DE BEERS
GROUP OF COMPANIES

May 5, 2017

Angela Love
Regulatory Officer
Mackenzie Valley Land and Water Board
7th Floor, 4922 48th St.
PO Box 2130, Yellowknife, NT
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Dear Ms. Love:

Re: Re-submission of Gahcho Kue Reclamation Research Plan and Closure Options for the ICRP V.3 (MV2005L2-0015 and MV2005C032)

De Beers Canada Inc. (De Beers) would like to thank the Board for granting the extension for this submission (Board letter of April 6, 2017) to May 8, 2017.

We are pleased to provide for Board review and approval:

- Responses to the Board comments of March 16th regarding both reclamation research (Table 1) and options for closure (Table 2);
- A revised Reclamation Research Plan (Appendix E of the Interim Closure and Reclamation Plan); and
- Revised Closure Options by Facility for inclusion within Section 5.2.4 of the ICRP (Table 3).

This updated submission addresses all comments received to date concerning reclamation research and closure options. We believe it provides the additional clarity and detail that reviewers had requested and represents an improved description of the research and closure options remaining for the Gahcho Kue Mine. We look forward to the focused review and approval of these sections of the ICRP so that we may progress through the remaining items within the Board's work plan and towards implementation of the plan at the site

If you have any comments or questions about this submission, please contact me at sarah.mclean@debeersgroup.com or 867-688-9227 at any time.

Respectfully,

Sarah McLean

Sarah McLean

Regulatory Specialist

DE BEERS CANADA

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Table 1 Reclamation Research Plan

Objectives – approved March 16, 2017	Reclamation Research	MVLWB Comments (MVLWB letter March 16th, 2017)	De Beers Response May 5. 2017
SW1 - Air quality levels safe for people, vegetation, aquatic life and wildlife	N/A	N/A	Acknowledged
SW2 - Drainage pathways for surface runoff are physically stable.	N/A	N/A	Acknowledged
SW3 - Surface runoff and seepage water quality that is safe for people, vegetation, aquatic life, and wildlife. MR2 - Contaminated rock and non-hazardous waste disposal areas within piles will be safe for aquatic life, people or wildlife.	Seepage (Quality and Quantity)	a) Please identify how this reclamation research plan will address potential action level exceedance or identify mitigation measures to reduce seepage (i.e. different cover options).	a) During Operations, there are several approved defined low action levels related to water quality and quantity. These low action levels are articulated within the Groundwater Monitoring Program, and the Aquatic Effects Monitoring Program, and the Operational Water Management Plan. In most cases, an exceedance of a low action level would trigger the need to re-examine the model predictions, and to confirm or refute any potential long term effects or implications. The defined low action level management responses also typically involve defining moderate and or high action level thresholds and associated management responses. It is likely that the defined management response to a moderate or high action level threshold would include updating the water quality/quantity and/or hydrological model as well as consideration for the implications to the closure design of the facilities. This is aligned with Section 5, Task 2 and 3 of the RRP for Kennady Lake and Section 3, Task 2 for the Mine Rock Piles. The ongoing monitoring of seepage water quality and quantity, governed by the water license conditions and associated management plans, is linked

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			to the RRP Section 5, Task 1 for Kennady Lake and Section 3, Task 1 for the Mine Rock Piles. The information gathered in Task 1 will fed into Task 2 for each research program. Task 2 will be completed on schedule, whether there was an exceedance of a low action level or not. However, if there is an exceedance of a moderate or high level action threshold, Task 2 could be triggered at that time, if not already completed addressing the same inputs. In Task 2, we will conduct a comprehensive, multi-year analysis of the monitoring data obtained in Task 1. The collected data will be used to assess the appropriateness of the planned closure design of the facilities and the need for any additional post-closure water quality modeling. If a moderate/high action level associated with water quality or quantity is triggered, then this would seem to imply that water quality or quantity is diverging from expectations. This would also be a cause to implement Task 2 perhaps earlier than otherwise planned. Section 5, Task 3 of the RRP describe how the water quality and quantity and will be compared to initial predictions. If the operational water quality or quantity is higher than initial model assumptions and if these parameters have an influence on the reconnection of Kennady Lake within the local watershed, consideration could be given to mitigate this influence through adjustments to water management at site and/or design controls. Any mitigations would be specific to the scenario observed and would be further developed if the condition arises.
		b) Ongoing modelling and monitoring does not support the	b) Ongoing monitoring and updates to models will support the achievement of closure objectives. Understanding the

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		achievement of a closure goal. Please identify through the research how monitoring data will be used to identify closure activities or criteria. Please explain how ongoing monitoring (SNP, Geochemical Characterization, water balance, etc.) will contribute to this research. c) Please refine the timelines for research so that research findings are established and inform closure options and criteria prior to the submission of the Final Closure and Reclamation Plan (FCRP, 2025). Please clarify and explain if any of the contingencies identified in the ICRP for seepage will no longer be viable at a particular point in time.	water quality dynamics within the Controlled Area will contribute to developing final closure designs that are best suited to achievement of the closure objectives. The SNP program tracks the water quality in designated locations within the Controlled Area and the receiving environment. It ensures that water discharges meet EQCs prior to discharge. It will also provide a long term trajectory of water quality within the pond, therefore supporting more robust predictions about water quality into the future. The final closure cover options will be informed by this sort of data. c) See Updated Research timeline in the RRP Section 6
SW4 - Mine areas are physically stable for use by people and wildlife.	N/A	N/A	Acknowledged
SW5 - Safe passage and use for Caribou and other wildlife.	Landform Options (Wildlife Habitat)	Please describe all potential habitat functions (and species) De Beers will consider in the closure design and monitoring of all mine components.	The habitats and species to be considered in the closure design were discussed in the ICRP Sections 3.4.1, 3.4.2, and 3.4.3. Wildlife monitoring will be incorporated into the re-vegetation trials, whereby the use of revegetated areas by wildlife will be documented. Plots with demonstrated

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		Please provide more information on how the results of this research will contribute to final mine site conditions and the development of closure criteria that reflect reviewer concerns and recommendations. Please identify how progressive reclamation and associated wildlife monitoring results will inform landform research options, including the population and diversity of small mammals and birds. Please refine the timelines for research so that research findings are established and inform closure options and criteria prior to the submission of the FCRP (2025).	re-vegetation success over time, as well as use by wildlife species, will be preferentially selected for use in progressive reclamation efforts. For example, if direct seeding results in strong vegetative growth, resilience to wildlife use, and persistence year over year at the reclamation research trials, this approach may be used in the progressive reclamation efforts at suitable areas around the mine site. Monitoring of those progressively reclaimed areas will also continue and if successful may be used throughout the infrastructure areas during active closure. During active closure, De Beers will focus on establishment of vegetation in key priority areas, and then on monitoring the return of wildlife. As discussed in the De Beers Nov 24, 2017 response to ICRP comments, wildlife monitoring will likely begin with monitoring the return of the smaller animals, such as small mammals and birds. Occurrences of larger animals such as the VECs presented in Section 3.4.3 will also be monitored. It is anticipated that areas with higher frequencies of documented occurrences by wildlife will be considered more successful than those without. This may lead to replication of the revegetation techniques used in those areas to other key priority areas. The landform research, as listed in Section 2.3 of the RRP, aims to identify and assess feasibility of closure options for the final landforms that would improve habitat quality. Monitoring will be completed after reclamation is completed to assess performance. See the RRP Section 6 for the research timeline.

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K1 - Prevent PK from entering the surrounding terrestrial and aquatic environment. PK2 - Physically stable PK disposal areas to limit risk of facility failure. and MR1 - Physically stable slopes to limit risk of failure that would impact the people or wildlife.	Physical Stability of Rock Covers	a) Please explain why research into the physical stability of the mine rock covers is not required similar to the requirement for research into the stability of PK covers. Please discuss cover options for the mine rock piles providing rationale for why vegetative covers are not being considered for closure.	a) In order to evaluate and ensure the long term performance of the designed rock covers for the Fine PKC Facility and Coarse PK Pile, the geotechnical and thermal characteristics of the underlying materials must be first understood. Properties of PK are not widely available, and as such, assumptions for PK geotechnical and thermal properties were made during the design phase (De Beers, 2015c). Some basic research into appropriate cover types will utilize real data from these facilities to inform final closure cover options, ensuring a good fit. Cover layers will be designed and graded to limit ponding of water over the reclaimed PK facilities, to promote runoff towards Kennady Lake and limit infiltration. Ponding is not expected at the mine rock piles due to the coarse grade of the material and the slope of the facilities. Erosion is also not a concern for the same reasons. The mine rock piles will not be covered with a different material type (Section 5.2.2). Other facilities at site (coarse and fine PK) are in fact being covered with mine rock. Vegetation of the mine rock piles is not considered a viable option due to a lack of proven techniques for vegetating rock, lack of sufficient alternative cover materials (i.e. till), lack of clarity regarding reasons for re-vegetation (e.g. may be preferable to not encourage large mammal access), approved design of the piles as tall with relatively small footprint (resulting in relatively steep facilities), and costs. This closure approach was the basis of the Environmental Impact Review and factored into the final design of the mine rock piles. Thus, there are no cover options for the mine rock piles for they do not require a cover. Based on feedback from stakeholders, vegetation of select priority areas of the pile are

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		b) Please clarify the links between the cover design research and the vegetation research, including a timeline for knowing when and if the PK facilities will incorporate vegetative covers. c) Please clarify and explain if any of the contingencies identified in the ICRP for mine rock pile stability will no longer be viable at a particular point in time. d) Please include research into the effects of weathering on the stability of waste rock and PK piles and covers. This can include an analysis of ongoing research of both the physical and chemical stability of storage areas at other diamond mines in the NWT. e) Please refine the timelines for research so that research findings are established and inform closure options and criteria prior to	being researched (e.g., to support wildlife, see Section 2.3 of the RRP). b) The cover design research and the re-vegetation research are complementary and will proceed concurrently. The cover design task will consider the preliminary outcomes of the re-vegetation research when examining cover options for the facilities. Mine rock, fine and coarse PK will be included in the re-vegetation trials and therefore it is anticipated that preliminary outcomes from that research will be available for consideration in the cover options analysis (see Section 2.1 of the RRP). If vegetation of these piles is desired, the cover design may need to consider the growth medium (e.g., soil types) that could facilitate plant growth. The revegetation activities to achieve development of plants on the piles surface will need to consider the localized environmental conditions (e.g., types of plants, slope, moisture availability). See the RRP Section 6 for the timeline. c) See response to MR1 Closure Options for discussion on contingencies for mine rock stability. d) See Section 2.2 of the RRP (observations of weathering on the stability PK covers. Weathering of the mine rock is not considered as a potential issue to water quality. e) See the RRP Section 6 for the research timeline.

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		the submission of the FCRP (2025).	
PK3 – Chemically stable Processed Kimberlite Facilities (Piles) that do not endanger human, wildlife, or environmental health and safety.	Chemical Stability of PK and Mine Rock Facilities	a) De Beers has committed to updating chemical stability objectives and criteria. Please indicate if and how this will be captured through updates to Reclamation Research Planning. Please clarify how these updates change any research plans currently described in the ICRP. b) De Beers has committed to updating the text within Section 2.2 to consider weathering of the PK. Please include the chemical stability of the mine rock piles which has also been identified as a closure objective. c) Please include research into the effects of weathering on the chemical stability of waste rock and PK piles and covers. This can include an analysis of ongoing research of both the physical and chemical stability of PK storage areas at other diamond mines in the NWT.	a) The Board approved a set of interim objectives. De Beers will work with all of the approved objectives during operations, including the approved Chemical objectives. If an adjustment to any of the Objectives is necessary based on monitoring work, research outcomes, or operational requirements, De Beers will propose a revised Objective (s) in the Final Closure and Reclamation Plan required 24 months prior to Closure. There are no changes to the RRP anticipated as a result. b) Acknowledged, updates will be completed in the revised ICRP. c) See the RRP Section 2.2. Weathering of the mine rock is not considered as a potential issue to water quality.
OP1 - The backfilledand/or flooded pitswill not adverselyimpactestablishment and/ormaintenance ofsustainable	Stability ofChemocline	a) Please include a discussion of long-terminteractions with groundwater, and howthat may affect meromictic conditions.	a) As described in the ICRP Section 5.2.5.1.3, ICRP Appendix E (RRP) Section 4.1.3, and ICRP Appendix D (Supporting Documents) D.79 Stability of Chemocline, groundwater interactions with pit water are expected to continue to strengthen the meromictic conditions over time.

