISMS

Project Activity	Potential Effect	Relative Significance
Water Intake	Intrain fish in intake	Negligible because intake will be screened and low velocity
Blasting	Pressure effects may kill fish or eggs	Moderate, limited to C1 diversion and nearshore areas of Carat Lake
Angling	Deplete fish populations in site lakes	None, fishing will be prohibited in site lakes
Roads	Spills of harmful substances	Negligible (see Section 21.12)
C1 Diversion	Dry out and trap fish during low water	Low because of fish behaviour and lack of pool areas in the proposed diversion
Coversion of Long Lake	Eliminate a small population of slimy sculpins and burbot	High in Long Lake; moderate for the site
Fuel Farm Spill	Toxic substances enter water bodies	Low because of secondary containment and proposed management practices
Discharge of PK Effluent to Stream C3	Decreased water quality over natural background	Low as stream is used opportunistically by small numbers of fish

TABLE 6.1
SITE CUMULATIVE EFFECTS POTENTIAL AFTER MITIGATION

VEC	Mine			
	Facilities Contributing to Cumulative Effects	**Significance**	**Activities Contributing to Cumulative Effects**	**Significance**
Air Quality	Open pit, waste dumps, overburden stockpile, roads, airstrip	Low	Trucking, dozing, blasting	Low
Water Quality	Open pit, waste dumps, overburden stockpile, C1 Diversion	Low	Trucking, dozing, blasting	Low
Hydrology	Open pit, waste dumps, overburden stockpile, C1 Diversion	Moderate	Trucking, dozing, blasting	Nil
Permafrost	Open pit, waste dumps, overburden stockpile, C1 Diversion, roads, airstrip	Low	Trucking, dozing, blasting	Nil
Wildlife Habitat	Open pit, waste dumps, overburden stockpile, roads, airstrip	Moderate	Trucking, dozing, blasting	Moderate
Aquatic Habitat	Open pit, C1 Diversion	Low	Trucking, dozing, blasting	Nil
Wildlife	Open pit, waste dumps, overburden stockpile	Minor	Trucking, dozing, blasting	Moderate
Fish/Aquatic Organisms	Open pit, C1 Diversion	Nil	Trucking, dozing, blasting	Nil

VEC	Ore Processing			
	Facilities	**Significance**	**Activities Contributing to Cumulative Effects**	**Significance**
Air Quality	PKCA, Ore stockpiles, plant, power plant	Moderate	Trucking, dozing, ore drying	Low
Water Quality	PKCA, ore stockpiles, coarse kimberlite	Low	Trucking, dozing, ore drying	Low
Hydrology	PKCA, water intake	Moderate	Trucking, dozing, ore drying	Nil
Permafrost	Ore stockpiles, plant, coarse kimberlite	Low	Trucking, dozing, ore drying	Nil
Wildlife Habitat	Ore stockpiles, plant, coarse kimberlite	Moderate	Trucking, dozing, ore drying	Nil
Aquatic Habitat	PKCA, water intake	High	Trucking, dozing, ore drying	Nil
Wildlife	Ore stockpiles, PKCA, coarse kimberlite	Minor	Trucking, dozing, ore drying	Nil
Fish/Aquatic Organisms	PKCA, water intake	High	Trucking, dozing, ore drying	Nil

TABLE 6.2
MEASURABLE REGIONAL CUMULATIVE EFFECTS POTENTIAL

Effect	Izok Lk	Ulu	Hope Bay	Snap Lk	George Lk	Lupin	Ekati	Diavik	Bathurst Contwoyto Road
Air Quality[1]	No	No	No	No	No	No	No	No	Yes
Water Quality[2]	No	No	No	No	No	Unlikely	No	No	No
Hydrology[3]	No	No	No	No	No	No	No	No	No
Permafrost[4]	No	No	No	No	No	No	No	No	No
Wildlife Habitat[5]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquatic Habitat[6]	No	No	No	No	No	Yes	No	No	No
Wildlife[7]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Fish/Aquatic Organisms[6]	No	No	No	No	No	Yes	No	No	No

1 Excepting green house gases, principally CO_2. Cumulative contribution from all projects would be a small fraction of that of Nunavut and NWT communities.

