DE BEERS
CANADA
GAHCHO KUÉ PROJECT

September 13, 2012

File: S110-01-10

Chuck Hubert
Senior Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board
Suite 200, 5102 – 50th Avenue
PO Box 938
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Dear Mr. Hubert:

Fisheries & Oceans Canada – Round 2 Information Request
Responses - Gahcho Kué Project Environmental Impact Review

De Beers is pleased to provide the Mackenzie Valley Environmental Impact Review Board with responses to Round 2 Information Requests submitted by Fisheries & Oceans Canada.

Sincerely,

Veronica Chisholm

Veronica Chisholm
Permitting Manager

Attachment

c: L. Dow, A/Area Director, Fisheries & Oceans Canada

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Round 2 Information Request Number: DFO 2-1

Source: Fisheries and Oceans Canada

Subject: Technical Memo dated June 29th 2012, "Gahcho Kue Fish Habitat Compensation Plan - Update"

Preamble

No preamble provided.

Request

Fisheries and Oceans Canada provided comments to DeBeers Canada on a draft conceptual flow mitigation plan dated May 8th, 2012. These comments can be found in Appendix A of this submission. Many of the issues raised in our previous comments have been addressed in the June 29th "*Gahcho Kue Flow Mitigation Plan*" memo in the Future Work and Adaptive Management Section. Commitments were made to monitor during the operation period to refine the flow releases based on passage needs of fish. Additional field surveys will be done 2012 to validate the assumptions for the flow at which barriers to migration persist and on the availability and suitability of spawning and rearing habitat at a wide range of flows. The updated flow mitigation plan also identifies the outmigration in late summer to overwintering habitats as one of the objectives of the flow mitigation plan. The monitoring program should include the outmigration period to ensure that grayling have enough flow to return from the spawning and rearing areas, with a commitment to increase flows, if needed. DFO would also like to request the following information on this current version of the plan:

1. It is indicated that the target for providing access is 3 out of 4 years. How will the year skipped be determined? What if there is a series of dry years in a row?
2. What information was used to compile the information on timing and duration outlined in Table 1? Supporting documentation and data used in the development of this plan will be needed. The assumptions regarding the timing of life history stages of grayling are of vital importance in coordinating the discharge to support the life stages in question. Northern based information should used as the timing and duration of life stages is highly variable for species depending on latitude and prevailing climatic conditions.

In addition to other sources, the work by Jones et al., should be reviewed as they relate to grayling habitat use in NWT tundra streams. The use of existing scientific literature (especially research on northern systems), as well as ground truthing and monitoring of existing conditions should be used to develop and refine this mitigation plan.

3. Will the timing of flow be fixed or will the release of water be scheduled based on the environmental conditions any given year? E.g. If there is a late spring grayling would run later. The flow mitigation plan should accommodate the potential for inter-annual variability in the timing of freshet and other hydrological processes.

4. From Table 2 it appears that there is a focus on providing adequate flow for fish passage into spawning streams, but not the outmigration of adults and juveniles. This should be addressed.

Response

Response to Request 1:

As described in the June 29th memo entitled *Gahcho Kué Flow Mitigation Plan (June 2012),* (the plan), the specific design of the operational procedures to support the flow mitigation plan will be developed during the detailed engineering design phase (Golder 2012). Determining if augmentation is required and the level of flow augmentation will be based on the water year type (i.e., dry, average-dry, average wet, wet). Predicting the water year type will be done based on measurements of snow pack from the previous winter so that augmentation can be timed to start with the start of the freshet.

The intent of the flow mitigation is to achieve augmentation on all years other than dry years which, on average is expected to be 3 out of 4 years over the period of flow mitigation during operations and refilling. However, this may result in more than three consecutive years where augmentation is provided, and conversely, may also result in back-to-back dry years where no augmentation is provided. The operational monitoring plan will include details regarding scenarios about consecutive dry or wet years to develop operational protocols that De Beers will follow to provide protection to the downstream fish populations. These protocols will be developed in consultation with regulators.

Response to Request 2:

As referenced in Table 1 of Golder (2012) the information was sourced from Hubert (1985). In addition to Hubert (1985), several references related to Arctic grayling life history in northern systems were reviewed for the assessment of effects (Section 9.10.3 of the 2011 EIS Update [De Beers 2011]), as well as developing the flow mitigation plan. For example, these references included Clark (1992), Evans et al. (2002), Deegan et al. (2005), Jones et al. (2003a,b), Jones and Tonn (2004), and Stewart et al. (2007), among others.

As described under the *Future Work and Adaptive Management* section of the *Gahcho Kué Flow Mitigation Plan (June 2012)* submitted to the public registry on June 29, 2012 (Golder 2012), additional field surveys were conducted during the spring freshet in 2012, and future downstream flow monitoring programs will be conducted, with the details of the monitoring program being incorporated into the overall Aquatic Effects Monitoring Program (AEMP) as part of the permitting process. Future monitoring, once the flow mitigation plan has been implemented, will also be used to inform aspects of the flow mitigation plan (such as ramping rates to avoid fish stranding, duration of flow augmentation targets for each life stage, etc.). The flow mitigation plan will be adapted, as required, based on site-specific monitoring data and in consultation with regulators.

Response to Request 3:

The timing of when flow augmentation will begin will be defined in the operation procedure developed as part of the detailed design. However, it is the intent of the plan to match the natural timing of ice-off during each year when flow augmentation is required (Golder 2012). This may result in augmentation beginning as early as mid-May in some years and potentially delayed until mid-June in other years as determined through analysis of snow pack and regional hydrometric data. It is expected that ramping down in the fall will be kept consistent from year-to-year and will start at the beginning of September.