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aquaticecosystems and lifein the overlyingKennady Lake anddownstreamwaterbodies.		b) Please provide clarification, and researchdetails into effective mitigations in theevent water quality in Kennady Lake is notfollowing the intended trajectory as a resultof interactions with the open pit(s)	b) Contingency options were described in the ICRP Section 5.2.9.4: If a risk is identified near the end of Mine operation or during early mine closure, the closure and refilling plan can be adjusted accordingly. For example: - Breaching of Dykes E, F, and G can be delayed and refilling (pumping) from Lake N11 may be reduced or ceased to allow a longer closure period to address the potential water quality issue before the water level in thecontrolled basin is raised to its original lake elevation of 420.7 masl.- Isolate the basin area within Kennady Lake 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 refilled Kennady Lake.-Raise the containment dykes to store the poor quality water until the water quality meetsdischarge criteria.- Treat the poor quality water zone.See KL1 Closure Options response for discussion regarding research on this topic.
		c) The research objective should clarify itsgoals to establish effective numericalcriteria to ensure meromictic conditions areestablished and maintained – not justevents that could disrupt it.	c) Water quality in the open pits at closure is a research component considered in the Kennady Lake research - See the ICRP Appendix E (RRP) Section 5.1.3 Task 3. "Numerical closure criteria will be developed for water quality in the flooded pits, which are achievableand will not adversely impact establishment of sustainable aquatic ecosystems and life in the overlying Kennady Lake (Closure Objective OP1)." In other words, the objective of Task 6 (Section 5 of the RRP) is in fact to develop numerical criteria for water quality in Kennady Lake which considers the open pits water quality.
		d) Please refine the timelines for research sothat research findings are established	d) A timeline has been developed and included in the revised RRP.

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		andinform closure options and criteria prior tothe submission of the FCRP (2025).	
OP2 - Physically stable pit walls to limit risk of a failure impacting people and aquatic life.	N/A	N/A	Acknowledged
I1 - Disturbed areas will be safe for people, wildlife, and vegetation.	N/A	N/A	Acknowledged

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I2 - Re-vegetation targeted to priority areas. and I3 - Aesthetic conditions of the infrastructure areas are similar to surrounding natural conditions.	Revegetation	a) Please describe the actual actions that can be applied to disturbed areas to accelerate recovery in the Reclamation Research Plans. This can be informed by the ultimate closure objective and criteria, such as returning disturbed areas to the baseline habitat structures vegetation complexes), where possible. b) Please explain why goals are not being set and research designed to ensure these goals are met, as opposed to potentially reaching lower standards that are easier to achieve. The research design is too vague to assure revegetation success. c) Acknowledging that certain areas will not be returned to the exact land classification that they were prior to disturbance, target ecological land classifications should be used as a starting point from where to develop research objectives. Please identify the target ecological land classifications that will be used to guide reclamation/ revegetation efforts so that disturbed areas are returned to their natural state as much as	a) the potential actions to be applied to disturbed areas were described in ICRP Table 20 and include: - Grading surfaces to promote drainage and limit pooling, surface material loosening (scarification); -Placement of salvaged overburden and lake sediments as a growth amendment to priority locations; - Application of native species; and, - Additional activities determined by research findings at the revegetation test plots. b) Section 2 of the RRP has the goal to evaluate revegetation techniques to successfully revegetate priority disturbed areas. The anticipated outcome is the selection of re-vegetation techniques that are suitable, with proven success, for each substrate type to be prioritized for revegetation efforts. Re-vegetation of priority areas will occur for infrastructure areas, as per the approved interim objectives. Vegetation as a cover type for the PK facilities will also be evaluated as part of the re-vegetation research. The preliminary outcomes of the re-vegetation research into PK as a substrate (RRP Section 2.1) will inform the Physical Stability of Engineered Rock Covers research (RRP Section 3.1). The growth of plants and their timeline for establishment require research to assess what is practical and achievable. Thus revegetation success can not be set until this initial research is completed. c) Revegetation will be focused on plant species that are native to the mine. The final ecological land classification will be dependent on the localized ground conditions to support plant species.

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		possible. Effort (and the research) should strive to return the disturbed areas to ecological land classification units that are common/unique to the Gahcho Kué area. d) Please refine the timelines for research so that research findings are established and inform closure options and criteria prior to the submission of the FCRP (2025). e) Please describe when vegetation trials will be conducted and when they need to be concluded in order to be incorporated into the FCRP. f) There has been a lot of revegetation work and research carried out since 2009. The reference to Environmental Dynamics Inc. and MPERG, 2009 should be updated.	d) See Updated Research timeline in the RRP Section 6. e) Trial research timing can commence upon approval of the RRP. This timing provides certainty to De Beers regarding the research objectives. f) Acknowledged. Section 2.1, Task 1 of the RRP will complete a best management practices and case studies review.
KL2 - Physically stable constructed banks of Kennady Lake to limit risk of failure that would impact aquatic life, wildlife, and people.	N/A	N/A	Acknowledged

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KL3 - Kennady Lake is reconnected with the upstream and downstream and small craft navigation is possible within the Kennady Lake basin through the dyke and pit areas.	N/A	N/A	Acknowledged
All	Risk-Assessment	Please include details, including the timing, of the post-closure risk assessment and how the results will be used to inform the FCRP.	Human health and wildlife ecological risk assessments were completed during the Environmental Impact Review process. These risk assessments would be updated with the consideration of the results of the revegetation research (Section 2.1) and landform options research (Section 2.3 of RRP). It is anticipated that the risk assessments would be completed as part of the preparation of the Final Closure Plan. The human health and wildlife ecological risk assessments will contribute to the selection of the final closure plan for the site.

Table 2 Closure Options

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
SW1 - Air quality levels safe for people, vegetation, aquatic life and wildlife	Engineering design and construction of a cover placed over the fine PK deposited within the Fine PKC Facility. Cessation of mining and construction activities (e.g. diesel combustion, surface vehicle traffic, blasting, material crushing and handling, etc.) will play a large role in diminished air emissions.	While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Might any changes during mine operations or mine closure impact the closure activity described to meet the SW1 objective? Are designs for the PKC Facility cover completed? If so, please reference where they can be found, and if not when they might be available. Are there several design options that have been or will be evaluated in order to meet objective SW1? If so, please describe the options that have been or will be assessed. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	Within reason, any changes to the mine operation or closure activity are not anticipated to result challenges to meet SW1 objective. Fuel combustion sources are a main factor influencing air quality experienced at the mine and these source will be negligible to minimal after mine closure compared to operations. The PKC pile cover design has been developed to a schematic level. Final designs for the fine and course PKC piles will be completed prior to the facility reaching capacity in years 2021 and 2023, respectively. At closure, the following options are considered to mitigate against dust generation. - Options considered during initial mine planning: balancing the footprint of PKC and mine rock pile size to height, placement of a cover over the PKC piles, and promotion of natural revegetation at priority areas at disturbed areas. - Options that remain to be finalized include selection of the PKC pile cover type and configuration, selection of priority areas for natural revegetation and the method of natural revegetation. With respect to contingency planning, in the event that the closure activity is unsuccessful, a root cause analysis will be completed to allow for a site specific solution to be implemented. If required, maintenance of the surface materials to repair surface cracks/slumps and other signs of potential degradation will be completed.
SW2 - Drainage pathways for surface runoff	Final grading where	Are designs for drainage pathways already prepared? If so, please	The final plans for the drainage pathways at closure have not been prepared at this time. Detailed water

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are physically stable.	required to promote positive drainage. Drainage pathways (e.g., spillway at the Fine PKC Facility) will be established as per design and QA/QC. QA/QC protocol completed by a professional engineer.	reference where they can be found, and if not when they might be available. Are there several design options that have been or will be evaluated to promote physically stable drainage pathways in order to meet objective SW2? If so, please describe the options that have been or will be assessed Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	management plans for each storage facility during mine operation is described in the Water Management Plan (De Beers, 2017). The operational management plan will inform the management of water at closure. Final plans for site drainage at closure will be a component of the mine rock and PK piles progressive reclamation activities and will be developed in advance of closure of each pile. See Section 8 of the ICRP for a schedule. Plans for drainage pathways from the remainder of the mine site will be developed as part of the final closure plan (2026). Options to consider in the final drainage plans and based on site specific factors include: - stabilize embankments by removing weak or unstable materials from slopes and foundations and/or construct toe berms to flatten overall slopes; - avoidance of diversion structures; - breaching of embankments, dams and culverts if not required; - cover embankments, ditches, culverts, and other drainage channel slopes with erosion resistant material (e.g. soil, riprap, vegetation) - backfill excavations areas to achieve the final desired surface contours to restore the natural drainage or a new acceptable drainage With respect to contingency, should monitoring identify pathways that are not physically stable, a root cause analysis will be completed to allow for a site specific solution to be implemented. If required, maintenance will be completed to repair surface cracks/slumps and other signs of potential degradation.

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SW3 - Surfacerunoff and seepagewater quality thatis safe for people,vegetation, aquaticlife, and wildlife.	Characterization andmanagement of PAG rock duringoperations will occur as per theapproved management plans (De Beers, 2016b, 2015e).Fine-grained PK deposited in theFine PKC Facility will be cappedwith an engineered cover, as perapproved design and QA/QCprotocol.The cover will promote runoffand reduce interaction betweenrunoff and PK.Drainage pathways will beestablished for long-termstability to mitigate againsterosion. All	De Beers response on November 25,2016 provides further clarity on howwater that has come in contact withhydrocarbons will be collected anddeposited.Please list all options being consideredfor the management of all waste watersgenerated during closure actives. Ifactivities have been chosen addressingthis concern, please clarify in detail howthe closure activity addresses wastewaters generated during closureactives.De Beers response on November 25,2016 commits to providing an analysisof PAG rock management options.Please list all options being considered.De Beers has also committed toupdating Section 5.2.9.1 to include a clear statement of the approvedlocations for PAG rock storage withreference to the specific plans thatmanage the control of PAG rock.Is there a contingency plan to outlinehow the selected closure activity will bemodified if it is unsuccessful?	At closure, water that has come in contact with hydrocarbons will be managed similarly to that employed during operations, which includes the treatment of water with on-site treatment system (e.g., oil-water separator unit). If discharge water quality criteria are achieved, discharge the water to the receiving environment. If discharge water quality criteria are not achieved, remove contact water from site for management at an approved off-site facility. An alternative options will be to transfer of the contact water from the source locations (i.e., landfarm) to the Water Management Pond to be managed with the remainder of the mine site waters.During the active closure phase, the types of waste waters are anticipated to be similar to that produced during operations. Their management during closure is anticipated to be similar to operations and as documented in De Beers operation management plans. As the active closure phase is advance, it is anticipated that the current water treatment plants/facilities will be decommissioned and replaced with smaller scale treatment facilities until the active closure phase is completed.Liquid hazardous waste (exception of contact waters from hydrocarbon impacted soils) will be managed by removal from site. No other options are considered at this time.Seepage waters from the PK and mine rock piles are managed within the Water Management Pond and therefore addressed through the Kennady Lake objectives.As discussed in the PK and Mine Rock Management Plan (De Beers, 2016), approximately 15Mt of PAG mine rock will be produced. PAG mine rock, as well as any barren kimberlite, will be

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	potentially hazardousm aterials and equipment will be removed from site.		sequestered within the interior of the mine rock piles or placed within a pit. In the mine rock piles, PAG rock will be enclosed within enough non-AG rock to limit exposure to oxygen and water extending into the enclosed material. Approximately 3.34Mt of PAG will be under the submerged base of the mine rock piles, with 4.24Mt encapsulated within the center of rock piles.The PAG placed in a open pit (approx. 7.38Mt) will be flooded as Kennady Lake is refilled.Contingency for mine rock management is discussed in the PK and Mine Rock Management Plan (De Beers, 2016). As contingency, an additional 15Mt of storage capacity is provided by the mined-out Hearne Pit should the tonnage of PAG material produced increases during operation (up to 7.5% of total rock mined). Should stability issues arise, the side slope of the rock piles will be regraded to a flatter slope. If more tonnage of mine rock is produced than predicted, the footprint of the mine rock piles will be extended. Additional water management measures will be constructed as required (eg. water retention berms, diversion ditches, impoundments, pumping).