2 All except Lupin are in entirely separate drainage systems.

3 See water quality note; Lupin's withdrawal of water from Contwoyto Lake would be unmeasurable at the Burnside River where the Jericho site drainage joins the system.

4 By its nature not subject to regional effects from mining.

5 For all sites except Lupin only applies to the Bathurst caribou herd. While the local disturbance of caribou habitat is measurable at each site, the cumulate total is a very small fraction of the total area occupied by the herd and is thus not significant.

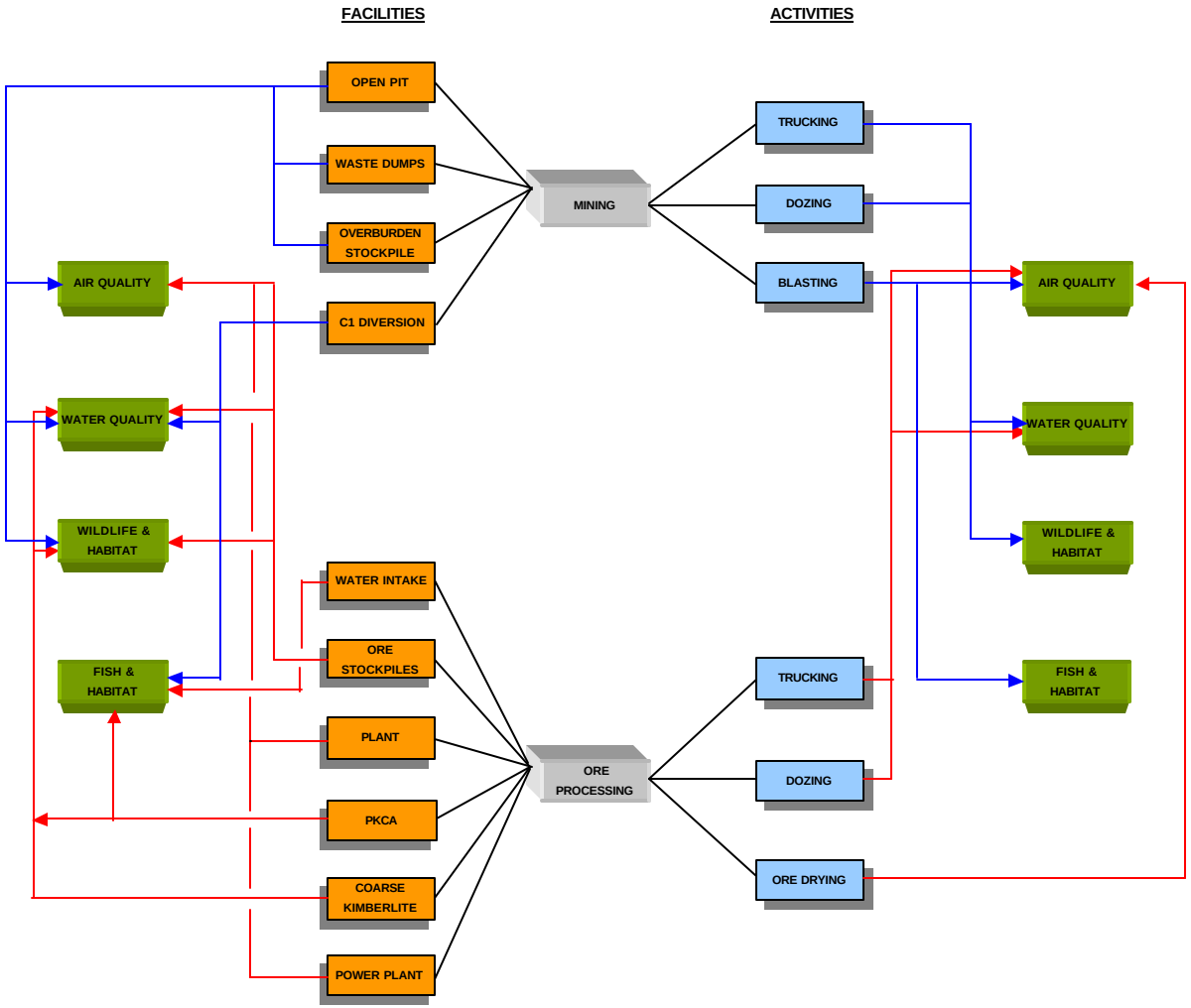
6 Since Lupin and Jericho are in the Burnside River basin, effects on aquatic habitat are measurable for the basin, but are not significant given the very small area of disturbance compared to the total area of the drainage basin.