Response to Request 4:

Outmigration for juveniles and adults has been addressed in the plan. As described in the *Current Conditions* section of the *Gahcho Kué Flow Mitigation Plan (June 2012)* submitted to the public registry on June 29, 2012 (Golder 2012), outmigration in the late summer to overwintering habitats is one of the key objectives of the flow mitigation plan, along with allowing migration access, maintaining habitat conditions for egg incubation and fry rearing, and providing a seasonally appropriate hydrograph based on the natural timing and duration of high flow and low flow events. Flow augmentation will be maintained throughout July and August, as described in Table 2 and illustrated in Figures 2 and 3 of the plan, in part to allow for outmigration of adult and juvenile fish (Golder 2012). To address DFO's comments on a previous version of the plan, outmigration was added to the list of objectives and to Table 1 to clarify that this aspect of Arctic grayling life history was considered (Golder 2012). Future monitoring will also include programs to assess outmigration timing, and the flow mitigation plan will be adapted, as required, based on the results of the monitoring program.

References

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De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

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September 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
ROUND 2 INFORMATION REQUEST RESPONSES

Round 2 Information Request Number: DFO 2-2

Source: Fisheries and Oceans Canada

Subject: Technical Memo dated June 29th 2012, *"Gahcho Kue Fish Habitat Compensation Plan - Update"*

Preamble

No preamble provided.

Request

DFO has met with DeBeers Canada on several occasions to discuss their conceptual fish habitat compensation plan as well as the approach to calculating and classifying the extent of the harmful alteration, or disruption or the destruction (HADD) of fish habitat that is likely to occur as a result of the project. DFO has requested on a number of occasions that DeBeers continue to explore additional compensation options beyond the flooding of the D-E-N area due to the timing of when the compensation area would be constructed and the uncertainties associated with its success (monitoring would have to occur over several years post-closure) as well as the potential environmental impacts associated with flooding the terrestrial environment. DFO will continue to work with DeBeers to further develop their compensation plan. The following questions relate specifically to the June 29th, 2012 memo:

1. Mercury mobilization from newly flooded soils and vegetation can lead to bioaccumulation of mercury in the food chain, ultimately causing increases in the fish populations. DeBeers has identified that this may be an issue in the proposed compensation of the newly developed habitat areas in the D-E-N lakes and that they plan to monitor to see if additional mitigation measures may be required prior to closure. How will the potential mobilization and bioaccumulation of mercury be evaluated for the flooding of the D-E-N lakes? How would it be monitored and what additional mitigation measures would be implemented to deal with any issues?
2. Please update Table 9 and 10 to include all impacted lakes specifically Lakes Kb4, N7, D1.

Response

Response to Request 1:

The June 29th *Gahcho Kué Fish Habitat Compensation Plan – Update* memo (Golder 2012) investigated a further increase in water level in the D-E-N lake area as an option to create replacement fish habitat in order to achieve no net loss of fish habitat according to the Fisheries and Oceans Canada (DFO) *Policy for Management of Fish Habitat* (DFO 1986). However, following consultation on the option with communities and DFO, this option is being reconsidered at this time and other compensation options are being evaluated for the No Net Loss Plan.

However, the option of raising of lake levels in the D-E-N lake area increases available aquatic habitat by increasing lake depth, volume and surface area, and allows for connections to formerly non-fish-bearing waters. The responses to Round 1 Information Requests (IRs) DFO&EC_55e, DFO&EC_58b, DKFN_25, and DKFN_37 (De Beers 2012a,b), provide information on the potential for mercury mobilization from flooding soil and vegetation and associated effects. As described in the responses to the Round 1 IRs listed above, monitoring of water quality, sediment quality and fish tissue will be incorporated into the monitoring programs for the proposed Gahcho Kué Project (Project) to confirm predictions. Monitoring of compensation habitats will also be required as part of the Project. Appropriate mitigation or management measures would be implemented as required, as part of the adaptive management associated with the monitoring programs.

As per the response to Round 1 IR DKFN_37 (De Beers 2012b), monitoring of mercury concentrations in edible fish tissue would be conducted prior to and following raising the lake using non-invasive techniques, to determine whether there is a potential issue. If, despite expectations to the contrary, mercury concentrations (adjusted for fish age, which is a major modifying factor) show a significant upward trend following water level increases, mitigation options would be considered. The actual management option(s) that may be employed in this unlikely scenario could include liming, but could also include fish barriers, fish consumption advisories, or selenium additions. Specific management options would be determined, if and when necessary, in consultation with regulatory agencies and communities.

Response to Request 2:

As requested, Tables 9 and 10 in the June 29, 2012 memorandum (Golder 2012) have been updated to include Lakes D1, Kb4, and N7; please see Tables DFO_2-2-1 and DFO_2-2-2 below.

Table DFO_2-2-1 Species Distribution within Affected Habitats and Compensation Footprint

Species	Waterbody															
	Kennady Lake	Lake D1	Lake D2	Lake D3	Lake D4	Lake D5	Lake D10	Lake E1	Lake E2	Lake Ka1	Lake Kb1	Lake Kb4	Lake N7	Lake N14	Lake N14a	Lake N14b
Arctic grayling	■		◊	◊	◊									■	■	
Burbot	■	■	◊	■	◊											
Lake chub	■													■	■	
Lake trout	■	◊	◊	■										■		
Ninespine stickleback	■													■	■	
Northern pike	■	■	■	■	◊			■								
Round whitefish	■															
Slimy sculpin	■	◊	◊	◊				■						■	■	

Note: ■ – documented occurence; ◊ - assumed occurrence; Shaded cells indicate species not captured and assumed to be absent.