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SW4 - Mine areas are physically stable for use by people and wildlife.	Final grading will promote positive drainage towards predisturbance drainage pathways where possible. Drainage pathways will be established for long-term stability to avoid issues with erosion. Engineered earthen structures remaining at the site (i.e. Mine Rock Piles, Fine PKC Facility and Coarse PK Pile) will be physically stable. See MR and PK closure objectives below for details specific to stability of mine waste areas.	Where will closure activities to establish pre-disturbance drainage pathways to meet objective SW4 be possible? Where will they not be possible? Please explain with rationale. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	The drainage pathways will not be re-established to pre-disturbance conditions within areas of the mine where there is a permanent landform (e.g., mine rock and PK piles). This is a result of these waste materials being placed for storage above any pre-disturbance drainage pathway. New drainage pathways are anticipated to be constructed as part of the mine rock and PK piles during operations and progressive reclamation to manage seepage waters from these areas to drain to the water management pond. Larger water drainage pathways that exist during operations that control the majority of surface runoff from the remainder of the mine site are anticipated to remain at closure. SW2 response provides discussion on the timing for completion of the drainage plans, as well as, the options and contingencies associated with drainage pathways at closure.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
SW5 - Safe passage and use for Caribou and other wildlife.	Removal of all buildings, equipment, and surface hazards. Engineered earthen structures remaining at the site (i.e. Mine Rock Piles, Fine PKC Facility and Coarse PK Pile) will be physically stable. See MR and PK closure objectives below for details specific to stability of mine waste areas. Mitigation of environmental risk to wildlife from soil, sediment or water will be completed as required based on the applicable closure criteria for environmental media.	De Beers response on November 25, 2016 has committed to working with Ni Hadi Xa to inform final closure design; roads will be scarified and re-contoured to help with safe passage of wildlife. Please list for all options being considered for the safe passage of wildlife for each mine component. If activities have been chosen addressing objective SW5, please clarify in detail how the closure activity addresses safe passage for each mine component. What types of soil, sediment, or water mitigation options may be most likely required to eliminate environmental risk to wildlife? Please provide examples. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	Final landform design is to be informed through completion of reclamation research (RRP, ICRP Appendix E, Section 2.3) and informed through engagement with Aboriginal communities, and Ni Hadi Xa. Options for safe passage of wildlife for each mine component are detailed below. Open pits - at closure the open pits will be flooded and inaccessible by wildlife. Safe passage of wildlife is not applicable to this mine component. Kennady Lake - at closure Kennady Lake will be flooded and inaccessible by land animals and therefore safe passage need not be considered.. The water quality will be safe for bird and other wildlife. Mine rock piles - at closure the following options are considered: permit, or deter wildlife, access on the pile. If wildlife access is permitted, options include: construction of access and egress ramps on the pile to permit passage onto and over the pile. Options for the access ramps include: location of access and egress, surface material type on the ramps and top of pile (e.g. fine materials, materials conducive to natural revegetation). To deter wildlife access, the options include: placement of large rocks at the base of the pile to prevent access onto the pile, and to design passages or corridors around the piles. Course PK pile - similar options as listed for the mine rock piles. Materials selected for cover construction will be devoid of any contamination and non-PAG. The cover will act as a physical barrier to prevent the PK from direct ingestion by wildlife.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
			Fine PK pile - at closure the following options are considered: permit, or deter wildlife, access on the pile. If wildlife access is permitted, options include: design of cover system to support wildlife movement. Options for cover include surface materials that encourage or deter natural revegetation, as well as, surface material type. To deter wildlife access, the options include: placement of large rocks around the pile to prevent access onto the pile, and to design passages or corridors around the piles. Materials selected for cover construction will be devoid of any contamination and non-PAG. The cover will act as a physical barrier to prevent the PK from direct ingestion by wildlife. Infrastructure areas - at closure options for closure include promote natural revegetation in priority areas, surface re-contouring to encourage design passages or corridors, eliminating steep slopes about breached culverts and drainage pathways. Contingencies will be implemented if there is observed potential degradation (e.g., surface cracks, slumps) that can be corrected through maintenance. Further, if wildlife monitoring demonstrates that the closure activity is not supporting safe movement, a root cause analysis will be completed to allow for a site specific solution to be implemented.
PK1 - Prevent PK from entering the surrounding terrestrial and	Engineering design of the Fine PKC Facility and Coarse PK Pile by a	Are designs for the PKC Facility and cover completed? If so, please reference where they can be found, and if not when they	The construction design for the coarse PKC pile (DeBeers, 2016 - Final Detailed Construction Plan Coarse Processed Kimberlite Facility) and FPKC facility are completed (Final Detailed Design Plan Dykes A1,F,G,H,I,J,K and L V.3 (De Beers 2015), Final Detailed

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
aquatic environment.	professional engineer. Deposition of the fine PK within the Fine PKC Facility, which will include a material cover at closure, or into Hearne pit. Coarse PK will be disposed of within the Coarse PK Pile, Hearne and 5034 pits, and the Coarse PK Pile.	might be available. Are there several design options that have been or will be evaluated in order to meet objective PK1? If so, please describe the options that have been or will be assessed. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	Design Plan Dykes, Dyke B,D,E, and Perimeter Berms V.1 (De Beers 2015)). The FPKC facility location is within a natural low basin that partially extends into the water management pond. PK is bounded by the native materials within the basin and an engineered filter dyke on the west and south sides. The filter dyke is designed to be long-term stable and contain the PK in place (De Beers, 2015). The cover designs are included in the approved construction designs, however De Beers has committed to considering alternative cover options as part of the RRP (RRP, ICRP Appendix E, Section 3). Final cover designs for the fine and coarse PKC facilities will be completed prior to facility closure. A cover for the PK piles will act as a physical barrier to contain the PK , thus mitigating its mobilization and accessibility as well as reducing the potential for erosion. Options considered involve selecting the cover material characteristics (size), thickness, and configuration (single layer, multiple layer, composite involving earthen fill and geotextile) to suit the site foundation conditions and cover design. The covers will also need to consider wildlife safety, as detailed within SW5 response. With respect to contingency, in the event that the closure activity is unsuccessful, a root cause analysis will be completed to allow for a site specific solution to be implemented.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
PK2 - Physically stable PK disposal areas to limit risk of facility failure. and MR1 – Physically stable slopes to limit risk of failure that would impact the people or wildlife.	Final landscape inspected and submission of as-built conditions in a summary report completed by a professional engineer. Post-closure geotechnical monitoring at appropriate locations.	Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	The Mine Rock and PK piles have been designed to be geotechnically stabile throughout operations and into closure. The piles are currently being constructed and operated according to the approved design which considered physical stability. Geotechnical monitoring during operation will inform the likelihood of success during closure. Post-closure geotechnical monitoring will also occur. With respect to contingency, in the event that the closure activity is unsuccessful, a root cause analysis will be completed to allow for a site specific solution to be implemented. Contingencies to apply depend on the site specific issue, but could include: buttressing slopes to minimize movements, improve foundation and/or drainage conditions to increase stability, or relocating deposited materials to assist in slope stabilization. Contingencies with regards to the physical stability of the cover placed on the coarse and fine PK piles will be addressed as part of their final design.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
PK3 – Chemically stable Processed Kimberlite Facilities (Piles) that do not endanger human, wildlife, or environmental health and safety.	NEW OBJECTIVE – no options or activity described in ICRP V.3	It is important to document all closure options considered throughout the life of a project to ensure there is a record of the rationale used for certain decisions and to learn from past experiences. It is the responsibility of the proponent to ensure that the closure options proposed would achieve the stated closure objectives, comply with all closure and reclamation requirements and include best practices. Please provide closure options and activities.	Runoff and seepage waters from the PK piles will be directed and managed within the Water Management Pond, thus addressed through the Kennady Lake objectives. Chemical stability associated with this objective only pertains to the solids portion of the PK and materials to construct the facility. Materials used to construct the piles and cover are non-PAG and therefore chemically stable. Further, the fine and coarse PK are geochemically characterized as non-PAG. Only non-PAG PK will be placed in the piles which is verified through a bi-annual geochemical audit (De Beers, 2015 - Geochemical Characterization Plan, Section 8). The fine and coarse PK piles are currently being constructed as per the approved design which has considered the chemical stability aspects. Further, specific to the coarse PK pile, ahead of the placement of the coarse PK within the facility, a layer of approximately 2 meters of non-PAG mine rock will be placed to provide separation of coarse PK from the tundra. This separation was provided to limit geochemical interactions of the PK with the tundra that have potential to give rise to chemical instability. In the unexpected event that PK is PAG, it will be placed in an approved location within mine rock pile and/or the open pit.
OP1 - The backfilled and/or flooded pits will not adversely	Poor quality and high TDS water encountered throughout	Tłı̨chǫ Lands Protection Department asked if alternative options to establishing meromictic conditions in Tuzo pit. Have any other options	Placement of the low quality water into the open pit is considered beneficial for the following select reasons: decrease the time to flooding since it is a source of water, the low quality water will be placed in the bottom of the pit where a

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
impact establishment and/or maintenance of sustainable aquatic ecosystems and life in the overlying Kennady Lake and downstream waterbodies.	mining will be managed in the WMP, then pumped into the bottom of the Tuzo pit at closure. Meromictic conditions will establish within Tuzo.	been considered for the management of water in flooded pit? Or is this option the only reasonable activity? While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Please list for discussion all options being considered for the safe return of aquatic life in Kennady Lake (including the flooded pit portions of the lake). If activities have been chosen addressing this concern, please clarify in detail how the closure activity addresses the safe return of aquatic life in the flooded pit portions of Kennady Lake. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	chemocline and will be covered with a freshwater cap, it returns the poor quality water initially removed from the open pit back to the pit at closure. Thus, it is considered as an appropriate closure options. Alternatives to refill Kennady Lake were considered in the Environmental Impact Statement (Section 2.3.2.3) and summarized in Section 4.4.1.4 of the ICRP. See KL1 objective response for discussion pertaining to the returning Kennady Lake to a state that will support a functioning aquatic ecosystem and traditional uses. The safe return of aquatic life will be considered in the selection of the constructed fish habitat features in Kennady Lake. De Beers will engage with DFO on this DFO Authorization (03-HCAA-CA6-00057.1) requirement. Further as per the DFO Authorization, De Beers will develop a Fish Habitat Validation Plan to demonstrate the use of the fish habitat features, as well as, fish surveys to inform on the return of fish to Kennady Lake.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
OP2 - Physically stable pit walls to limit risk of a failure impacting people and aquatic life.	Backfilling at the 5034 pit will be completed with consideration to slope stability at the adjacent Tuzo pit wall. No additional reclamation efforts are expected to be required at final closure, but options will be assessed following final inspection.	a) While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Might any changes during mine operations or mine closure impact the closure activity described to meet the OP2 objective? b) Please provide examples of the type of closure options that may be required to address objective OP2 at final closure following final inspection. c) Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	a) Changes to the mine operations are not anticipated to impact open pit closure activity (i.e., flooding the open pit). During mine operations the open pit stability is critical to worker safety and development of the open pit. The pits will be constructed as-per design with appropriate field adjustments to pit development based on monitoring and inspection to ensure stable pit walls. No additional closure options are considered necessary. b) During active closure, if the final inspection identifies a significant risk of pit wall failure which could lead to an impact to people or establishment of the chemocline, it may be possible to address that risk through additional blasting of the unstable area. Other potential options for addressing such a risk will be developed at that time by a qualified engineer. c) At closure the pits will be flooded. No additional closure options are considered necessary. In the unlikely event of a slope failure that results in an upset to the chemocline, which will naturally re-establish over time.
I1 - Disturbed areas will be safe for people, wildlife, and vegetation.	Post-closure Environmental Site Assessment and Remedial Action Plan completed by a professional engineer or geoscientist, in accordance with	De Beers response on November 25, 2016 has committed to working with Ni Hadi Xa to inform final closure design and that roads will be scarified, and re-contoured to help with safe passage of wildlife. Please list for discussion all options being considered for the safe passage of wildlife for mine infrastructure. I activities have been	See response to SW5 for response regarding safety of caribou and wildlife from the various mine components. Specific to infrastructure areas, which generally includes roads and pads, options considered include revegetation of priority areas and scarifying surface to promote natural revegetation. Where applicable to support wildlife access pathways around piles and infrastructure areas, the crossing locations may consider the slopes/grade of the land, material gradation to promote a "smooth" surface.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
	GNWT guidelines (GNWT, 2003)	chosen addressing this concern, please clarify in detail how the closure activity addresses safe passage for mine infrastructure. Is there a contingency plan to outline how the selected closure activities will be modified if it is unsuccessful?	The Environmental Site Assessment will identify areas of potential contamination and the Remedial Action Plan will be developed to ensure the sol quality that remains is of acceptable quality to support objective I1. Vegetation components will be further assessed as part of objective I2.
I2 - Re-vegetation targeted to priority areas. and	Revegetation efforts will include some combination of the following activities across the various mine areas: • Grading surfaces to promote drainage and limit pooling, surface material loosening (scarification); • Placement of salvaged overburden and lake sediments as a growth amendment to priority locations; •	Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	Research is proposed to assess the re-establishment of native vegetation (ICRP, Appendix E RRP, Section 2) on various disturbed surfaces at the mine. The outcomes from the research will be used to assess the need to develop a contingency plan. At this time, is it likely that if one method of revegetation is unsuccessful, an alternative method will be employed.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
	Application of native species; and, • Additional activities will be determined by research findings at the revegetation test plots.		
I3 - Aesthetic conditions of the infrastructure areas are similar to surrounding natural conditions.	Removal of all buildings, equipment, and surface hazards. Final grading will reflect surrounding topography and re-establish natural drainage pathways where possible. Application of native vegetation.	Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	The closure activities are viewed as routine and there is limited risks for the closure activity not be achievable. No contingency plan is warranted.
KL1 - Return Kennady Lake to a state that will support a functioning aquatic ecosystem and traditional uses.	Management and mitigation of potential risk from mine waste products in accordance with approved engineering designs	De Beers response on November 25, 2016 provides further clarity on how Kennady Lake will support a functioning ecosystem. Closure activities described include fish habitat features such a finger dykes, artificial reefs, and littoral habitat construction to offset the	Section 5 of the RRP (Appendix E, ICRP) describes the research that will be completed to further understand the water quality in the Water Management Pond and the predicted water quality at mine closure. The research is to inform the development of a Closure Water Management Plan for refilling Kennady Lake (Part G, Item 5 of the Water Licence). The Closure Water Management Plan will address the management of water and its quality into