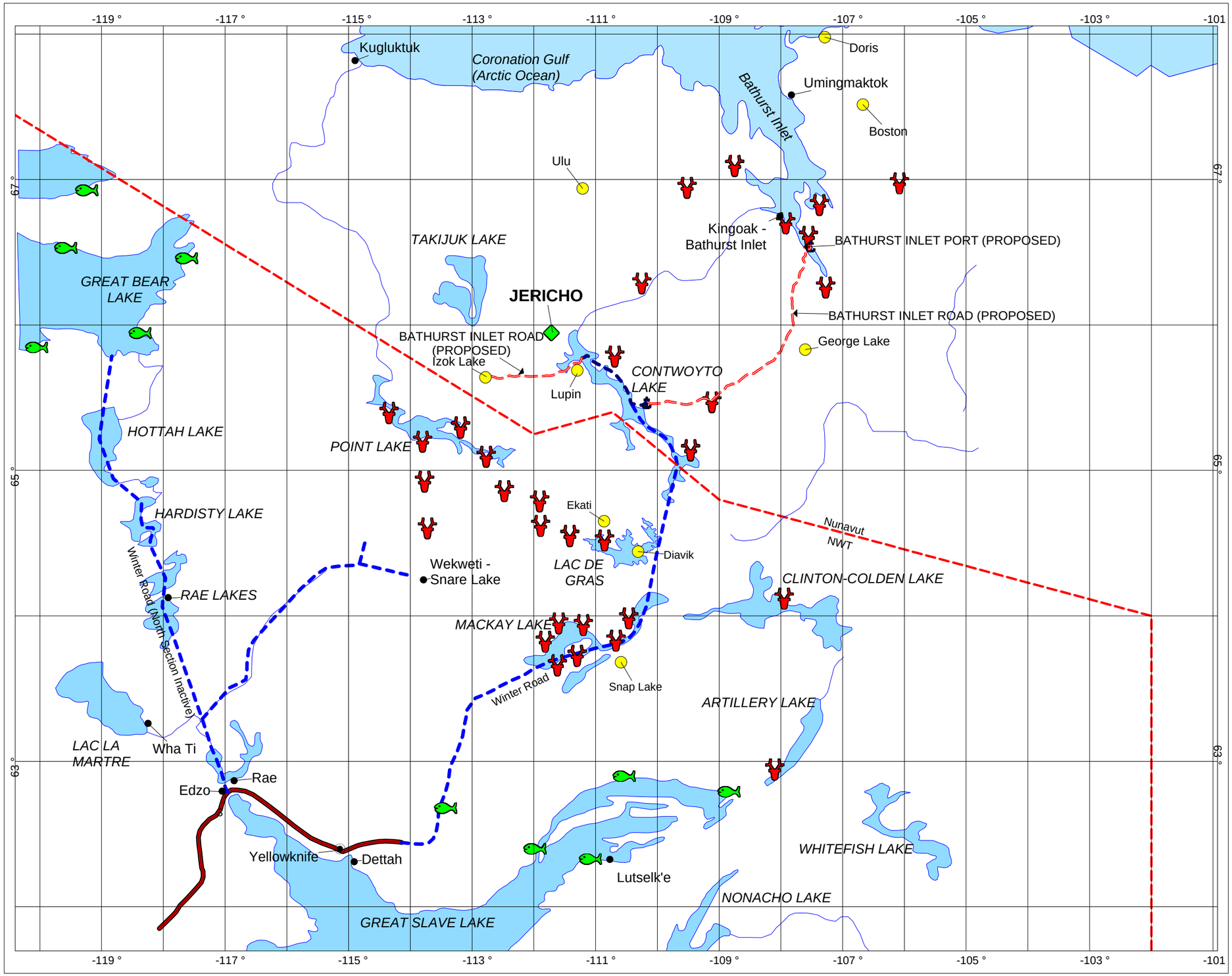
7 For all sites except Lupin only applies to the Bathurst caribou herd. Diavik and Ekati have shown that local effects on caribou could occur because of the presence of the proposed and existing, respectively, mines. Assuming the other projects listed would have a lesser effect than the two large diamond mines (because the projects are smaller), measurable effects could not be expected to extend beyond the local area and thus no measurable cumulative effects would occur.