Table DFO_2-2-2 Fish Species Captured and Sampling Date/Method for Waterbodies within Affected Habitats and Compensation Footprint

Waterbody	Fish Species Captured	Sampling Date (Sampling Method)
Kennady Lake	ARGR, BURB, LKCH, LKTR, NNST, NRPK, RNWH, SLSC	Summer 1996 (AN, GN, MT, OB), Fall 1996 (AN, GN) Summer 1999 (GN, MT) Winter 2004 (AN), Summer 2004 (AN, EF, ES, GN, MT), Fall 2004 (AN, EF, GN) Spring 2005 (FF), Summer 2005 (EF) Summer 2010 (GN)
Lake D1	BURB, NRPK	Summer 2003 (MT), Spring 2004 (FF)
Lake D2	NRPK	Spring 2004 (FF), Summer 2004 (GN), Fall 2004 (EF) Summer 2007 (EF, GN, MT) Summer 2010 (GB, MT)
Lake D3	BURB, LKTR, NRPK	Summer 2004 (GN), Fall 2004 (EF) Summer 2007 (EF, GN, MT) Summer 2010 (GN, MT)
Lake D4	not sampled	not sampled
Lake D5	no fish captured	Summer 2011 (EF, MT)
Lake D10	no fish captured	Summer 2003 (MT) Summer 2005 (EF, GN)
Lake E1	NRPK, SLSC	Summer 2004 (GN), Fall 2004 (EF) Summer 2007 (EF, GN, MT) Summer 2010 (GN, MT)
Lake E2	no fish captured	Summer 2003 (MT) Summer 2005 (EF)
Lake Ka1	no fish captured	Summer 2003 (MT) Summer 2005 (EF)
Lake Kb1	no fish captured	Summer 2005 (EF)
Lake Kb4	no fish captured	Summer 2003 (MT), Summer 2005 (EF)
Lake N7	no fish captured	Summer 2004 (GN), Fall 2004 (EF)
Lake N14	ARGR, LKCH, LKTR, LNSC, NNST, SLSC	Summer 2005 (EF, GN) Summer 2010 (GN, MT) Summer 2011 (GN, MT)
Lake N14a	ARGR, LKCH, LNSC, NNST, SLSC	Summer 2010 (GN, MT) Summer 2011 (EF, GN, MT)
Lake N14b	no fish captured	Summer 2010 (GN, MT) Summer 2011 (EF, MT)

Notes:

Fish species: ARGR = Arctic grayling, BURB = burbot, LKCH = lake chub, LKTR = lake trout, LNSC = longnose sucker, NNST = ninespine stickleback, NRPK = northern pike, RNWH = round whitefish, SLSC = slimy sculpin.

Method: AN = angling, EF = backpack electrofishing, ES = boat electrofishing, FF = fish fence, GN = gill net, MT = minnow trap, OB = observed.

References

De Beers (De Beers Canada Inc.). 2012a. *Fisheries & Oceans Canada and Environment Canada Joint Information Request Responses – Gahcho Kué Project Environmental Impact Review*. Submitted to Mackenzie Valley Environmental Impact Review Board. April 2012.

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GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
ROUND 2 INFORMATION REQUEST RESPONSES

Round 2 Information Request Number: DFO 2-3

Source: Fisheries and Oceans Canada

Subject: Technical Memo dated June 18th 2012, *"Detailed Alternatives Analysis Report*"

Preamble

No preamble provided.

Request

1. For the assessment of water and waste management alternatives the following impacts were considered from an economic perspective.

    - Capital cost impacts (dyke design and method of construction, quarry requirements, water treatment plant, fine PKC facility, lake refilling and closure costs, camp and infrastructure requirements, support services (planes, trucking, etc).
    - Operating cost impacts (water transfer and pumping, increased fuel and labour costs; water treatment plant operating costs, monitoring and inspection, etc).
    - Schedule impacts (extended design and construction period, seasonal construction restrictions, construction sequence issues, etc).

    DFO noted that for several options the cost of compensation was not included in the total economic analysis. For example Alternative A2, where Area 2,3,5 and 7 would not be dewatered, could have lower costs of compensation compared to other options with greater impacts on Kennady Lake. Other things to consider in the evaluation are the benefit of maintaining overwintering habitat, and maintaining a persistent population of lake trout during operations. By maintaining a semblance of the ecological function of these areas, the time required to return Kennady Lake to a viable self sustaining aquatic ecosystem at closure could be greatly reduced.

    Please include the cost of habitat compensation and effectiveness monitoring for all options within this analysis.

2. The mine plan proposes to use the 3 pits to store processed kimberlite tailings as well as water from the water management pond. While using

mined out pits for storage makes sense, effects on water quality once Kennady Lake is flooded are unknown.

Will the Reclamation Research Plan include an assessment of the predicted and actual water quality in the pits after they have been filled and prior to the rest of Kennady Lake being flooded?

3. With both alternatives provided for mine rock storage it is stated that seepage and runoff from the mine rock piles will flow directly into Kennady Lake after re-filling.

   What is the water quality of the seepage and runoff water expected to be over the long term from the waste rock piles?

4. As part of the proposed mine plan, the 3 pits referenced above as well as the impacted sediment from the water storage pond area will be submerged at closure in addition to the seepage from the waste rock piles and the process kimberlite containment facility all of which could influence water quality in Kennady Lake at closure. What is the worse case scenario, if water quality cannot be met in Kennady Lake after refilling? What would be the costs associated with implementing contingency or adaptive management options?

5. It is stated in the Alternatives Analysis, that "*earlier alternatives suggested a fish passage channel could be constructed to allow water to flow to Area 8. The channel canal was considered uneconomical due to the extensive earthworks undertaking, and schedule impacts. Furthermore, with no head differential between Area 3 and Area 8, design would necessitate a deep channel and wide channel to avoid full freezing and snow blockage conditions*." As identified by DeBeers, BHP Billiton constructed a 4-km diversion channel at the Ekati Diamond Mine, "*bypassing the southern portion of Panda Lake and Koala Lake providing for a water and fish bypass channel between the upstream lakes and Kodiak Lake*."

   Please compare the anticipated level of effort, difficulty and technical feasibility of the construction of a diversion channel to Area 8, to what was undertaken for the Panda Diversion Channel.

6. One of the disadvantage listed for Alternative A is the need for a TSS treatment plant. However, a treatment plant could reduce the area required for water management.

Please provide a comparison of the area required for water management with a treatment plant and without a treatment plant.

7. On page 27 a disadvantages of Alternative A is that "*The environmental risk of uncontrolled water seepage will be high, both during mine operation and after closure, because the raised west Area 6 pond contained within the ring dyke has high head of water above the natural topography*."

   In DeBeers' preferred mine plan, water from the water management pond would be pumped into Tuzo Pit. Could a similar approach be used to pump water from Area 6 into one of the pits thereby reducing the risk of uncontrolled water seepage at closure? Could this area then be capped or designed in a way to no longer store water at closure?