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
	and management plans. Construction of fish habitat as per DFO authorization. Discharge of poor quality water into the bottom of the Tuzo pit, establishment of meromictic conditions to inhibit the upward transport of potentially harmful water quality constituents. Breaching of perimeter dykes allowing Kennady Lake to refill. Supplemental pumping from up gradient lakes to shorten the time required for flooding.	disturbance caused by the mine. De Beers response on November 25, 2016 provided an explanation on what information is required prior to fully describing all potential water treatment options at closure if water quality in Kennady Lake is not as predicted. This may be reasonable given that this is an interim closure and reclamation plan, however it may be helpful to have further discussion surrounding the most likely treatment options that would be considered. Please list for discussion all options being considered for to support the safe return of aquatic life in Kennady Lake. If activities have been chosen addressing this concern, please clarify in detail how the closure activity addresses the safe return of aquatic life in Kennady Lake. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	closure. In the event that treatment of water is necessary to support objective KL1, best practices that are practically and economically feasible will be considered and may include: biological, chemical or physical treatment processes. The method of water treatment must consider the quantity and quality of the water, which will be further defined through completion of the research program. Thus, if treatment is necessary, the options for treatment will be further developed at that time.

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Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
KL2 - Physically stable constructed banks of Kennady Lake to limit risk of failure that would impact aquatic life, wildlife, and people.	Banks constructed within Kennady Lake (e.g., interface of lake and mine rock piles (will be physically stable.	While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Might any changes during mine operations or mine closure impact the closure activity described to meet the KL2 objective? Please provide examples of the type of closure options that may be required to address objective KL2 at final closure following final inspection. Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	It is not anticipated that changes to mine operations or mine closure will impact the closure activity to achieve KL2 objective. The type of closure options include: - for areas with low erosion potential, non-structural measures (i.e. development of simple erosion barriers based on field monitoring during mine activities) will be applied; - for areas with higher erosion potential, structural measures including placing a layer of protection material may be applied, and may mean constructing the shoreline so that is has a low slope with reduced wave action. With respect to contingency, in the event that the closure activity is unsuccessful, a root cause analysis will be completed to allow for a site specific solution to be implemented.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
KL3 - Kennady Lake is reconnected with the upstream and downstream and small craft navigation is possible within the Kennady Lake basin through the dyke and pit areas.	The downstream slope of Dykes B, J, N, and K will be flattened and covered with a 1 m thick erosion protection material layer (2028). Dykes B, N, and K will be partially breached to a final crest elevation of 417.0 masl (2029), then completely breached, along with the entirety of Dyke J, to 418 masl.	While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Might any changes during mine operations or mine closure impact the closure activity described to meet the KL3 objective? Please provide examples of the type of closure options that may be required to address objective KL3 (i.e. types or erosion protection material). Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	Within reason, any changes to the mine operation or closure activity are not anticipated to result challenges to meet KL3 objective. The type of closure options include: - the selection of a granular material size and thickness that will perform the design function. - the incorporation of a geosynthetic into the design to aid in material separation and erosion control. The final closure and reclamation plan will provide the design details regarding the preferred selection. It is not considered necessary to develop a contingency for this closure activity, it is a routine construction activity with low risk of being unsuccessfully implemented.
MR1 - Physically stable slopes to limit risk of failure that would impact the people or wildlife.	Engineering design including stability analysis that meets design criteria for factor of safety as per industry guidelines	De Beers response on November 25, 2016 has committed to working with Ni Hadi Xa to inform final closure design for mine rock piles. Please list for discussion all options being considered for the safe passage of wildlife for mine rock piles. If activities have been chosen addressing	Options and contingencies for the stability and safe passage of people and wildlife at mine rock piles at other mines are discussed in section SW5 and PK2&MR1 above.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
	(Piteau Associates Engineering Ltd., 1991). Construction and operation have been completed as per the approved Mine Rock Pile designs (De Beers, 2015j) and construction management plans (De Beers, 2015i)	this concern, please clarify in detail how the closure activity addresses safe passage for mine rock piles. While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Might any changes during mine operations or mine closure impact the closure activity described to meet the MR1 objective? Are there several design options for the Mine Rock Piles that have been or will be evaluated in order to meet objective MR1? If so, please describe the options that have been or will be assessed (reference relevant section of EIR, if applicable). Cover options for the mine rock piles should at least be discussed and analyzed under an options analysis providing rationale for why vegetative covers are not being considered for closure. Is there a contingency plan to outline how the selected closure activity will be	

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
		modified if it is unsuccessful?	
MR2 - Contaminated rock and nonhazardous waste disposal areas within piles will be safe for aquatic life, people or wildlife.	Isolation of contaminated rock and non-hazardous waste disposal areas within the interior of Mine Rock Piles. Waste areas will be covered with low permeability material to reduce infiltration. Permafrost is predicted to aggrade within the interior of the piles to reduce permeability.	De Beers response on November 25, 2016 provided clarification on the construction method of the mine rock piles. While there is limited flexibility to make major adjustments to the technical approaches described in the ICRP, refinements can be made to some aspects of the plan (e.g., mine rock pile contouring, revegetation, filling rates, etc.). Might any changes during mine operations or mine closure impact the closure activity described to meet the MR2 objective? Are there several design options for the Mine Rock Piles that have been or will be evaluated in order to meet objective MR2? If so, please describe the options that have been or will be assessed (reference relevant section of EIR, if applicable). Is there a contingency plan to outline how the selected closure activity will be modified if it is unsuccessful?	The placement of contaminated rock and non-hazardous waste will be according to the approved mine rock design (De Beers 2015 - Final Detailed Construction Plan South Mine Rock Pile and Overburden Stockpile). At closure, inert solid materials (from demolition waste) will be deposited within the Mine Rock Piles or the mined out Tuzo Pit (ICRP, Section 5.2.5.5.2). In the event that these materials are not directed to the mine rock pile or backfilled in the open pit, the contingency would be construct a facility to contain these waste materials or remove from site if only minor quantities.

Objectives – approved March 16, 2017	Activities/ Options – Table 20 in ICRP	Board Comments	De Beers Response May 5. 2017
MR3 - Chemically stable mine rock piles that are safe for aquatic life, humans and wildlife.	NEW OBJECTIVE – no options or activity described in ICRP V.3	It is important to document all closure options considered throughout the life of a project to ensure there is a record of the rationale used for certain decisions and to learn from past experiences. It is the responsibility of the proponent to ensure that the closure options proposed would achieve the stated closure objectives, comply with all closure and reclamation requirements and include best practices. Please provide closure options and activities.	Runoff and seepage waters from the mine rock piles will be directed and managed within the Water Management Pond, thus addressed through the Kennady Lake objectives. Chemical stability associated with this objective only pertains to the solids portion of the waste rock and materials to construct the facility. Management of mine rock was the subject of a detailed options analysis during initial mine planning and documented within Section 4.4.1.2 of the ICRP. Management of PAG mine rock will be completed as per the approved design (De Beers 2015 - Final Detailed Construction Plan South Mine Rock Pile and Overburden Stockpile) and management plan (De Beers 2016 - Rock Placement Verification Program Report). PAG material placement will be below the ordinary high water level (submerged) and above the ordinary high water level. For the latter, the PAG material will be placed within the centre of the pile and include an encapsulation cover. The mine rock piles have been designed and operations have been approved and achieve objective MR3. No additional closure options and activities are considered necessary.

Table 3 Summary of Closure Options by Facility

Facility	Reference	Related Research	Remaining Options
Open Pits	May 5 response - Closure Options - OP1 May 5 response - Closure Options - OP2 ICRP Section 5.2.4	RRP Section 4	a) Placement of low quality water in open pits prior to flooding
			b) Options to ensure pit stability, including blasting of unstable areas or other options determined by an engineer
			c) Options to enhance meromictic stability
Mine Rock Piles	May 5 response - Closure Options - SW3 May 5 response - Closure Options - SW5 May 5 response - Closure Options - PK2 & MR1 May 5 response - Closure Options - MR1 May 5 response - Closure Options - MR2 ICRP Section 5.2.4 ICRP Section 5.2.9	RRP Section 2.2 RRP Section 2.3	a) Options for mine rock management, including: - utilizing additional storage capacity of Hearne Pit for increases in PAG rock - regrading sides to flatter slopes should stability issues arise - increasing footprint of piles should more tonnage of mine rock be produced - constructing additional water management measures as required (e.g. water retention berms, diversion ditches, impoundments, pumping)
			b) Options to permit wildlife access and enhance habitat quality, including: - revegetation (e.g. methods, priority areas, etc.) - construction of egress and access ramps - location of access and egress - surface material type on ramps and top of pile (e.g. fine materials, materials conducive to natural revegetation)
			c) Options to deter wildlife access, including: - placement of large rocks or steep slopes at base of piles to prevent access - designing passages or corridors around the piles
			d) Options for mine rock pile stability, including: - buttressing slopes to minimize movements - improving foundation and/or drainage conditions to increase stability - relocating deposited materials to assist in slope stabilization
			e) Options/contingencies for disposal of inert waste, including: - deposition within Mine Rock Piles or mined out Tuzo Pit - disposal in a facility constructed on-site - remove from site if only minor quantities
Processed Kimberlite Facilities	May 5 response - Closure Options	RRP Section 2.3 RRP Section 3	a) Dust generation mitigation options, including: - PKC cover type and configuration

Facility	Reference	Related Research	Remaining Options
	- SW1 May 5 response - Closure Options - SW5 May 5 response - Closure Options - PK1 May 5 response - Closure Options - PK2 & MR1 May 5 response - Closure Options - PK3 ICRP Section 5.2.4 ICRP Section 5.2.9		- Priority areas for natural revegetation and method of natural revegetation
			b) Options to permit wildlife access and enhance habitat quality, including: - revegetation (e.g. methods, priority areas, etc.) - cover design to support wildlife movement (e.g. surface materials that encourage or deter natural revegetation, as well as, surface material type) - construction of egress and access ramps - location of egress and access
			c) Options to deter wildlife access, including: - placement of large rocks at base of piles to prevent access - designing passages or corridors around the piles
			d) Cover design options, including: - cover material characteristics (size) - thickness - configuration (e.g. single layer, multiple layer, composite involving earthen fill and geotextile) - vegetative cover
			e) Options for PK area stability, including: - buttressing slopes to minimize movements - improving foundation and/or drainage conditions to increase stability - relocating deposited materials to assist in slope stabilization
			f) Runoff and seepage waters directed and managed within Water Management Pond
			g) Final height options for Fine PKC Facility dykes, depending on beach slope
Infrastructure	May 5 response - Closure Options - SW2 May 5 response - Closure Options - SW3 May 5 response - Closure Options - SW5 May 5 response - Closure Options - I1 May 5 response -	RRP Section 2.1 RRP Section 2.2 RRP Section 2.3 RRP Section 5	a) Final drainage plans including: - Stabilizing embankments by removing weak or unstable materials from slopes and foundations and/or construct toe berms to flatten overall slopes - Breaching of embankments, ditches, culverts, and other drainage channel slopes with erosion resistant material (e.g. soil, riprap, vegetation) - Backfilling excavation areas to achieve the final desired surface contours to restore the natural drainage or a new acceptable drainage
			b) Options for the management of hydrocarbon contaminated water from hydrocarbon impacted soils, including: - Treat hydrocarbon contaminated water on-site - Send hydrocarbon contaminated water off-site
			c) Selection of Priority areas to promote revegetation

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Facility	Reference	Related Research	Remaining Options
	Closure Options - I2 ICRP Section 5.2.4		d) Methods of revegetation (e.g. scarification, soil augmentation, active seeding, etc.)
			e) Options to allow safe passage of wildlife, including surface re-contouring to encourage design passages or corridors, with consideration of: - slopes/grade of the land - eliminating steep slopes about breached slopes and drainage pathways - material gradation to promote a "smooth" surface
Kennady Lake	May 5 response - Closure Options - KL1 May 5 response - Closure Options - KL2 May 5 response - Closure Options - KL3 ICRP Section 5.2.4 ICRP Section 5.2.9	RRP Section 5	a) Water treatment options (if necessary), including biological, chemical, or physical treatment processes
			b) Options for physical stability, including: - for areas with low erosion potential, non-structural measures (i.e. development of simple erosion barriers based on field monitoring during mine activities) will be applied - for area with higher erosion potential, structural measures including placing a layer of protection material may be applied, and may mean constructing the shoreline so that it has a low slope with reduced wave action
			c) Erosion protection material layer properties, including: - granular material size and thickness that will perform the design functions - incorporation of a geosynthetic into the design to aid in material separation and erosion control
			d) Refilling plan and options to shorten time required for re-filling of Kennady Lake, including order of dyke breaching and pumping of water -alternative sources of water -alternative pumping rates and volumes -progressive reclamation of a sub-basin (e.g. Area 7)
			e) Constructed fish habitat features (e.g. littoral zones, finger dykes) and their placement -construction methods, materials, timing -placement of features within the basin

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APPENDIX E

RECLAMATION RESEARCH PLAN

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1 INTRODUCTION

This appendix summarizes the Reclamation Research Plan (RRP) proposed for the Gahcho Kué Mine (Mine) to address specific uncertainties regarding mine closure, many of which have been identified as topics of interest by stakeholders and technical reviewers during the Environmental Impact Review and Water Licensing processes (MVLWB, 2014). The currently planned research projects range in scope from preliminary desktop reviews to field-based research studies to focused technical assessments that would support the development of detailed engineering designs. It is expected that the research programs will evolve over time based on findings of the initial research tasks and potential changes to the Mine's operational activities. As such, research projects may be adjusted within this RRP throughout the Mine's lifespan.

