GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

SECTION 14

SUMMARY AND CONCLUSIONS

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14 SUMMARY AND CONCLUSIONS

This section provides a summary of the principal elements of the Gahcho Kué Project (Project) and predictions of the environmental impact of the Project. The Project is expected to have significant positive impacts on the economic environment, and positive and negative (but not significant) impacts on the social and cultural environments. The Project is not predicted to have significant adverse impacts on most components of the biophysical environment (e.g., groundwater and permafrost, hydrology, soils, vegetation, caribou and other wildlife). Finalizing predictions of environmental significance with respect to the aquatic ecosystem of Kennady Lake following post-closure are dependent on the execution of further study in 2011 of the potential for nutrients to increase.

Project Summary

- The Project is a new open-pit diamond mine and processing plant to be located at Kennady Lake, which is approximately 280 kilometres (km) northeast of Yellowknife, Northwest Territories (NWT). De Beers Canada Inc. (De Beers) will mine three kimberlite ore bodies (i.e., 5034, Hearne, and Tuzo) located under Kennady Lake.
- De Beers considered both scientific and traditional knowledge in planning the Project and incorporating environmental design features and mitigation measures to eliminate or reduce any potential harmful effects. These features include Project design elements, environmental best practices, management policies and procedures, and social programs.
- At the start of construction, natural watershed flows will be diverted away from Kennady Lake, dykes will be constructed to isolate and manage water within Kennady Lake, and areas of Kennady Lake will be dewatered to allow the ore bodies to be mined. During dewatering, water will be discharged through the natural outlet of Kennady Lake (in Area 8) and by pipeline to Lake N1. When total suspended solids (TSS) levels increase, the remaining water will be pumped and treated in Kennady Lake and all further discharge will be directed to Lake N11.
- The Project construction phase will be approximately two years. Mining will begin with the 5034 Pit and end with the Tuzo Pit. The minimum design life for mining (i.e., operations) is anticipated to be 11 years, with a possible two year extension. Progressive reclamation will occur throughout the life of the Project; interim closure will be achieved in 2 years.
- About 63% of the mine rock (i.e., mainly granitic rock that surrounds the ore) will be deposited on two mine rock piles and about 37% will be deposited in the mined-out 5034 Pit and possibly the Hearne Pit. Mine rock will also be used to cover the Fine Processed Kimberlite

Containment (PKC) Facility and Coarse PK Pile. Any potentially acid-generating (PAG) mine rock, as well as barren kimberlite, will be sequestered within the interior of the mine rock piles, with special precautions to prevent acidic seepage.

- After diamonds in the size range of 1 to 28 millimetres are processed and recovered at the Project site, they will be weighed, sized, and cleaned at an existing sorting facility in Yellowknife. De Beers has agreed to make 10% of its rough diamonds, by value, from the Project available to manufacturers approved by the Government of the NWT and by De Beers.
- At closure, most of the natural watershed drainage to Kennady Lake will be restored. This inflow will be augmented by water from Lake N11 to reduce the time for re-filling Kennady Lake to approximately 8 years. When water quality meets regulatory requirements, the dam separating most of Kennady Lake from Area 8 will be breached and downstream flow from Kennady Lake will be restored.

Air Emissions and Noise Impacts

- The estimated total greenhouse gas emissions from the Project represent about 7% of the estimated total for the NWT and about 0.01% of the estimated national total.
- Atmospheric emissions modelling results predict peak concentrations of sulphur dioxide during operations that are below the Ambient Air Quality Standards for NWT. Annual peak concentrations of nitrogen dioxide are predicted to slightly exceed guidelines. Sulphur and nitrogen dioxide concentrations are expected to peak at 2.9 km and 1.6 km outside of the Project development area boundary, respectively.
- The maximum 24-hour $PM_{2.5}$ concentrations are predicted to exceed the NWT Air Quality Standard outside the Project development area for up to 69 days in a year. The exceedences are located in areas to the south, west and east of the Project. They are primarily a result of fugitive road dust emissions from haul roads along the development area boundary. Particulate fugitive emissions are also based on conservative estimates. Areas of exceedence are confined to a 3-km radius around the Project, with predictions decreasing rapidly with increasing distance from the development area boundary.
- Maximum predicted 24-hour and annual TSP concentrations outside the development area are above guidelines. The exceedences are located in areas to the south, west and east of the Project and they are due primarily fugitive road dust emissions from haul roads along the development area boundary. The areas of exceedence are confined to a 2-km radius of the Project, with predicted concentrations decreasing rapidly as distance from the development area boundary increases. As with the other particulates, the TSP fugitive emission estimates are

expected to be a conservative representation of predicted air quality changes.