8. DeBeers identified that a disadvantage associated with a TDS treatment plant is that high TDS residual brine and sludge will need to be properly disposed of.

   Does the inclusion of a TDS treatment plant reduce the amount of water that would need to be managed over the life of mine? Could the waste from the TDS treatment plant be placed in the Tuzo pit?

9. Perimeter dykes presented in Option 3A in Section 4.1.1.4 will be constructed around the west portion of Area 6 before mine production; the final dykes will have a maximum height of 28 m and a total length of approximately 3,900 m. The Area 7 pond will be used to store the contact water, including the pit water that does not meet the discharge criteria, **in Year 11** after the mined-out 5034 and Hearne pits are full.

   If Area 7 is utilized for contact water storage at the beginning of operations rather than waiting until Year 11, how would this affect the height of the dyke required for Area 6?

10. DeBeers has not provided sufficient evidence to prove that fish habitat in Areas 2, 3 and 5 will be destroyed by drawing down the water level by 3 metres. As there is no regulatory mechanism to allow the deposit of a deleterious substance, alternatives should be assessed by DeBeers accordingly.

Please provide additional information on the proposed alternatives that don't require the deposit of a deleterious substance into fish frequented waters (e.g. Option 6 or 3 in the Fine PK alternatives options).

11. It is stated in the Alternatives Analysis that the 3 metre proposed drawdown would cause high quality lake trout and round whitefish spawning habitat to be exposed and unavailable. High quality habitat that would be lost is in the 2 to 4 metre depth range which is kept free of silt and fine organic debris by wave generated currents and below the zone of ice scour. "*As the lake level is reduced, the lake bed in the remaining areas would still be subject to up to 2 m of ice scour. Beyond this new ice scour zone, the substrate is composed primarily of loose, organic sediment that would not be suitable for lake trout and round whitefish spawning,* ***at least during the initial years*** *until sufficient wave action clears the sediments from the substrate. Therefore, suitable spawning habitat for these fish species would be lost for the duration of the mine*".

    How many years does DeBeers believe it will take for wave action to expose suitable spawning habitat? If wave action created suitable habitat in the "initial years" spawning habitat would not be lost for the duration of the mine.

Responses

Response to Request 1:

The structure of the alternatives analysis (De Beers 2012a) was such that three major criteria were used to assess the viability of each alternative in a hierarchical process. These criteria included:

- Technical feasibility;
- Economic viability; and
- Environmental considerations.

Economic viability is only one of three criteria; however, the alternative must be economically viable and technically feasible to warrant further detailed consideration of environmental impacts. Alternatives that were eliminated from further analysis based on economic criteria were discarded because the entire project costs did not meet minimum economic hurdles set by the joint venture partners. None of the alternatives were eliminated because one was nominally less economic than another.

Habitat losses associated with Alternative A (Areas 2, 3, 5 and 7 are not dewatered), would be less than Alternative B (Areas 2 to 7 partially or fully dewatered), and a comparable smaller amount of habitat compensation replacement would be required. However, direct habitat compensation costs, based on the conceptual compensation plan submitted in the 2010 Environmental Impact Statement (EIS; De Beers 2010), represent less than one percent of the overall construction and operating costs and were therefore not a significant factor in the economic analysis of the alternatives. Similarly, the cost of effectiveness monitoring does not represent a significant cost relative to the overall construction and operating costs.

Response to Request 2:

A Reclamation Research Plan has not yet been developed for the Gahcho Kué Project (Project), but it is anticipated that water quality in the open pits (e.g., Hearne and Tuzo pits) and at a number of locations in Kennady Lake will be monitored as Kennady Lake is refilled. This monitoring will be an important component of the Surveillance Network Plan (SNP) and Aquatic Effects Monitoring Program (AEMP) programs during the operations and closure phases. Monitoring data from the pits, and the refilling Kennady Lake, will be assessed and compared to water quality projections.

It is important to note that fine processed kimberlite (PK) will only be stored in the mined out 5034 and Hearne pits and not in Tuzo Pit.

Response to Request 3:

The projected drainage water quality from each of the mine rock piles is presented in Table DFO 2-3-1. The quality is defined for two conditions (i.e., freshet and steady state) because the drainage quality from the mine rock piles is assumed to exhibit seasonality at the Project. During the freshet period, fresh oxidation products and readily soluble salts will be flushed from mine rock placed in the piles during the winter months. Following the initial flushing of these materials, the runoff is expected to obtain a more constant, or “steady-state”, water quality for the remaining runoff months.

The approach to assign water chemistry to seasonal runoff from the mine rock piles is detailed in Appendix 8.II of the 2012 EIS Supplement (De Beers 2012b). In summary, leachate concentrations measured during initial and long-term stages of geochemical testing (i.e. humidity cell testing) for each mine rock material (lithology) were selected to represent the water chemistry source term inputs for the mine rock pile runoff in the Kennady Lake water quality model.

The long-term drainage water quality from the mine rock piles will be a function of the materials stored within the facilities at closure, i.e., it is determined by mixing the water chemistry source terms for each material in their relative storage proportions at each month. The mine rock lithology units expected to be stored in the West and South Mine Rock Piles include:

- granite;
- altered granite;
- granodiorite;
- altered granodiorite;
- diorite; and
- diabase.

In addition to the above units, coarse PK will also be stored in the West Mine Rock Pile.

It is important to note, to provide a conservative estimate of the Kennady Lake water quality, depletion of chemical constituents was not considered in the water quality evaluation and each modeled parameter was assumed to have an infinite parent source. Using this approach, the mine rock pile drainage is identical during the operations and post-closure phases of the Project.