The RRP should not be viewed as a detailed description of all tasks required to advance closure planning for the Mine, as many activities other than research will inform the closure process. These additional activities may include ongoing engagement with Aboriginal parties, execution of the various monitoring programs, and innovations made in mine closure practices across the industry. The programs proposed may instead be viewed as a compilation of research planned for addressing identified areas of uncertainty in the ICRP.

A schedule is provided below for the initial tasks identified for each research project. The schedule has been broken down into early-term (2016 – 2019), mid-term (2020 – 2024), and late-term mining operations (2025 – 2028). An integrated schedule of all research tasks is also provided at the end of the RRP in Section 6.0.

De Beers has committed to completing research to support closure planning. The following table provides a summary of these research commitments. The commitment number and description were extracted from the complete list provided in Table 1, Section 1.4 of the ICRP.

Table E1: Summary of research commitments and status.

No.	Commitment Description	Commitment Status
1	Within twenty four (24) months following issuance of this Licence, the Licensee shall submit an Interim Closure and Reclamation Plan to the Board for approval, in accordance with the Mackenzie Valley Land and Water Board and	Section 2.1, Task 1 addresses the option of revegetation of priority areas on the Mine Rock and PK piles. Section 2.3, Task 1 and 3 addresses the investigation into landform design

No.	Commitment Description	Commitment Status
	Aboriginal Affairs and Northern Development Canada's November 2013, or subsequent editions, *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories*. In addition to conforming with the Guidelines, the Licensee shall: a) Propose methods to reduce the period of time required for the recovery of the Water Management Pond; b) Include a research plan for investigating cover options for the Waste Rock piles and processed kimberlite; and c) Include any implications the results of the Rock Placement Verification Program required under Part E, item 7 have on Waste Rock handling and closure and Reclamation options.	options, including cover options, for the Mine Rock and PK piles. Section 3.1, Task 1 addresses the investigation into cover options for the PK piles. Section 5.1, Task 2 addresses potential options to reduce the timing of refilling Kennady Lake.
11	During operations, part of closure planning should include the identification of potential mechanisms through which full lake mixing could occur (e.g. weathering, pit wall slumping) and use the results of ongoing investigations and studies to implement measures such that chemocline stability will be enhanced. Once mining is complete, the information gathered should be used to improve the likelihood that successful pit lake stratification can be achieved over the long-term.	Section 4.1, Task 1 and 3 address enhancing the chemocline chemical stability.
12	During operations, closure planning should identify and develop methods to reduce the period of time required for recovery of the refilled Kennady Lake.	Section 5.1, Task 2 addresses potential options to reduce the timing of refilling Kennady Lake. Section 5.1, Task 5 addresses completing progressive restoration of a sub-basin of Kennady Lake during operations to inform closure planning.
23.	Seepage water quality and thermal conditions in the waste storage facilities will be monitored throughout all stages of the Project. DBCI is committed to the development of a Mine Waste Management Plan. De Beers is committed to the development of a monitoring program to verify the water quality predictions and the effectiveness of mitigation.	Section 2.2, Task 1 addresses monitoring of water quality data. Section 2.2, Task 2 addresses verification of the predictive model for water quality and the effectiveness of mitigation.
29	De Beers has committed to look for opportunities to restore Area 7 earlier in the mine plan.	Section 5.1, Task 4 addresses restoration of Area 7 during mine operations and prior to mine closure.
31	Experience gained from closures of the Ekati and Diavik mines will be used at the Project site to develop a re-vegetation management plan to support the successful restoration of the site. Reclamation activities will include:) An evaluation will consider the physical aspects of re-vegetation, such as re-contouring, erosion control techniques, seedbed preparation, surface roughening, and the use of soil amendments, which	Section 2.1, Task 1 addresses a desktop review of experiences from applicable mine sites. Section 2.1, Task 2 addresses field research which will consider the physical aspects of re-vegetation such as those listed. Task 3 will resolve the issue of availability of stockpiled soil.

No.	Commitment Description	Commitment Status
	collectively promote natural secondary succession. J Traditional knowledge will be considered in reclamation and closure plans.	Section 2.3, Task 1 addresses the review of comparable mine site landform features. Section 2.3, Task 3 addresses collecting traditional knowledge information.
32	The monitoring activities associated with Project construction, operations, and closure, are described below, and are designed to work in conjunction with other programs. J Identification of areas where vegetation is intact. A general site survey to identify areas where healthy vegetation is maintained and where vegetation is showing signs of degradation will be carried out on a regular basis. Estimates of the extent of intact (undisturbed) and degraded vegetation will be recorded. J Identification of areas where re-vegetation is required. Disturbed areas will be identified from the general site survey identified above, as well as from surveys conducted as part of the monitoring program associated with the closure and reclamation plan (Section 10). Disturbance estimates will include descriptions of areas that have been re-vegetated and an indication of treatment effectiveness. Test plots will be established at longer-term monitoring stations to evaluate treatment effectiveness as well. J Implementation of re-vegetation efforts. Areas identified as requiring re-vegetation (e.g., from the general site survey and/or closure and reclamation monitoring) will be assigned an appropriate treatment. Vegetative material (seed or otherwise) will be composed of non-invasive species. The long-term re-vegetation goal is to facilitate and encourage the re-establishment of native vegetation. Treatments will be designed such that they optimize success (e.g., timing will coincide with favourable weather events). J Survey timing. The timing of the surveys will be planned according to when the areas were re-vegetated and the potential for soil erosion. For example, areas with a high potential for soil erosion will likely be surveyed more frequently following treatment. Test plots will be established at longer-term monitoring stations.	Section 2.1, Task 2 addresses completion of field test plots.
39	De Beers commits to developing a revegetation plan for riparian and aquatic vegetation as part of the interim closure and reclamation plan for Kennady Lake. The details of the plan will be developed in consultation with DFO and would include opportunities for early implementation.	Section 2.1, Task 5 addresses the development of a Revegetation Plan which will include riparian and aquatic areas.

No.	Commitment Description	Commitment Status
	Monitoring of the reestablishment of aquatic vegetation in the refilled lake will also be included as part of the AEMP.	
40	De Beers commits to reviewing options for storing overburden (need to identify areas where overburden can potentially be stockpiled) and to incorporating this material into their reclamation and closure planning where appropriate.	Section 2.1, Task 3 addresses the use of overburden material use in reclamation planning.
43	De Beers commits to gather and provide existing information on best management practices for reclamation (specific to vegetation restoration and vegetation trials).	Section 2.1, Task 1 addresses collection of best management practices and Task 2 addresses completion of field trials.
46	De Beers commits to undertaking vegetation trials to determine relative success of the effort and to inform best management practices.	Section 2.1, Task 2 addresses completion of field trials.
48	Ongoing investigation and research will be undertaken through the Mine life on mechanisms to enhance meromixis in the Tuzo pit during the refilling of Kennady Lake.	Section 4.1, Task 1 and 3 address research into enhancement of meromixis.
59	Metrics such as habitat capability and suitability will be considered as potential evaluation methods during revision of the ICRP.	Section 2.3, Task 2 evaluates the habitat suitability for the mine components and landform options.
62	De Beers has committed to listen and have an open conversation with Aboriginal communities about preferences regarding re-vegetation of mine rock piles.	Section 2.3, Task 3 addresses collecting traditional knowledge information.

2 SITE WIDE

2.1 REVEGETATION

Revegetation of disturbed areas in northern regions typically occurs at slow rates due to a variety of factors including: cool short summers, low precipitation levels, limited availability of soil, and the scarcity of endemic plant seeds or other propagules in sufficient quantities for use in large-scale planting or seeding. There are limited examples of successful and well-documented revegetation programs in northern latitudes, especially for large-scale disturbances (Environmental Dynamics Inc. and MPERG, 2009).

The revegetation goal at the Mine is to achieve the re-establishment of native vegetation at the mine site at priority areas. De Beers has committed to gathering information on revegetation best practices and undertaking field trials to inform the refinement of the planned revegetation methods at the various disturbed infrastructure areas (e.g. roads, laydown areas, airstrip, etc.) across the site (De Beers, 2014a). The research will inform the closure options and criteria for revegetation.

The current ICRP outlines that the Mine Rock Piles will not be covered or re-vegetated, consistent with approaches at other northern diamond mine sites (De Beers, 2013a). Additionally, the current ICRP does not consider revegetation of the PK Piles. In response to stakeholder interest, revegetation of some portion of the Mine Rock Piles and PK Piles will be assessed as a potential option for improving wildlife habitat post-closure, and is described in Section 2.1 and Section 2.3. Revegetation efforts will be also be implemented at priority infrastructure areas. De Beers expects vegetation will grow at the disturbed areas of the mine site and wildlife will safely use the site. Research to understand the landforms desired to achieve this objective are described in Section 2.3. The completed research may inform the objectives and criteria of future versions of the closure and reclamation plan.

2.1.1 **Uncertainty**

Research is designed to target key areas of uncertainty. The first area of uncertainty related to re-vegetation is related to methodology. What methods are most effective at revegetating infrastructure areas at the mine (e.g. roads, pads) and what is the potential to vegetate unique substrates like mine rock, processed kimberlite, riparian and aquatic environments? These key questions will be addressed through a desktop study of results achieved at other northern and applicable mines (Task 1), and through field trials to be conducted at Gahcho Kue (Task 2). Soil is a critical element to any re-vegetation effort, yet there is some uncertainty regarding the volume available for reclamation. Task 3 will address that area of uncertainty by comparison the available volumes with the recommended volumes derived from Task 1 and Task 2. Once these areas of uncertainty are sufficiently resolved, the specific criteria related to revegetation success will be established (Task 4). Finally, with the criteria developed, a Revegetation Plan will be developed (Task 5).

2.1.2 **Research Objective**

The following objectives will be addressed in completion of this research.

- Assessment of best management practices for revegetation at comparable mine sites.
- Evaluation of revegetation methods and their effectiveness for upland, riparian and aquatic areas.
- Identify optimum use of overburden stockpile material for use in revegetation.
- Development of revegetation closure criteria.
- Development of a Revegetation Plan.

With respect to future updates to the closure and reclamation plan, the research will: inform options for revegetation methods, inform the monitoring program for revegetation in upland, riparian and aquatic areas, and define criteria for revegetation success.

2.1.3 Overview of Tasks

2.1.3.1 Completed Tasks

This research project has not been initiated to date.

2.1.3.2 Remaining Tasks and Scopes of Work

Task 1: Desktop Review of Revegetation Practices at Comparable Mines

A desktop review will be completed that summarizes the successful revegetation practices at other northern and applicable mine sites. Revegetation of upland (e.g., rock piles, PK piles, and infrastructure areas), riparian, and aquatic areas will be targeted.

The study will summarize the following:

- Best management practices with regards to revegetation as documented through successful revegetation practices at comparable mine sites.
- Options for surface preparation (e.g. re-contouring, roughening, erosion control, salvaged soil spreading, etc.) to promote natural secondary succession in upland and riparian areas.
- Options for revegetation in aquatic areas.
- Metrics applied to measure revegetation success.
- Potential for metals uptake in vegetation at PK areas post closure.
- Traditional Knowledge documented that is relevant to this topic.