- The deposition of potential acid input to lakes from sulphate and nitrate were provided as inputs to the Key Line of Inquiry: Water Quality and Fish in Kennady Lake The maximum deposition occurs near the three mine pits and around the plant site, where haul road emissions are coupled with those from the power generation plant. The annual deposition of nitrogen during construction and operations was less than 5 kg/ha/y for all lakes. Based on these results, Project-related deposition of sulphate and nitrate in the Kennady Lake watershed is not predicted to result in lake acidification or effects to aquatic life.
- A human health risk assessment was completed to evaluate how the predicted changes to air quality outlined herein could potentially affect human health. The health of on-site workers and off-site traditional or recreational land users is not expected to be detrimentally affected by the changes to air quality that may occur as a result of Project activities. However, this statement is contingent on the results of further study and the implementation of mitigative strategies to the extent required to maintain exposure levels below those that would be of concern.
- Noise levels during construction and closure will vary depending on the type and level of activity. However, effects from construction and closure activities on the acoustic environment are expected to be temporary and periodic. The effect on the acoustic environment during operations will be continuous. The projected noise levels at identified noise receptors for the Winter Access Road, airstrip, and mine operations are below the benchmarks, with the exception of the 40 A-weighted decibels limit at 1.5 km from the Project due to operations. The distance for noise attenuation to background for mining operations (including blasting) is predicted to be 3.5 km. The distance for noise from the airstrip to attenuate to background levels is predicted to be 5.5 km.

Habitat Losses

- The Project footprint, which includes the Fine PKC Facility, Coarse PK Pile, mine rock piles, open-pit mines, plant site, airstrip, and Winter Access Road, is expected to be 1,235.4 ha. This includes 853.3 ha of terrestrial and aquatic resources that will be directly impacted. The remaining 382.1 ha consists of waterbodies that will remain unchanged.
- Project components that will not be reclaimed at closure (i.e., the mine rock piles, Fine PKC Facility, and Coarse PK Pile) are expected to result in the permanent loss of 302.7 ha of plant and wildlife habitat.

Aquatic Impacts

- The Project is not predicted to have measureable residual effects on the hydrogeological system. Temporary changes to groundwater flows will

occur with the dewatering and re-filling of Kennady Lake. However, re-filling of Kennady Lake to pre-mining levels at closure and other measures are predicted to reduce or remove potential effects on hydrogeology.

- Dewatering will result in the temporary loss of fish populations and lower trophic communities from the main basins of Kennady Lake (except Area 8). Although the lake will only be partially dewatered and will serve as the Water Management Pond for the Project during operations, the depth, habitat, suspended sediment, and water quality conditions will not be suitable to support a fish community.
- Following closure, the hydrology of the reconnected Kennady Lake system is expected to be fairly similar to existing conditions once Dyke A separating most of Kennady Lake from Area 8 is removed and pumping from Lake N11 ceases. The natural drainage of most small watersheds to Kennady Lake will be restored; however, in the A watershed, Lake A3 will continue to flow to the L watershed.
- During the post-closure period, maximum total concentrations for four metals (i.e., cadmium, chromium, copper, and iron) are projected to be higher than Canadian Water Quality Guidelines for the Protection of Aquatic Life. These metals have been measured in Kennady Lake above guideline concentrations under existing (baseline) environment conditions. All other water quality parameters are expected to be below guidelines and so will have a negligible effect on surface water quality.
- Three trace metals (i.e., copper, iron, strontium) are expected to have maximum concentrations exceeding their respective chronic effects benchmarks at one or more points during the closure phase of the Project. These trace metals and their benchmarks will require further study.
- The potential for increased phosphorus post-closure is uncertain at this time. As a result, potential effects related to phosphorus have not been presented and will not be available until such time as additional analysis is completed. This information will be provided to the Panel in 2011.
- Water quality in the refilled lake is expected to return to conditions suitable to support aquatic life over time. The physical and chemical environment in Kennady Lake, therefore, will allow re-establishment of an aquatic ecosystem, although the re-established communities may differ from pre-development communities.
- The projected impacts of the Project on the suitability of water within the Kennady Lake watershed to support a viable and self-sustaining aquatic ecosystem are considered to be not environmentally significant. Water quality is predicted to change, but is expected to result in negligible effects to aquatic health in Kennady Lake. Changes to water quality in waterbodies downstream of Kennady Lake are also predicted to result in negligible effects to aquatic health.