Table DFO 2-3-1 Simulated Mine Rock Pile Drainage Water Quality

Parameter	Units	West Mine Rock Pile		South Mine Rock Pile	
		Freshet	Steady-State	Freshet	Steady-State
General Water Chemistry					
Total Dissolved Solids (TDS)	mg/L	230	53	191	42
Hardness[(a)]	mg/L as $CaCO_3$	139	30	129	23
Major Ions					
Calcium (Ca)	mg/L	34	7.4	30	5.8
Chloride (Cl)	mg/L	23	4.2	4.3	4.2
Fluoride (F)	mg/L	0.39	0.22	0.33	0.21
Magnesium (Mg)	mg/L	13	2.7	13	2.1
Potassium (K)	mg/L	12	2.9	8.9	1.9
Sodium (Na)	mg/L	16	1.6	8.3	0.79
Sulphate (SO_4)	mg/L	111	22	123	26
Nutrients					
Nitrate (NO_3)[(b)]	mg/L	0.084	0.084	0.084	0.084
Nitrogen - Ammonia (NH_4)[(b)]	mg/L	0.032	0.032	0.032	0.032
Nitrogen - Kjeldahl (TKN)[(b)]	mg/L	0.35	0.35	0.35	0.35
Phosphorus (P), dissolved	mg/L	0.012	0.012	0.011	0.011

Table DFO 2-3-1 Simulated Mine Rock Pile Drainage Water Quality (continued)

Parameter	Units	West Mine Rock Pile		South Mine Rock Pile	
		Freshet	Steady-State	Freshet	Steady-State
Dissolved Metals					
Aluminum (Al)	mg/L	0.33	0.41	0.39	0.48
Antimony (Sb)	mg/L	0.0052	0.00085	0.006	0.00094
Arsenic (As)	mg/L	0.0038	0.0026	0.0028	0.0028
Barium (Ba)	mg/L	0.1	0.09	0.04	0.037
Beryllium (Be)	mg/L	0.0008	0.00064	0.00094	0.00075
Boron (B)	mg/L	0.44	0.083	0.24	0.058
Cadmium (Cd)	mg/L	0.00013	0.000086	0.00015	0.000097
Chromium (Cr)	mg/L	0.00073	0.0021	0.0007	0.0023
Cobalt (Co)	mg/L	0.011	0.0044	0.012	0.0052
Copper (Cu)	mg/L	0.007	0.006	0.0073	0.0066
Iron (Fe)	mg/L	0.4	0.42	0.47	0.49
Lead (Pb)	mg/L	0.0018	0.0018	0.0021	0.0022
Manganese (Mn)	mg/L	0.31	0.05	0.36	0.057
Mercury (Hg)	mg/L	0.00001	0.00001	0.00001	0.00001
Molybdenum (Mo)	mg/L	0.039	0.0016	0.029	0.0011
Nickel (Ni)	mg/L	0.028	0.011	0.032	0.012
Selenium (Se)	mg/L	0.0011	0.00041	0.0011	0.00048
Silver (Ag)	mg/L	0.00011	0.00011	0.00012	0.00012

Table DFO 2-3-1 Simulated Mine Rock Pile Drainage Water Quality (continued)

Parameter	Units	West Mine Rock Pile		South Mine Rock Pile	
		Freshet	Steady-State	Freshet	Steady-State
Strontium (Sr)	mg/L	0.39	0.082	0.29	0.049
Thallium (Tl)	mg/L	0.000097	0.000043	0.0001	0.000048
Uranium (U)	mg/L	0.017	0.00085	0.019	0.00096
Vanadium (V)	mg/L	0.015	0.0081	0.005	0.0018
Zinc (Zn)	mg/L	0.042	0.024	0.049	0.028

(a) Theoretical hardness calculated based on simulated calcium and magnesium concentrations.

(b) Blasting residues were mixed directly in Kennady Lake resulting in nitrogen concentrations similar to background water quality from mine rock drainage.

Response to Request 4:

The water quality assessment conducted for the 2012 EIS Supplement (De Beers 2012b, Section 8) concluded that water quality in Kennady Lake is expected to be acceptable for reconnection with downstream waterbodies. A detailed response to contingency measures is presented in the response to AANDC_12 (De Beers 2012c) in the first round Information Requests.

The contingency options available to De Beers as presented in AANDC_12 (De Beers 2012c) in the event water in Kennady Lake does not meet water quality objectives post-closure are listed below:

- Water quality will be monitored throughout the mine life to identify future risk and proactively deal with potential issues during mine operations and closure before Kennady Lake is fully restored. During closure, the rate of refilling of Kennady Lake will be determined by supplemental pumping of water from Lake N11 and by water flowing into Kennady Lake after the removal of dykes E, F and G. The following measures can be applied to identify the risk and deal with the potential water quality issues:
  - If a specific water quality issue is identified during mine operation, the overall water and mine waste management plans will be modified to mitigate the issue.
  - If a risk is identified during early mine closure, adjust the closure and refilling plan accordingly. For example, breaching of Dykes E, F, and G can be delayed and refilling pumping from Lake N11 may be adjusted to allow a longer closure period to deal with the potential water quality issue before the water level in the controlled basin is raised to its original lake elevation of 420.7 metre (m).
  - Identify the key sources of the poor quality water and develop specific plans to improve the water quality.
- In an unlikely case that the water quality cannot meet discharge criteria after the water level in the controlled basin continues to rise towards the original lake elevation of 420.7 m, the following measures can be applied:
  - Delay or constrict the flow rate after breaching of Dykes E, F, and G.

- Reduce the refilling pumping from Lake N11 may be adjusted to allow a longer closure period.
- Isolate the basin with poor quality water from the area where the water quality can meet discharge criteria. This will allow early restoration of a portion of the controlled basin. For example, Area 7 may be restored earlier.
- Raise the containment dykes to store the poor quality water until the water quality meets discharge criteria.
- Treat the poor quality water zone.

The cost of contingency measures is dependent on the contingency option required. The cost of treatment is dependent on the water quality issue that presents itself; for example, the Detailed Alternatives Analysis Report (De Beers 2012a) suggests that the cost of establishing and operating a total dissolved solids (TDS) Water Treatment Plant is over $100 million. Direct costs associated with contingency options that extend beyond closure (i.e., longer refilling time than projected) would be approximately $500,000 per year.