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 2: Upland and Riparian Revegetation Test Plots

Field test plot to assess coverage of native plant species on disturbed land representative of infrastructure areas will be completed. The research will assess the viability of alternative methods (e.g. scarification and natural vegetative ingress, direct seeding, mounding), success of various test species, and coverage of vegetative growth. Test plots will be constructed in areas with ground conditions representative of infrastructure areas including well drained upland areas (e.g. elevated rock pads graded for drainage), and riparian areas. Test plots will also include unique substrates such as processed kimberlite and mine rock. Aquatic revegetation plots will be conducted as part of Section 5, task 5.

The revegetation methods to evaluate will be informed by the research completed in Task 1 and will include: re-contouring, erosion control techniques, seedbed preparation, surface roughening, and the use of soil amendments (e.g. topsoil, fertilizer, etc.), which collectively promote natural secondary succession. Active revegetation techniques will also be considered including seeding and planting. The outcome of this study will be instrumental in tailoring the species recommended for revegetation from Task 1 to the Gahcho Kue site specifically.

Various native plant species will be selected to evaluate their growth and coverage within each tested ground condition. The plant species will be selected based on several factors including Traditional Knowledge, natural occurrence in the area, demonstrated success in re-vegetation projects at other northern sites and readily available seed source.

The research findings will be summarized within the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 3: Overburden Stockpile Volume Balance and Management

Lake-bottom sediment and till removed from Kennady Lake to facilitate mining are stockpiled in an area adjacent to the South Mine Rock Pile. A portion of the overburden may be used in construction; the remainder is available for use in site reclamation as a soil amendment to support revegetation.

There is an insufficient volume of overburden to use in all revegetation areas. The priority areas for revegetation will be mapped and categorized as high, medium and low desire for revegetation. An estimate of the overburden volume requirements for the high, medium and low revegetation areas will be completed.

A comparison of the overburden use to the volume stockpiled will be completed to document the priority areas that can and cannot have this material used as a soil amendment.

The research findings will be provided within with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence) and will be used during the development of the Revegetation Plan (Task 5).

Task 4: Development of Revegetation Closure Criteria

Utilizing the desktop study and field research described in Tasks 1, 2, and 3 closure criteria will be developed to satisfy closure objective I2 and potentially other objectives (e.g., SW5). The criteria will be selected based on achievable coverage of plants for the environmental setting at the mine.

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 5: Revegetation Plan

Utilizing the information collected in Tasks 1, 2, and 3 and remaining in line with the closure criteria developed in Task 4, a Revegetation Plan will be developed. The plan will describe the methods and priority areas for revegetation in order to meet the objectives and criteria of the ICRP. It will address aquatic, riparian, and upland vegetation and will include monitoring designed to measure achievement of criteria.

The Revegetation Plan will describe the methods of revegetation to achieve the desired habitat use, aesthetics or land use consistent with the ICRP objectives and criteria. Monitoring of revegetated areas will be described, including assessing species diversity and coverage. Wildlife use of treated areas (re-vegetated areas) will also be monitored. Adaptive management actions will be developed to address the scenario that revegetation criteria are not on a trajectory of being achieved. The aquatic aspects of the Revegetation Plan will be developed in consultation with DFO and where applicable satisfy requirements of the DFO Authorization (03-HCAA-CA6-00057.1)

Monitoring of aquatic habitat use by fish will be detailed within the Fish Habitat Validation Plan (described in Section 5.0) that is subject to approval by DFO as per the Fisheries Authorization (03-HCAA-CA6-00057.1).

The Revegetation Plan will be provided to the Board as part of the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

2.1.4 Linkages to Other Research

The engagement for landform features completed in Section 2.3 may identify a preference by community members to revegetate certain priority areas of the Mine Rock and/or PK Piles. Research into revegetation of certain priority areas the Mine Rock and PK Piles is incorporated into the research described in Task 1 and 2, as well as potentially Task 5 (the Revegetation Plan) should Tasks 1 and 2 indicate that revegetation at these areas is desirable, achievable and will lead toward meeting the approved criteria and ultimately the objectives for these facilities.

The research described in Task 2 is also addressed as a component of the Aquatic Progressive Restoration Pilot Project described in Section 5.0 Task 5.

2.1.5 Project Research Schedule

Year	Project Activities
2017 – 2019	Desktop review of revegetation practices at comparable mines (Task 1) Revegetation test plots (Task 2) Overburden stockpile volume balance and management (Task 3)
2020 – 2024	Continued revegetation test plots research (Task 2) Continued overburden stockpile volume balance and management (Task 3) Development of revegetation closure criteria (Task 4)
2025 – 2028	Continued revegetation test plots research (Task 2) Development of revegetation plan for permanent closure (Task 5)

2.2 POST CLOSURE SEEPAGE QUALITY AND QUANTITY

Predictions for seepage quality and quantity from the Mine Rock and PK Piles during both operations and post-closure mine phases has been a topic of interest for stakeholders (MVEIRB, 2013). De Beers has committed to completing monitoring at these areas for applicable parameters (e.g., seepage quality and quantity, piezometric and thermal properties of the structures, etc.) to verify the initial EIS predictions and allow for adaptive management of mitigation during operations, as well as the refinement of the closure design, as necessary (De Beers, 2014a).

The quantity and quality of seepage from the Mine Rock and PK Piles will influence Kennady Lake water quality and its management to support achieving the Kennady Lake closure objectives.

2.2.1 Uncertainty

There is always some uncertainty when predicting future conditions. The future water quality conditions at Kennady Lake were predicted based on baseline data, the mine plan, incorporation of all existing related information, assumptions, complex analysis, and modelling. Even after all the analysis was completed and the Project was approved, it is acknowledged that some uncertainty remains regarding the post-closure water quality expected at Kennady Lake. This uncertainty will be addressed through additional research. The key areas of uncertainty remaining include:

- Post-closure water quality associated with run-off and seepage from the Mine Rock and PK Piles.
- Adaptive management strategies and their effectiveness if the water quality and quantity from the Mine Rock and PK Piles is higher than initial predictions.
- The potential impact of weathering of the PK on the run-off and seepage quality from the PK Piles.

2.2.2 Research Objective

The following objectives will be addressed by completion of the research.

- Confirm and/or refine the post-closure seepage mass loading predictions from the Mine Rock and PK Piles.
- Development of adaptive management strategies if the mass loading predictions are higher than initial predictions.
- Assessment of the effectiveness of the adaptive management strategies to support the closure objectives for the Kennady Lake water quality.

With respect to future updates to the closure and reclamation plan, the research will: inform the water management options at closure for each open pit and Kennady Lake and inform adaptive management and contingencies for run-off and seepage water quality from the Mine Rock and PK Piles.

2.2.3 Overview of Tasks

2.2.3.1 Completed Tasks

This research project has not been initiated.

2.2.3.2 Remaining Tasks and Scopes of Work

Task 1: Data Collection

The following water quality and quantity monitoring will be completed during mine operations to assess the run-off and seepage from the Mine Rock and PK piles. Operational data is necessary to predict the post-closure water quality and quantity and is also a requirement of the water licence (MV2005L2-0015).

- Seepage quantity and quality from the mine rock piles will be monitored at survey stations established along the toes of the mine rock piles and/or in streams draining from the Mine Rock Piles as outlined in the approved Processed Kimberlite and Mine Rock Management Plan Version 4 (De Beers, 2015a) and Surveillance Network Program.

- Field testing will be carried out to measure the volume, rate of flow, field pH, and conductivity. The collected water samples will be sent to an accredited laboratory to analyze the chemical characterization of the seepages, such as major ions, pH, conductivity, sulphate, nitrogen as total ammonia, metals, and total suspended solids.

- The seepage surveys will be completed twice per year during spring freshet and late fall. Additional seepage surveys will be completed after significant rainfall events.

Geochemical monitoring will be completed during mine operations according to the approved Geochemical Characterization Plan (De Beers, 2015b) The operational data is necessary to validate assumptions in the predictions of post-closure water quality and quantity.

A summary of the results from this operational monitoring will be reported within the Annual Water Licence Report (Part B, Item 10 of the Project water licence).

Task 2: Comparison of the Measured and Predicted Seepage Data

A comparison of the measured and predicted seepage data from the Mine Rock and PK Piles will be completed annually and reported within the Annual Water Licence Report (Schedule 1, Item1.j.vi of the Project water licence).

Following completion of mining at Hearne Pit, a comparison of the multi-year monitoring data obtained in Task 1 against the key assumptions and predictions from the EIS (De Beers, 2010) will be conducted. The validity of key model assumptions and inputs will be assessed against the measured data and recommendations will be developed to refine the predictions of post-closure water quality and quantity from the Mine Rock and PK Piles. The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 3: Assessment of PK Weathering

De Beers agreed to further assess the implications of PK weathering if there is evidence in the operational data that it is contributing to a deterioration in water quality. The comparison of measured and predicted seepage conducted annually on sample locations downstream of the PK facilities (Task 2) will be utilized as a trigger for initiation of the Assessment of PK weathering research task. If the

comparison indicates that weathering of the PK facilities is a potential cause of the deterioration of water quality, then a focussed research task will be initiated to examine extent of weathering, implications of weathering on water quality, and potential mitigations to reduce the weathering. In this scenario, a detailed research plan will be developed and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

2.2.4 Linkages to Other Research

The run-off and seepage water quantity and quality from the Mine Rock and PK Piles are measured within the Water Management Pond. Thus, these locations are sources at the mine that may influence the water quality in Kennady Lake at closure. Thus, there are linkages from this research to the research presented within *Section 5.0 – Timeline for Reconnection of Kennady Lake to Surrounding Waterbodies*.

At closure, the PK piles are to be covered. The cover type can influence the run-off and seepage quality but also wildlife use. Cover options that may support wildlife habitat is detailed in *Section 2.3 – Final Landform Options to Support Wildlife Habitat*.

2.2.5 Project Research Schedule

Year	Project Activities
2017 – 2019	Data collection Comparison of measured and predicted seepage data Assessment of PK weathering
2020 – 2024	Continued data collection Continued comparison of measured and predicted seepage data Continued assessment of PK weathering Comparison of predicted and multi-year measured seepage data
2025 – 2028	Continued data collection Continued comparison of measured and predicted seepage data Continued assessment of PK weathering

2.3 FINAL LANDFORM OPTIONS TO SUPPORT WILDLIFE HABITAT

Recent closure engagement activities (De Beers, 2014b) have highlighted a desire by stakeholders to improve the planned post-closure conditions for the Mine area. More specifically, Aboriginal parties have expressed a desire for the post-closure condition to include landform features that do not pose a risk and also carry the potential for some benefit to certain wildlife species.

De Beers has agreed to investigate potential opportunities for the final landform design that may provide improved habitat quality for local wildlife expected to return to the Mine area post-closure. Such opportunities that may be investigated include access and egress ramps, surface material properties suitable for caribou travel, perch sites for birds, nest sites, den sites, and escape cover as well as revegetation options at priority areas on or around the Mine Rock and PK Piles (see Section 2.1). The extent to which wildlife are predicted to benefit from the potential landform features will be assessed to evaluate options for implementation. Options to limit wildlife access as a means to ensure Mine Rock and Coarse PK Piles are safe for wildlife will also be assessed.

2.3.1 Uncertainty

There are specific uncertainties regarding the closure options that would ensure safe use and provide potential benefit for caribou and other local wildlife, as follows:

- What landform options have been successful at other northern mines in facilitating safe wildlife use and travel?
- Where landform design should be modified/enhanced to encourage wildlife use (e.g. gentle slopes, vegetation, perch sites);
- Where landforms should be designed/modified to discourage wildlife use (e.g. steep slopes to discourage ungulate travel);
- How travel routes should be developed in the final landform (e.g. access/egress ramps, surface material properties);

- Preferences of Traditional Knowledge holders regarding final landforms to achieve objectives related to wildlife

2.3.2 Research Objective

Identify landform features for each mine component to inform closure options for final landforms that would improve habitat quality for caribou and other local wildlife.

2.3.3 Overview of Tasks

2.3.3.1 Completed Tasks

This research project has not been initiated to date.

2.3.3.2 Remaining Tasks and Scopes of Work

Task 1: Desktop Review of Final Landforms at Comparable Mines

A desktop review will be completed that summarizes the final landform features at other northern and applicable mine sites. Landform features associated with rock piles, PK piles, and infrastructure areas will be targeted.

The study will summarize the following:

- Best management practices and Traditional Knowledge with regards to landform features that support or restrict wildlife habitat for key wildlife species.
- Options for landform features that support wildlife habitat, their physical characteristics and habitat function, and the benefit(s) to wildlife habitat.
- Options for landform features that restrict wildlife habitat and their physical characteristics and habitat function.
- Recommendations for viable landform features that can be used to inform final site design, habitat function and stakeholder engagement (see Task 2 for details).