FIGURES


LEGEND
EXISTING HYDRO
POTENTIAL HYDRO
EXISTING MINES
POTENTIAL MINES
VICTORIA ISLAND
Inuvik
Holman
Paulatuk
Calville Lake
Fort Good Hope
Norman Wells
Upper Bracket
Head of Rapids
Fort Norman
Fort Franklin
#6 White Eagle Falls
#7
#7 Rocknest Lake
Wrigley
Rae Lakes
Colomac Mine
#8
Snare Lake
#7
#4
Snare Rapids
Snare Falls
Snare Cascade
Snare Forks
Siemon Rapids
Basler Lake Dam
La Martre Falls
Lac La Martre
Lower Rapids
Rae Edzo
Fort Simpson
Nahanni Butte
Jean Marie River
Trout Lake
Fort Providence
Kakisa
Hay River
Enterprise
Pine Point
Fort Resolution
Giant Mine
Yellowknife
Miramar Mine
Dettah
Bluefish
Ptarmigan Mine
Nicolas Lake
New Discovery Mine
#3 Wet Back
#5 Willow Creek
#6 Rocky Defile Rapids
#1 Blochy Falls
#2 Escape Rapids
#4 Sandstone Rapids
Coppermine
#4 Wilberforce Falls
#5 (Storage)
#1 Burnside Falls
#3(1) Lower Burnside
Bathurst Inlet
Izok Lake
Lupin Mine
BHP
Diavik
Ptarmigan Lake (Storage)
Anderson Falls
Vee Canyon
Tyrell Falls
Artillery Lake (Storage)
Mosquito Canyon
Dead Moose
Snowdrift
Nonacho
Three Bears Rapids
Benna Thy
Nataikai Falls
Twin Gorges I
Twin Gorges II
Elsie Falls
Nonde Rapids
Tsu Lake
Fort Smith
FIGURE 2.1
LOCATION MAP
HYDRO AND MINESITES
Courtesy NT Power

FIGURE 3.1
SIMPLIFIED LOCAL CUMULATIVE EFFECTS LINKAGES





LEGEND

- Town
- City
- Jericho Kimberlite
- Mineral Deposit
- All Weather Road or Hwy
- Winter Road
- Fishing Lodge
- Hunting Camp

Bathurst Port & Road Facilities

- Proposed Port (Contwoyto & Bathurst Inlet)
- Proposed Road (Ice Road & Barge)
- Proposed Road (All Weather)

N W E S

Tahera Corporation

FIG 5.1

COMMUNITIES, MINES AND HUNTING AND FISHING CAMPS ON THE RANGE OF THE BATHURST CARIBOU HERD

Date:19/12/2002

Author: MJ

Office: VAN

Scale: 1:3000000

Projection: Longitude / Latitude (NAD 27 for Canada)

25 0 25 50
kilometres

ATTACHMENTS

ATTACHMENT 2.1
UNPUBLISHED PROPOSED MINING PROJECT OUTLINES

Izok Lake Project. Metall Mining Corporation. Environmental Evaluation Report. 1993.