Response to Request 5:

The Ekati diversion channel is 3.3 km long in both bedrock and overburden cuts (Rescan 2007, 2011). In areas of overburden, the channel was over-excavated during the winter months and backfilled with a 1 to 2 m thick rock layer to protect the permafrost underneath. The width of the channel is 4 to 16 m wide bankfull, with a 2 m wide average bed width at the bottom of the channel to ensure adequate water depth/volume for fish (BHP 1995). The mean gradient of the channel is 0.3% (or a head from the inlet to the outlet of approximately 10 m). The Ekati channel was constructed during the pre-development and development phases of the project when there was supporting infrastructure existing at the site. The channel was substantially widened over the mine life to push back the slopes in the overburden sections of the channel.

A channel from Area 4 to Area 8 would be approximately 2.6 km. There is little head differential (none on a static basis as both areas are part of Kennady Lake) between Area 8 and Area 3. The channel would have to be very wide to pass the required flows or alternatively, with a narrower channel, the head would have to rise in Area 3 to provide the necessary flows in the channel. The required channel widths depend on how much water is diverted through the channel; assuming that flows through the channel will be similar to the existing flows to Area 8, the channel would be required to have the capacity to support a peak flow of 1.5 m^3/s. The required width of the channel is a function of the water rise in Area 3. Assuming no ice buildup in the channel, if the water is allowed to rise 0.5 m in Area 3 the required channel width is 80 m, or if the water was allowed to rise 1.0 m in Area 3 the required channel width would be 20 m. The channel cut depth would be a maximum of 14 m, with an average of approximately 8 m. Such an undertaking would require the drilling, blasting, hauling, and disposal of 500,000 to 1,500,000 m^3 of additional rock material prior to the dewatering of Kennady Lake and mine development. To construct this channel in advance of mine pit development would increase the project development schedule by at least one additional year.

A diversion channel from Area 3 to Area 8 would allow uncontrolled flows to Area 8. The construction of this feature would impose its own effects to the surrounding and downstream environments (including total suspended solids [TSS] sediment loading, runoff from the storage location of excavated materials), and would be a prohibitively costly alternative to pumping during the operations stage of the Project. Careful consideration to the risk of sedimentation would be required for any works adjacent to and within Areas 3 and 5 (i.e., construction of Dykes B, H, I, J, and mine rock placement in the West Mine Rock Pile). The option of a diversion to Area 8 would only be applicable to Alternative A, which has been determined to be not the preferred alternative for all selection criteria compared to Alternative B.

Response to Request 6:

Alternative Option A1 as described in the Detailed Alternatives Analysis Report (De Beers 2012a) uses a TSS water treatment plant and revised waste and water management plan to reduce the impacts to Areas 2, 3 and 5. The water management pond (WMP) in Alternative Option A1 is an engineered structure located in Area 6 as opposed to using the natural basin of Area 3 and 5 in Alternative B. The Area 6 WMP in Alternative Option A1 has an area of 1.0 km^2 compared to Alternative B with an area of 3.2 km^2.

Although the WMP in Alternative A has smaller surface area than Alternative B the restored areas of Kennady Lake at closure will be similar. Moreover, Alternative Option A1 requires a ring dyke 4,200 m long and up to 35 m high with associated environmental risks, technical challenges, and costs. Therefore, the alternatives analysis concluded that Alternative A would be unsupportable as a development alternative.

Response to Request 7:

Water in the Alternative A WMP could be disposed of in Tuzo Pit at the end of mine life. The remaining fine PK in Area 6 would continue to consolidate and eventually be capped during the mine closure phase. The maximum fine PK head will be approximately 12.5 m in Area 6. It will be retained by the large ring dykes around the Area 6 pond. The fine PK will continue to consolidate and release pore water, which will be supplemented by the infiltration of additional water from rain and snow melt into the fine PK. The additional water and pore water will be retained by the ring dyke; however, there is an increased risk of release of this water to the environment outside of the controlled area and the perpetual reliance upon the engineered dykes after closure. In comparison, for the preferred mine plan the fine PK head in Area 2 is negligible and therefore the environmental risk is significantly reduced.

Response to Request 8:

Alternative Option A2 considered using a TDS treatment plant to treat the pit water. The purpose of the TDS treatment plant was to reduce the amount of water requiring storage in Area 6 (Alternative Option A2 compared to Alternative Option A1). The amount of water to be managed is the same in both cases; however, the water is treated and released in Alternative Option A2, compared to Alternative Option A1.

The brine produced by a TDS treatment plant could be stored and later deposited in Tuzo Pit; however, until Tuzo Pit (Year 11) is available, brine would have to be temporarily stored in a secured storage facility that would require ongoing care and maintenance. The following provides additional detail on the use of a TDS treatment plant for the Project.

The preferred mine plan has 12 Mm^3 of water being pumped from the pits to the WMP. A TDS treatment plant would be used to treat this water in Alternative Option A2, discharging the treated water to environment throughout the mine life. A TDS plant produces highly concentrated brine that must be disposed of securely. The residual brine volume from a typical TDS reverse osmosis plant is between 20 to 50% of the inflow volume. This brine can be further reduced by high energy evaporation treatment, such that the brine represents approximately 5% of the initial inflow volume. Assuming that a combined reverse osmosis and evaporation system is used, the volume of brine remaining would be approximately 600,000 m^3 and would require on-site storage. Combined storage with the fine PK in Area 6 or Hearne Pit or in the mined out 5034 Pit could be considered to minimize storage requirements. Storing the brine presents an additional environmental risk to the Project.

It should be noted that the Detailed Alternatives Analysis Report (De Beers 2012a) concluded that Alternative Option A2, which included the TDS treatment plant, was not economically supportable due to the added capital and operating costs. Furthermore, a TDS treatment plant did not provide additional storage capacity to significantly offset the risks of the “A” alternatives.

Response to Request 9:

To clarify, under Option A3 Area 7 is utilized for contact water storage from the beginning of operations. This is stated in Section 4.1.1.4.1 in the Detailed Alternatives Analysis Report (De Beers 2012a):

“Runoff from Area 7 and the seepage water from Dykes A, B, H, I, J will be collected in the drained Area 7 basin, treated in the TSS water treatment plant, and discharged to Area 8 during the mine operation until Year 10”.