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 2: Evaluation of Habitat Suitability Index

For each mine component and for the viable landform options identified in Task 1, the capacity of the closure features to support key wildlife species, including caribou, grizzly bear, wolf, fox, wolverine, moose, muskoxen, upland breeding birds, waterbirds, and raptors, will be assessed. This will be accomplished by calculating its Habitat Suitability Index value. Comparing the results of the Habitat Suitability Index for each landform option will provide additional context regarding their relative benefits. Recommendations to further inform the selection of the final landform features will be provided.

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 3: Engagement and Feedback

Completion of engagement to further understand community preferences for each mine component will be conducted. Engagement will involve a workshop specifically on closure options, considering the results of Tasks 1 and 2, to gather feedback. This engagement will be used to inform the final closure design. The engagement will include discussions of preferences with respect to: :

- Habitat function for key wildlife species
- Future land use and aesthetics
- Wildlife safety
- Landform features and areas of revegetation

Any Traditional Knowledge collected during engagement will be used to further inform the final design of the landform feature.

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

2.3.4 Linkages to Other Research

The engagement for landform features completed in Task 3 above may identify a preference by community members to revegetate priority areas of the Mine Rock and/or PK Piles as a cover option. Research into revegetation on the Mine Rock and PK Piles would be incorporated into the research within *Section 2.1 – Revegetation*.

2.3.5 Project Research Schedule

Year	Project Activities
2016 – 2019	Desktop review Evaluation of habitat suitability index Engagement and feedback
2020 – 2024	Additional research will be determined by findings of the initial tasks.
2025 – 2028	Additional research will be determined by findings of the initial tasks.

3 PROCESSED KIMBERLITE CONTAINMENT FACILITIES

3.1 PHYSICAL STABILITY OF ENGINEERED COVERS

At closure the PK piles are to be covered. The current ICRP had adopted rock covers as the cover type to be applied to the PK piles. This is consistent with the Conceptual Closure Design (De Beers, 2013b) and considered during the Environmental Impact Review (MVEIRB, 2013). Based on stakeholder feedback with regards to landform options that may benefit wildlife habitat, De Beers has committed to evaluate alternative cover types and revegetation of the PK piles (see Section 2.3).

Regardless of cover type selected for the PK piles, to ensure the long term performance of a cover, the geotechnical and thermal characteristics of the underlying materials must be first understood. Properties of PK are not widely available, and as such, assumptions for PK geotechnical and thermal properties were made during the detailed design phase of the containment dykes (De Beers, 2015c). Additionally, instrumentation within the PK piles is required to monitor water levels and the thermal conditions within the deposited materials. These instruments may be used to calibrate, or confirm, assumptions in numerical models used in the design of the rock cover. Further, geotechnical stability performance monitoring data at the PK Piles should be evaluated and compared to initial predictions and assumptions.

The current ICRP has applied the following covers to the PK Piles:

- The Coarse PK Pile will be covered with a layer of non-acid generating (NAG) mine rock approximately 1 m thick. (De Beers, 2010, 2015a).

- The Fine PK Pile will be covered with approximately 1 m of coarse PK followed by 1.5 m of NAG mine rock (De Beers, 2014c).

The mine rock layer thickness will depend on actual fine PK properties, local conditions, and equipment used for mine rock placement. The final geometry of the cover layer will be graded to limit ponding of water over the reclaimed facility and promote runoff towards Kennady Lake and limit infiltration.

3.1.1 Uncertainty

Due to the limited geotechnical data of the PK geotechnical and thermal properties at Gahcho Kué at the time of the design stage, there is uncertainty regarding the cover type and characteristics that will ensure long term physical stability and erosion resistance.

3.1.2 Research Objective

The objective of this research project is to gain an improved understanding of the PK characteristics that will be deposited in the Fine and Coarse PK Piles. The main research objectives include:

- Confirm the geotechnical and geothermal properties of PK deposited in the Fine and Coarse PK Piles;
- Assess the thermal regime in the deposited PK within the Fine and Coarse PK Piles;
- Identify effective methods to ensure the engineered cover is resistant to wind and water erosion processes;
- Assess the required thickness of the cover to achieve objectives; and
- Optimize the cover configuration and material types (e.g. potential use of a geotextile) to achieve constructability and performance requirements.

With respect to future updates to the closure and reclamation plan, the research will inform the cover closure options for the PK piles.

3.1.3 Overview of Tasks

3.1.3.1 Completed Tasks

Research has yet to begin regarding the cover for the PK disposal facilities.

The Construction Management Plans for the perimeter dykes that contain the Fine PK were been developed and approved by the MVLWB (De Beers, 2015c; De Beers, 2015d). The Final Detailed Construction Plans for these dykes were also provided as per the water license requirements. The Final Detailed Construction Plans illustrated the geotechnical design of the dykes including the seepage, slope stability, and thermal criteria and thermal analysis. The design utilized assumptions

for the material properties of the PK based on the designer's previous design experience at other diamond mines in the NWT.

The Construction Management Plan for the Coarse PK Pile was also developed and approved by the MVLWB (De Beers, 2016b). The geotechnical design of the pile is included in the Final Detailed Construction Plan submitted to the Board as per the water license. As for the Fine PKC Facility dykes, the Coarse PK Pile design utilized assumptions regarding PK material properties.

3.1.3.1.1 Findings of Research Completed

The long term performance of the cover is contingent on conditions at the dykes which enclose the Fine PK Pile. Key engineering studies completed in support of dyke design at the Fine PK Pile (De Beers, 2015c) include the following:

- Design of Dyke L using predictive seepage modelling to perform two basic functions:
  - control erosion of dyke materials; and,
  - allow drainage of seepage water.
- Slope stability modelling of all Fine PK Pile dykes to meet the minimum factor of safety requirements for static and seismic conditions set forth by the Canadian Dam Association; and
- Thermal modelling to make sure that the geomembrane liners in Dyke A1 are keyed into perennial frozen material to retain its water retention objective.

Key engineering study into the long-term stability of the Coarse PK Pile include the slope stability modelling that was documented in the design report (De Beers, 2016b).

3.1.3.2 Remaining Tasks and Scopes of Work

Task 1: Desktop Review of Cover Options and Performance

A desktop review will be completed that summarises the cover types employed at other northern and applicable mine sites that have conditions comparable to the PK Piles. Comparable conditions for the Fine PK Pile may include: saturated and partially saturated fine PK within the facility; potential for excess ground ice with the PK; slurry deposition employed during mine operation; and cold environment.

Comparable conditions for the Coarse PK Pile may include: compacted waste material placed in dry state; pile slope; and cold environment. The study will summarize the following:

- Best management practices with regards to cover design and long-term performance.
- Options for cover material types and characteristics.
- Performance of the cover to achieve the design objectives.
- Recommendations for cover design considerations for the Fine and Coarse PK Piles and if applicable, additional research.

The scope of this desktop review will be further informed from the cover option considerations related to revegetation (see Section 2.1) and landform design (see Section 2.3).

The desktop review will be presented as a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 2: Geotechnical Investigation

Geotechnical and thermal properties of the PK within the Fine and Coarse PK Piles will be assessed to aid in the design of the cover. The geotechnical investigation will include the following:

- Laboratory testing of fine and coarse PK samples to update / refine the PK properties assumed during initial design of the Fine and Coarse PK Piles. Testing will target the key geotechnical (e.g., strength properties, water and ice contents, size, etc.) and thermal properties of the PK that represent the foundation upon which a cover is placed.
- Installation of thermal (i.e., thermistors) and hydraulic monitoring (i.e., piezometer or vibrating wire piezometers) instruments within the deposited PK to measure the ground temperatures and water level.

Grab samples of PK for geotechnical testing could be completed during deposition and during installation of the thermal and hydraulic monitoring instruments.

Installation of thermal and hydraulic monitoring instruments would be completed after the PK piles are substantially constructed to permit these instruments to be used after cover is placed. The geotechnical investigations will be completed in advance of facility closure to aid in the final cover design.

The geotechnical information collected will be documented in the factual reports to support cover design.

3.1.4 Linkage to Other Research and Life of Mine Plan

Landform options to support wildlife habitat is a research item addressed in Section 2.3. Additionally, revegetation of priority areas of the PK piles is also an aspect that is being considered and researched within Section 2.1.

An outcome from the landform and revegetation research may be a PK Pile cover that differs from the rock covers currently adopted as part of the ICRP. Depending on the selected cover type and characteristics, there may be a need for additional research to ensure long-term physical stability and/or to support the desired habitat features.

3.1.5 Project Research Schedule

Year	Project Activities
2016 – 2019	Desktop review Geotechnical investigation
2020 – 2024	Continued geotechnical investigation Additional research will be determined by findings of the initial tasks
2025 – 2028	Additional research will be determined by findings of the initial tasks

4 OPEN PITS

4.1 STABILITY OF CHEMOCLINE WITHIN FLOODED PITS

The successful establishment, and long term stability of meromictic conditions within the flooded Tuzo Pit (and partially flooded Hearne Pit) has been identified as a primary area of concern by various stakeholders during the permitting and licensing processes (MVEIRB, 2013; MVLWB, 2014). De Beers has committed to investigating potential mechanisms (e.g. weathering, pit wall slumping) through which full lake mixing could occur within Kennady Lake during or following refilling at closure. As part of this assessment, potential options to enhance the stability of an established chemocline within the flooded pits (Hearne and Tuzo) would also be investigated for implementation (De Beers, 2014a). Completion of this research project will help identify potential risks regarding water quality during the refilling of Kennady Lake, and inform the refilling plan contingencies outlined in Section 5.2.9.4 of the ICRP.

4.1.1 Uncertainty

There remains some uncertainty among stakeholders that poor water quality will be isolated in the bottom of Tuzo Pit at closure and that the meromictic conditions will be established and maintained as predicted. De Beers will conduct additional research into the following specific areas in order to strengthen confidence in the model predictions through scientific research:

- Development and stability of meromictic conditions within the flooded open pits.
- Evaluation of options to enhance meromictic stability.
- Evaluation of potential lake mixing mechanisms (e.g., pit wall slumping) to asses the influence the stability of the chemocline.
- Post-closure water quality in the open pits.

4.1.2 Research Objectives

The objectives of the research are to:

- Refine the current predictions of post closure pit water quality and meromictic conditions in the open pits with operational data.
- Develop methods to enhance meromictic stability in the open pit that may be implemented during operations and at closure.

With respect to future updates to the closure and reclamation plan, the research will: inform the water management options at closure of each open pit, inform options to enhance meromictic stability, and develop closure criteria for the open pits associated with closure objective OP1.

4.1.3 Research Plan Overview

4.1.3.1 Tasks Completed

The model to predict water quality in the open pit at closure and the development of meromictic conditions has been developed (De Beers, 2011) and was subject of in-depth review during the Environmental Impact Review and Water Licencing process for this Project.

Assessment of conditions that may result in chemocline instability within the flooded open pits (De Beers, 2011). This involved a long-term analysis that evaluated the stability of stratification (meromictic conditions) following the refilling of Kennady Lake. Various interactions of physical and chemical processes that may affect mixing were assessed, including flow, thermal and substance mass loading regimes, meteorological forcing conditions (e.g., air temperature, wind, solar radiation, precipitation, evaporation, etc.) and lake-bottom interactions and ice cover.

4.1.3.2 Remaining Tasks

Task 1: Desktop Review of Recent Pit Lake Case Studies and Available Measures for Enhancing Chemocline Stability

A desktop review will be completed that summarizes best management practices for the establishment and maintenance of stable meromictic conditions in the flooded open pit. The review will identify open pits and/or lakes in a comparable setting and environmental condition as Gahcho Kué and summarize:

- Key factors that contributed to the development and stability of meromictic conditions.
- Factors considered that may influence the stability of the chemocline.
- Measures implemented to enhance chemocline stability in flooded open pits over time and during the refilling process.

This research will inform the development of the Closure Water Management Plan (Schedule 5, Part G, Item 1 of the Project water licence) and updated open pit water quality modelling (Task 3). The desktop review will be presented as a research report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 2: Comparison of Measured and Predicted Pit Water Quantity and Quality Data, Assessment of Implications to Closure

An analysis of any significant differences between the measured and predicted water quality and quantity data will be documented, along with any recommendations and/or updates to the model predictions or additional research. This analysis will be completed annually and reported within the Annual Water Licence Report (Schedule 1, Item 1.g.ii and 1.g.iii of the Project water licence).

Should the monitoring data trigger a low action level threshold, as detailed within the Groundwater Monitoring Program (De Beers, 2015e), the validity of key model assumptions and inputs will be assessed against the measured data and recommendations will be developed to refine the predictions of post-closure pit water quality. A summary of action level exceedances and action taken in response will be completed annually and reported within the Annual Water Licence Report (Schedule 1, Item 1.g.ii of the Project water licence).