"Major project components include:

- the mine area (with the open pit, process plant, tailings and waste rock disposal areas, airstrip, employee housing, storage facilities, power plant, etc.);
- a winter road approximately 300 km long to transport concentrates from the mine area to a marine port facility on Coronation Gulf;
- the marine port (including berthing facility, ship loader, and ancillary facilities) loaded approximately 19 km east of Coppermine [Kugluktuk]; and
- marine shipping of concentrates to world markets.

The winter road will be constructed annually and operate from about December 15 to April 30. Marine shipping will take place during the period June through November. Concentrates may be shipped east or west out of the Coronation Gulf, to receiving smelters in Western United States and Asia.

During the production period an average of 3,000 tonnes per day of ore would be mined and milled to produce concentrate. In addition, approximately 11,000 tonnes per day of low grade or waste material would be removed from the mine and placed in waste dumps.

Water from the mill tailings…will be recycled back into the processing plant and the remaining tailings will be placed in the Izok Lake basin."

The project is on hold as feasibility studies indicated the ore body was uneconomic at the current (1993) zinc prices. According to DIAND (Yellowknife, pers. comm.) there is some renewed interest in the deposit, but no formal proposals have been received by DIAND.

If the Bathurst port and road are constructed as presently (2002) envisaged (port on Bathurst Inlet, all weather road from the port to Contwoyto Lake, barge/winter road across Contwoyto Lake and all weather road between Contwoyto Lake and Izok Lake), a winter road to Kugluktuk and a port on Coronation Gulf would not be constructed.

Ulu Project. Echo Bay. Environmental Assessment Report. 1997.

The project is conceived as an underground mine with processing of ore at Lupin, although processing on site was an earlier consideration.

"As the ore is mined, it will be stockpiled on an ore storage pad to await transport to Lupin. This ore storage pad has been designed to store ore mined during the period when hauling to Lupin is not possible. Included in the pad design is a system for the collection and testing of runoff prior to release.

Facilities planned for the Ulu site include a 60-man camp with sleeping and dining sections, vehicle repair shop, power house, warehousing, office and change rooms, diesel power generating plant, fuel storage tanks, fresh water and sewage systems, a garbage incinerator, and an ore storage area. Explosives and detonator storage will be near Camp 3, about 12 kilometres from the Ulu site. Power for the mine and site facilities will be supplied by four diesel generators with a total capacity of 2 megawatts; a fifth generator set is a standby unit for the camp. One portable diesel generator is used for the air strip facilities and two trailer-mounted sets (500 kilowatt total capacity) are for the crusher and main ventilation fan.

To meet the ore transport function, a winter road capable of handling the travel of a fleet of 45 tonne payload (B-train configuration) trucks will be established. About twenty-five trucks will be in the fleet, with twenty-four hour per day operation during the haul season, December to May. The haul season is expected to be about 150 days; 135 days of hauling ore with 15 days expected to be lost due to poor weather conditions.

The total length of the preferred winter haul road route is 171.25 kilometres with 97.25 kilometres being overland. The preferred route avoids many animal denning and archaeological sites; criteria considered in the route selection process.

An airstrip has been constructed capable of handling small aircraft (i.e., Twin Otter) used for the transport of people and some freight to the Ulu site. The strip is approximately 1,200 metres long by 23 metres wide and is equipped with lights and a non-directional beacon."

The Ulu Project was further explored in 2000, but no plans to exploit the deposit have been announced by Echo Bay.

Non-Technical Project Summary Goose Lake Project - Kit Resources and Kinross Gold. 2000.

The George and Goose Lake iron formation gold deposits have been explored for a number of years by a number of companies. The non-technical project summary discusses exploration, but not development. Development concepts for the deposit included a number of options, none of which was explored fully to Tahera'ss knowledge:

- a mine and mill at George Lake and trucking of ore on a 65 km all weather road from Goose Lake;
- a mine and mill at Goose Lake and trucking of ore on the same proposed road from George lake;
- satellite mining of both deposits and trucking of ore to Lupin Mine over a winter road.

The project is currently undergoing further exploration, according to the application reviewed (cited above).