This is the primary difference between Options A1 and A3 of Alternative A. The use of Area 7 for contact water storage reduces the required water storage and therefore the height of the ring dyke in Area 6.

Response to Request 10:

De Beers provided an assessment of on-land alternatives (i.e., ring dyke facility in Area 6) in the Detailed Alternatives Analysis, which that was submitted to the MVEIRB Public Registry on June 18, 2012 (De Beers 2012a). The assessment provided economic, technical and environmental rational for the preferred project description alternative. The preferred alternatives will result in impacts to fish and fish habitat from dewatering in partially dewatered areas of Kennady Lake (see Section 6, De Beers 2012a). The following provides additional clarification of this assessment.

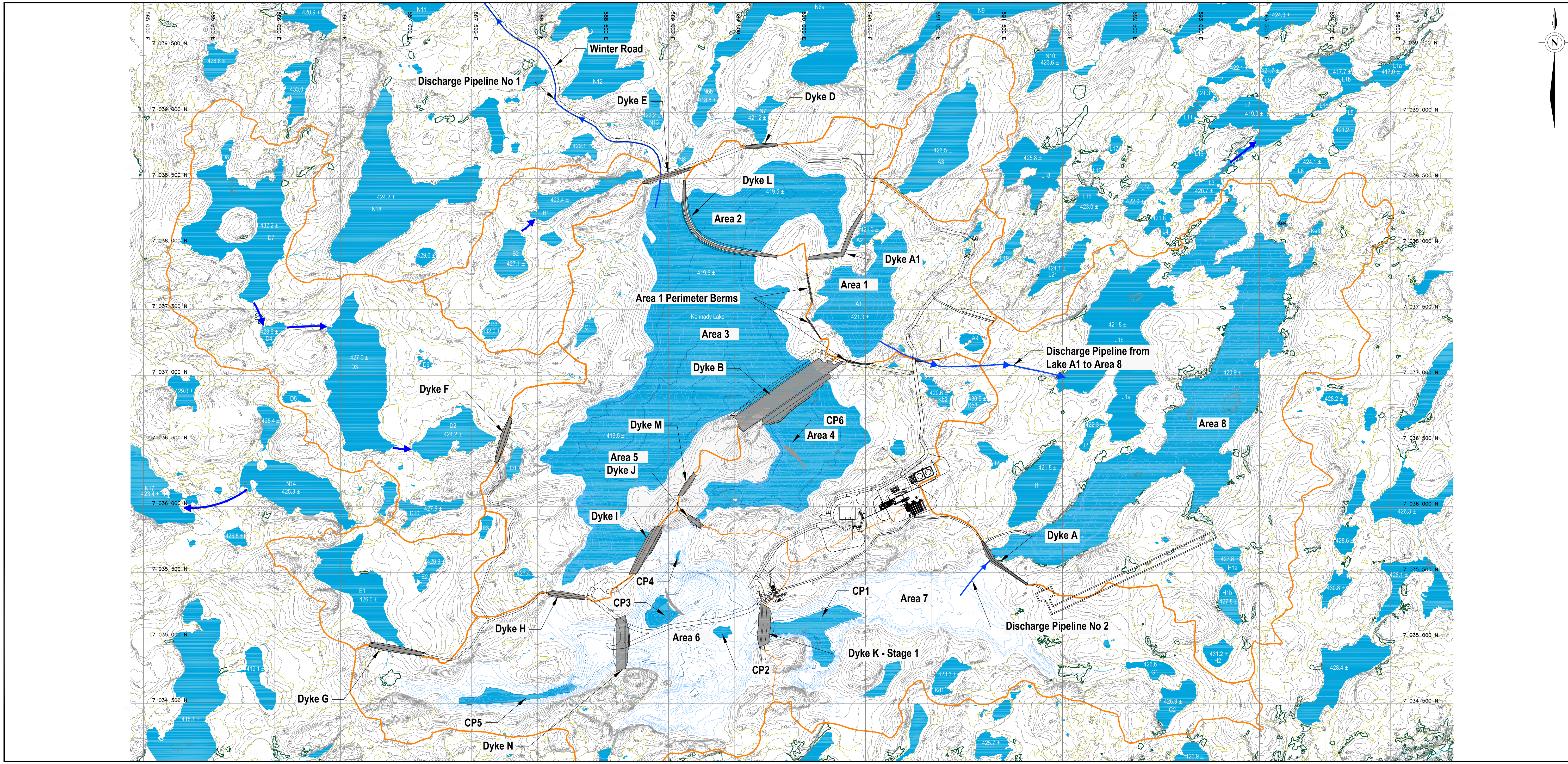
Based on De Beers' understanding of habitat conditions within Kennady Lake to access the kimberlites, the dewatering and mining activities during the construction phase of the proposed Project will result in a series of effects to fish and fish habitat, which cumulatively will result in habitat conditions in the isolated and partially dewatered portions of Kennady Lake (i.e., Areas 2, and 3 and 5) being no longer suitable for the persistence of fish. These Project activities include:

- isolation of Areas 2 to 7 of Kennady Lake through the construction of perimeter dykes to block inflow and outflow;
- dewatering the isolated lake to the maximum extent possible; and
- construction of internal dykes to segregate lake basins to allow access to the kimberlites located below the lake bottom by further dewatering.

These activities will result in the substantial reduction of available fish habitat and changes to water quality due to elevated TSS and turbidity. The primary effects are summarized as follows:

- The isolation of Areas 2 to 7 through the construction of perimeter dykes to block inflows from the upstream watersheds A, B, D and E and outflows to Area 8 will remove access to inflowing and outflowing stream connections, which are critical feeding, rearing and spawning locations for arctic grayling and northern pike for the life of the mine.