- Recovery of the phytoplankton, zooplankton, and benthic invertebrate communities is predicted to occur within five to ten years after Kennady Lake is re-filled. However, the communities may be different from the pre-development communities,
- The re-establishment of the fish community within Kennady Lake, and the speed at which it will occur, will depend on the ability of fish to re-colonize the refilled lake, the habitat conditions within the lake, and how succession takes place within the refilled system after it has been fully connected to the surrounding environment. It is expected that a fish community will become re-established in Kennady Lake; however, the fish community may be different than what exists currently. The composition of the fish community is dependent on the nutrient and limnological characteristics that develop in the refilled lake. The analysis of nutrient levels in the refilled lake is on-going, with results being filed in 2011. The physical habitats in the reconnected lake are expected to be similar to those that currently exist, although the area and depth profiles of the lake will have changed.
- Northern pike, Arctic grayling, and burbot are likely to be large-bodied fish species that become re-established in the re-filled Kennady Lake. Northern pike is expected to be one of the last fish species to re-establish a stable, self-sustaining population in Kennady Lake following complete refilling. Upon development of suitable habitat conditions for lake trout in the refilled lake, it is expected that this species can become re-established and will also require a long time to develop a stable, self-sustaining population following the complete refilling of Kennady Lake.
- Within Kennady Lake, the projected impacts on the abundance and persistence of Arctic grayling, lake trout, and northern pike are considered to be not environmentally significant. It is expected that self-sustaining populations of these fish species will become established in the refilled lake. Downstream of Kennady Lake the projected impacts on the abundance and persistence of Arctic grayling, lake trout, and northern pike are also considered to be not environmentally significant.
- The potential effects of changes to nutrient levels in Kennady Lake have not been presented. They are the subject of continuing evaluation and are therefore not included at this time in the determination of environmental significance for any aquatic environment assessment endpoints. Once the continued analysis is complete, the significance determination will be updated as appropriate and required.
- A habitat compensation plan will be implemented to provide fish spawning, rearing, and foraging habitat. The purpose of the habitat compensation plan is to create new fish habitat so that there is no net loss in the production capability of fish habitat and no net adverse effects on fish populations.

Terrestrial Impacts

- Approximately 79.3 ha of ecological land cover types with moderate to high potential to support rare plant species (i.e., round-fruited sedge – Chamisso's cottongrass fen, sheathed cottongrass – bog rosemary sedge fen, and water sedge – narrow-leaved cottongrass fen) will be directly altered by the Project footprint. Overall, the magnitude of direct impacts from the Project on plant populations and communities is predicted to be low. A high magnitude impact was classified for the water sedge – narrow-leaved cottongrass fen community type. All impacts, except for fragmentation, occur at the local scale and most are expected to be reversible within 20 to 75 years of closure. Project impacts should not significantly influence the persistence of plant populations and communities, listed species, and the continued opportunity for use of traditional plants.
- The habitat quality analysis showed that most of the decrease in preferred caribou habitats from development occurred prior to 2006. Conditions on the seasonal ranges improved from 2006 to 2010. Results also indicated that the application of the Project resulted in negligible (i.e., not detectable) to low (i.e., within the range of baseline values) magnitude changes to preferred caribou habitat, relative to 2010 baseline conditions for both the Bathurst and Ahiak caribou herds. Cumulative habitat changes from the Project and previous, existing, and future developments are expected to be low in magnitude.
- Dust and sensory disturbance effects from the Project are predicted to occur at local and regional scales, respectively, and these effects are expected to reversible in the long-term.
- The energetics model predicted that incremental impacts from the Project and cumulative impacts from the Project and additional developments on caribou reproduction were negligible and low in magnitude, respectively. Based on the predicted number of disturbance encounters for a landscape with the Project and the Taltson Hydroelectric Expansion Project, female caribou would have to increase encounter rates with developments by at least 20 times during a summer of high insect harassment to not produce a calf the following spring.
- Incremental and cumulative effects from the Project and other developments (previous, existing, and future) to caribou population size and distribution at the scale of seasonal ranges were examined by linking results from habitat quality and energetics models to input parameters in a population viability analysis (PVA). The focus of the PVA models was to determine the relative changes to the risk of caribou population persistence for different environmental conditions.
- The PVA predicted that incremental impacts from the Project and Taltson Hydroelectric Expansion Project decreased projected population

sizes by a low magnitude; whereas, cumulative impacts from the Project and other developments decreased projected population sizes by a moderate (i.e., slightly exceeds baseline values [10% to 20% decrease]) magnitude. Cumulative effects were larger when increases in insect activity levels or harvest rates were included. Thus, the overall magnitude of cumulative impacts from development on caribou population size is predicted to be moderate, but dependent on the level of insect harassment and harvesting. The duration of the residual impacts from the Project on caribou populations is expected to be long-term and impacts should be reversed within two caribou life spans (within five to ten years following closure).