- The drawdown of Areas 2 to 7 will destroy approximately 75% the current littoral zone and related shoreline habitat in a relatively short period of time. The re-establishment of a productive littoral zone at a new water level will not be immediate and would be anticipated to take several years if the lake were to remain at a stable water level; however, during dewatering in the construction and early operations phases, the water level within these areas is expected to fluctuate substantially (e.g., Area 6 will be dewatered completely, and Areas 3 and 5 will vary by as much as 2 m each year).
- The 'new' shoreline would also be hampered by persistent TSS stemming from wind and wave action stirring up newly exposed fine sediments from the bottom substrate at the lowered water level and also the additional influence of ice scour in the winter following the drawdown (see response to DFO 2-3 Request 11). Spawning success for certain fish species, such as lake trout and round whitefish, would be greatly reduced due to a lack of clean rock shoreline spawning habitat, an absence of suitable offshore spawning sites and sedimentation issues that would smother fertilized eggs.
- TSS levels in the drawdown of Areas 2, 3 and 5, will also be exacerbated as a result of additional mine activities, such as dyke construction (i.e., Dykes B, H, I, J, K, L, and M) (Figure DFO 2-3-1). In particular, the construction of dykes H, I, and L, will be wet installations (i.e., they will be constructed within the lake while water is still present), which causes far greater physical disturbance to the surrounding aquatic environment than dykes constructed in completely dewatered areas. The construction of dykes will further contribute to TSS in the dewatered portions of Kennady Lake over that which will potentially be mobilized through the initial withdrawal of water.
- The drawdown is also expected to reduce the amount of available overwintering habitat in Areas 3 and 5 relative to existing conditions, providing additional pressure on fish.



LEGEND

430	Existing Ground Contours 5m Index - 1m Intermediate
415	Bathymetry Contours 5m Index - 1m Intermediate
CP	Collection Pond
	Winter Road
	Marsh Area
	Scrub
	Sub-watershed Boundary
	Drainage Flow Direction
	Discharge Pipeline
	Lake/Pond

NOTES

Base data source: EBA Figure 4.2 - Stage 1 - Initial Lake Dewatering (June-July, 2013)

Source: Adapted from Figure 3.9-1 of De Beers 2010

GAHCHO KUÉ PROJECT

Water Management Areas, Dykes, Collection Ponds, and Lakes Associated with the Project

PROJECTION: UTM Zone 12	DATUM: NAD83
SCALE: 500 0 500 METRES	DE BEERS CANADA
FILE No: IR2_DFO2-3_Other-001-CAD	DATE: March 3, 2012
JOB No: 11-1365-0001	REVISION No: 4
OFFICE: GOLD - SAS	DRAWN: BDS/TAH; CHECK: JF

Figure DFO 2-3-1

De Beers asserts that the cumulative impacts of dewatering, loss of habitat, increased TSS and mine activities resulting in disturbance (e.g. dykes) on the remnant aquatic environment would lead to the rapid degradation of habitat within the isolated and dewatered lake that would render the habitat no longer able to support an environment suitable for the persistence of fish. Further, these cumulative impacts would have adverse effects on fish populations such that recruitment for several species would be severely compromised, or would not occur at all, leading to populations declining or not being viable and sustainable. Moreover, these disturbances will persist for several years, and carry on into the initial stage of operations (i.e. the construction of Dyke B, which separates Area 3 and 5 from Area 4 to allow mining of Tuzo Pit, will commence in Year 4).

As such, De Beers has assessed the effects of the preferred alternative on fish and fish habitat of Kennady Lake and has concluded the dewatering and drawdown will result in impacts to fish habitat. De Beers recognizes that the harmful alteration, disruption or destruction of fish habitat is prohibited unless authorized by Fisheries and Oceans Canada (DFO) and has accordingly applied for an Authorization pursuant to Section 35(2) of the *Fisheries Act*. De Beers is developing a No Net Loss Plan in consultation with DFO and the communities to offset any losses of fish habitat arising from the drawdown in Kennady Lake.

Response to Request 11:

Under the water management plan detailed in the Project Description of the 2012 EIS Supplement (De Beers 2012b), suitable spawning habitat that is lost as a result of the initial dewatering of Kennady Lake would not re-establish for the life of the proposed Project; see Section 3.9.6 of the 2012 EIS Supplement (De Beers 2012b) for a discussion of the operational water management plan.

As described in Section 6.2 of the Detailed Alternatives Analysis (De Beers 2012a), the drawdown in Areas 2 to 7 (to the maximum extent possible) will destroy approximately 75% of the current littoral zone and related shoreline habitat in a relatively short period of time. The re-establishment of a productive littoral zone at a new water level will not be immediate and would be anticipated to take several years if the lake were to remain at a stable water level; however, during dewatering in the construction and early operations phases, the water level is expected to fluctuate by as much as 2 m each year. With the drawdown, it would be expected that the 'new' shoreline would also be hampered by persistent TSS stemming from wind and wave action stirring up newly exposed fine sediments from the bottom substrate at the lowered water level and also the additional influence of ice scour in the winter following the drawdown. Additionally, TSS levels in the drawdown of Areas 2, and 3 and 5, will be exacerbated as a result of additional mine activities, such as dyke construction (i.e., Dykes B, H, I, J, K, L, and M). Spawning success for certain fish species, such as lake trout and round whitefish, would be greatly reduced due to a lack of clean rock shoreline spawning habitat, an absence of suitable offshore spawning sites and sedimentation issues that would smother fertilized eggs.

Furthermore, during operations, Areas 3 and 5 (the WMP) will receive additional inflows and runoff, primarily associated with the freshet (i.e., the melting of accumulated snow and ice in the isolated watershed), which will change water levels in these areas. The spring inflows will have to be managed for the Project to proceed safely. The subsequent dewatering in the second year of construction and the operational discharge of water from Areas 3 and 5 are expected to result in fluctuating water levels during early operations in the order of 2 m each year; it is anticipated that the water quality in the WMP will be acceptable for discharge to Lake N11 to Year 3 of operations (Section 9.2.5 of the 2012 EIS Supplement [De Beers 2012b]). As a result, the water level within Areas 3 and 5 is not expected to remain stable for a sufficient period of time to result in the creation of suitable shoreline spawning habitat. It is, therefore, anticipated that suitable shoreline spawning habitat would be lost for lake trout and round whitefish for the duration of the mine.

References

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