- At the scale of the population for grizzly bear, wolverine, and wolf, the magnitude of direct changes to habitat quantity and fragmentation from the Project and other developments is predicted to be negligible to low. No esker habitat is expected to be disturbed by the Project. Impacts to movement and behaviour of wolverines and wolves from the Winter Access Road and Tibbitt-to-Contwoyto Winter Road will only occur periodically each year during the seasonal operation of the winter roads.
- The magnitude of Project-specific effects from changes in habitat quality to grizzly bear, wolverine, and wolf populations is predicted to be negligible to low. The magnitude of cumulative changes to the habitat quality of the seasonal ranges ranged from low to moderate. The Project is not expected to impact the persistence of grizzly bear, wolverine, and wolf populations. Analysis indicated that harvest levels had more of an effect on the population persistence of grizzly bear and wolverine than developments.
- The magnitude of changes from the Project to habitat quantity and fragmentation, and habitat quality are predicted to be negligible to low for other ungulates (i.e., moose and muskoxen). Changes to habitat from the mine rock and coarse PK piles and Fine PKC Facility will be permanent, while all other effects are expected to be reversible in the medium- to long-term.
- The magnitude of direct changes from the Project to habitat quantity and fragmentation, and habitat quality are predicted to be negligible to low for upland breeding birds, water birds, and raptors. The impacts vary from local to regional in geographic extent
- An ecological risk assessment was completed to evaluate the potential for adverse effects to individual animal health associated with exposure to chemicals from the Project. No impacts were predicted for caribou, carnivore, moose, and muskoxen health; however, there was a potential for effects to the health of aquatic-dependent species (i.e., water fowl and shorebirds) as a result of boron levels in Kennady Lake after re-filling. De Beers is committed to further study of this potential issue in 2011 and will incorporate mitigation as required to prevent negative effects to waterfowl and shorebirds.

Socio-economic Impacts

- Residual impacts from the Project on the economy of the NWT (government revenues) are predicted to be positive and significant. Impacts from the Project on family and community cohesion, and social disparity are expected to be mainly positive and not significant. Impacts from the Project on employment, training, infrastructure, culture, and heritage, and archaeology are predicted to be not significant.
- The Project will annually contribute to substantial government revenues. The Project will spend approximately $910.9 million on goods and services over the life of the mine, and the NWT gross output will increase by an estimated $300.6 million as a result of this initial business demand. Project construction will increase the NWT gross domestic product (GDP) by about $112.8 million, and will increase the national GDP by about $395.3 million. The total GDP that is attributed to the NWT during the 11-year operations phase is estimated at $3.3 billion, where the majority ($3.1 billion) is the value added through the production of diamonds.
- The Project is not anticipated to increase drug or alcohol consumption, and other negative lifestyle choices beyond current conditions. The Project will not have a negative impact on social disparity, cost of living, or social problems. Effects will vary across communities due to some factors such as experience with mining and the availability of labour and businesses.
- The Project will moderately contribute to the growth of a skilled local labour force in the NWT. An estimated 554 full-time equivalent (FTE) jobs will be created annually during operations (direct and indirect combined). The number of positions filled by NWT residents will depend on market conditions, which are expected to change over the life of the mine.
- The effects of training on local communities during the lifespan of the Project are anticipated to be moderately positive on maximizing skills development for employees. More people in the LSA are expected to benefit from training and employment opportunities provided by the Project. These benefits are expected to extend after mine closure.
- The Project will add to overall truck traffic for at least the first five years. Peak truck traffic during the construction and operation phases of the Project can be accommodated without impeding other users and their operations. After that, it is expected that traffic from the Ekati and Diavik diamond mines will decrease, reducing the total volume of truck traffic.
- The Project will have a small measurable residual impact on in-migration, and costs to the government to upgrade infrastructure and to monitor and regulate the Project. Any external or temporary labour brought in by the Project will not likely remain in the NWT.

- Project activities will not be heard or seen at culturally-important areas. Following closure, permanent landscape changes include two mine rock piles, the Coarse PK Pile, and the Fine PKC Facility, which could be visible should someone travel near the site in the future (perhaps at a distance of 30 km). As a result, the Project is expected to cause a small permanent change in the cultural landscape.
- Archaeological investigations identified 35 sites (lithic scatters) that were located within 1 km of the Project site. Nine of these sites had moderate to high archaeological significance and varying levels of subsurface excavation and surface collection will be required if they cannot be avoided. The majority of archaeological sites along the Winter Access Road are not likely to be impacted by Project activities because they are on elevated terrain. One site may require markers to avoid impact to the site.

14.1 ACRONYMS

%	percent
De Beers	De Beers Canada Inc.
ha	hectare
km	kilometre
LSA	Local Study Area
m	metre
NWT	Northwest Territories
PAG	potentially acid-generating
PK	processed kimberlite
PKC	Processed Kimberlite Containment
Project	Gahcho Kué Project
PVA	population viability analysis
RSA	Regional Study Area