Task 3: Refinement of the Open Pit Water Quality Predictions

After partial flooding of Hearne Pit (first pit to be flooded), the open pit water quality model will be updated to incorporate operational water quality and quantity data. Post-closure water quality predictions will be revised. Potential methods to enhance the stability of meromictic conditions will be evaluated. Potential mechanisms that may influence the stability of the chemocline will be evaluated.

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

Task 4: Development of Numerical Closure Criteria

Utilizing the updated predictive model from Task 3, numerical closure criteria for the mixolimnion, or surface water zone, will be developed for water quality in the flooded pits, which will satisfy the Open Pit closure objective OP1. Additional metrics will be developed to confirm meromictic conditions and its stability and resistance to mixing. For example, equations that quantitatively describe the stability of two water layers on the basis of their density, incorporating other physical conditions (e.g. temperature, wind, etc.) will be evaluated to inform the closure condition. Such examples are Schmidt Stability (Schmidt, 1928) and Lake Number (Imberger and Patterson, 1990).

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

4.1.4 Linkage to Other Research Projects

The flooded open pits are positioned below the original bed surface of Kennady Lake. Thus, there is a direct connection between the open pits and Kennady Lake, thus the water quality in the open pits has potential to influence the time to fill of Kennady Lake and the water quality in Kennady Lake. Kennady Lake time to fill and water quality is the subject of research described in *Section 5.0 – Kennady Lake.*

4.1.5 **Project Tracking and Schedule**

Year	Project Activities
2017 – 2019	Desktop review of recent pit lake case studies and available measures for enhancing chemocline stability Comparison of measured and predicted pit water quantity and quality data, assessment of implications to closure
2020 – 2024	Continued comparison of measured and predicted pit water quantity and quality data, assessment of implications to closure Refinement of the open pit water quality predictions Development of numerical closure criteria
2025 – 2028	Continued comparison of measured and predicted pit water quantity and quality data, assessment of implications to closure Additional research will be determined by findings of initial research tasks.

5 KENNADY LAKE

5.1 TIMELINE FOR RECONNECTION OF KENNADY LAKE TO SURROUNDING WATERBODIES

During the licensing process, various stakeholders expressed concerns regarding the water quality in the Water Management Pond at the end of operations and in the refilled lake during closure. Additionally there was interest in the amount of time required for the re-establishment of a viable, self-sustaining ecosystem in Kennady Lake that is compatible with the regional watershed (MVLWB, 2014).

It was recommended by the GNWT-ENR that pumping the entire contents of the WMP to Tuzo Pit at closure would reduce the time period required for recovery of the water quality in Kennady Lake, and consequently reduce the timeline for achieving a sustainable aquatic ecosystem in Kennady Lake. De Beers agreed to monitor water quality in the WMP throughout operations, and using the monitoring data to evaluate the water management options available at closure (e.g. increased volume pumped into the Tuzo Pit) to inform the potential to enhance the recovery of the lake (De Beers, 2014d).

De Beers has committed to returning Kennady Lake to a state that will support a functioning aquatic ecosystem and traditional uses. This commitment is reflected in closure objective KL1. To this end, De Beers will execute its DFO Authorization (03-HCAA-CA6-00057.1) that requires the following select items:

- A “Patterns in Fish Movement and Habitat Use” study to increase understanding of migration and movement of fish in northern regions, undertaken at Kennady Lake.
- Construction of fish habitat features in Kennady Lake.
- Demonstration of the use of the fish habitat features by evaluating fish presence on the features at the appropriate life stages as defined in a Fish Habitat Validation Plan. The Fish Habitat Validation Plan is subject to approval by DFO.
- Completion of fish surveys to inform if sufficient numbers of fish have returned to Kennedy Lake.

5.1.1 Uncertainty

The following areas uncertainties will be addressed through research.

- Post-closure water quality in Kennady Lake.
- Methods to reduce the time to refill Kennady Lake and re-connect to the downstream watershed.
- Development of water quality and functioning aquatic ecosystem closure criteria to satisfy closure objective KL1.

5.1.2 Research Objectives

With respect to future updates to the closure and reclamation plan, the research will: inform the water management options at closure for Kennady Lake, inform contingencies to address refilling of Kennady Lake and its water quality in Kennady Lake, inform the selection of fish habitat features that will support a functioning aquatic ecosystem, inform options to restore Area 7 of Kennady Lake earlier in the mine plan, and develop closure criteria for Kennady Lake associated with closure objective KL1.

5.1.3 Research Plan Overview

5.1.3.1 Tasks Completed

The model to predict water quality in Kennady Lake at closure has been developed (De Beers, 2011) and was subject of in-depth review during the Environmental Impact Review and Water Licencing process for this Project.

Refilling times for Kennady Lake and options to reduce it were also modelled (De Beers, 2010) during the Environmental Impact Review and Water Licencing process for this Project, and in subsequent updates (De Beers, 2012).

5.1.3.2 Remaining Tasks

Task 1: Data Collection and Analysis

Operational monitoring data of water quality and quantity in the open pits and at the water management pond area will be collected as part of various site monitoring programs (e.g. SNP, groundwater). Operational data is necessary to predict the post-closure water quality and quantity and is also a requirement of the Project water licence (MV2005L2-0015).

A summary of the results from this operational monitoring are reported within the Annual Water Licence Report (Part B, Item 10 of the Project water licence).

Task 2: Refinement of the Kennady Lake Water Quality Predictions and Water Management Options Assessment

Prior to refilling Kennady Lake, the Kennady Lake water quality and quantity model will be updated to incorporate operational water quality and quantity data. Post-closure water quality predictions will be refined. Potential options to reduce the timing of refilling Kennady Lake (as noted in Section 4.4.1.4 of the ICRP) and the reconnection with the surrounding watershed will be evaluated for consideration in the development of the Closure Water Management Plan (Schedule 5, Part G, Item 1 of the Project water licence).

The research finding will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report. Further, the analysis will inform the development of the Closure Water Management Plan (Schedule 5, Part G, Item 1 of the Project water licence) which will include adaptive management responses and contingencies to refilling Kennady Lake and closure water quality.

Task 3: Comparison of Measured and Predicted Water Quantity and Quality Data, Assessment of Implication to Closure

During refilling of Kennady Lake, a comparison of the measured and predicted water quality and quantity in Kennady Lake will be completed annually and reported within the Annual Water Licence Report (Part B, Item 10).

An analysis of any significant differences between the measured and predicted water quality and quantity data will be documented, along with any recommendations and/or updates to the model predictions or additional research.

This analysis will be completed annually and reported within the Annual Water Licence Report.

Task 4: Aquatic Progressive Restoration Pilot Project

A pilot project will be undertaken to assess the performance of the closure conditions to achieve proposed closure criteria. Area 7, a sub-basin of Kennady Lake is the preferred area to complete this research. If Area 7 is unavailable, an alternative sub-basin will be sought. Within the selected sub-basin, select fish habitat features will be constructed and the dyke connecting Area 7 to the surrounding watershed will breached when the water quality is deemed acceptable. Monitoring will occur to evaluate the use of the fish habitat and return of fish.

The pilot project would address De Beers commitment to restore Area 7 earlier in the mine plan. Further, the study will aid in the development of the Fish Habitat Validation Plan and inform on the time required to return a portion of Kennady Lake to a functioning aquatic ecosystem.

The scope of this study will be further defined through discussions with DFO and documented within the Annual Water Licence Report (Part B, Item 10 of the Project water licence).

Task 5: Development of Measurable Closure Criteria

Utilizing the updated predictive model from Task 2, water quality closure criteria for Kennady Lake will be developed to satisfy Kennady Lake closure objective KL1.

Criteria to define the successful use of fish habitat features at appropriate life stages, as well as, quantity of fish within Kennady Lake, will be developed to satisfy Kennady Lake closure objective KL1 and DFO Authorization (03-HCAA-CA6-00057.1). Said information will be documented within the Fish Habitat Validation Plan that is subject to DFO approval.

The research findings will be summarized in a report and submitted with the Annual Closure and Reclamation Plan Progress Report (Part J, Item 4 of the Project water licence).

5.1.4 Findings of Research Completed

No research has been completed at this time.

5.1.5 Linkage to Other Research Projects

The flooded open pits are positioned below the original bed surface of Kennady Lake. Thus, there is a direct connection between the open pits and Kennady Lake, thus the water quality in the open pits has potential to influence the time to fill of Kennady Lake and the water quality in Kennady Lake. The open pit water quality and quantity is a subject of research described in *Section 4.0 – Open Pits*.

5.1.6 Project Tracking and Schedule

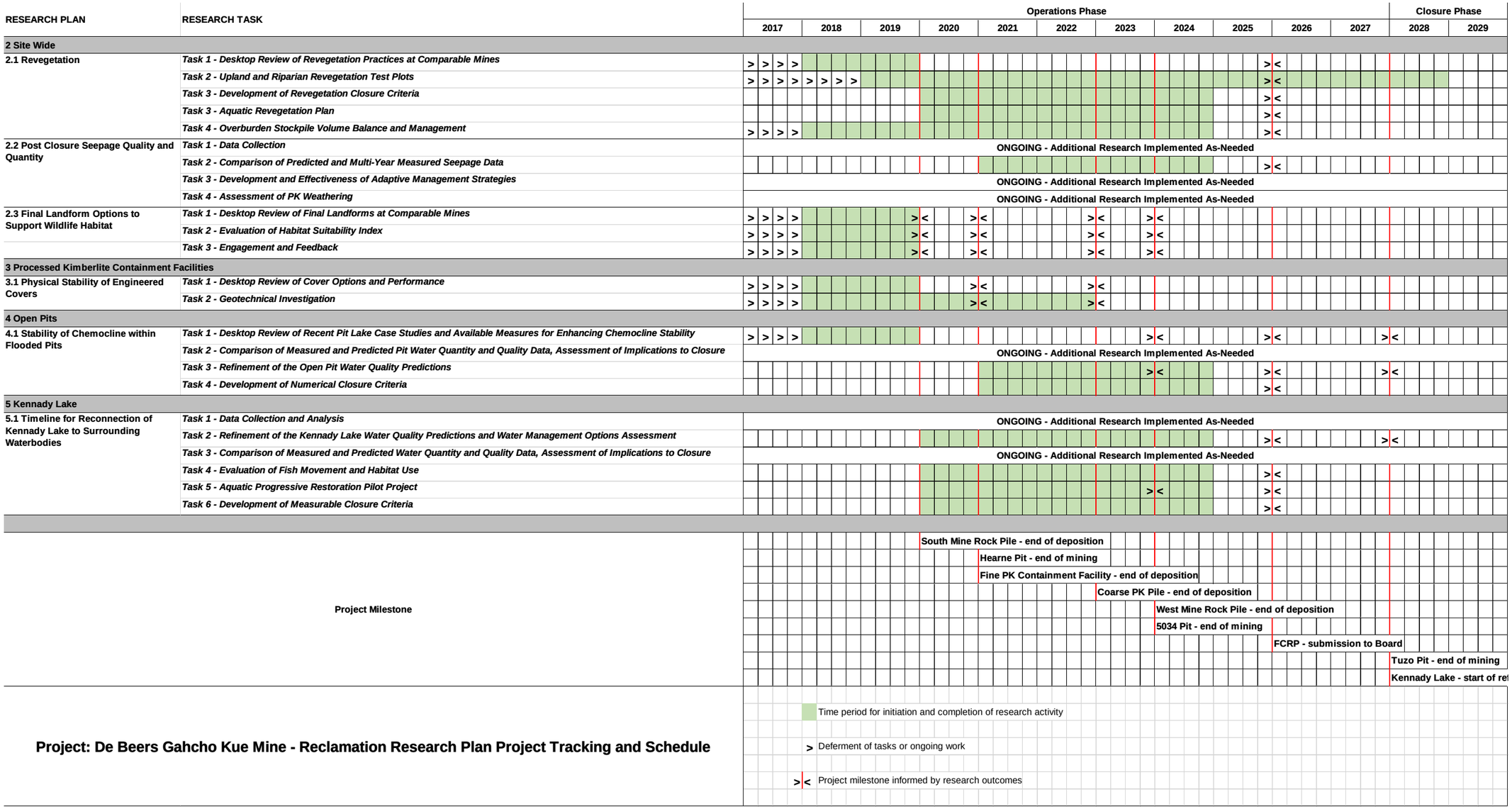
Year	Project Activities
2017 – 2019	Data collection and analysis Comparison of measured and predicted water quantity and quality data, assessment of implication to closure
2020 – 2024	Continued data collection and analysis Continued comparison of measured and predicted water quantity and quality data, assessment of implication to closure Refinement of the Kennady Lake water quality predictions and water management options assessment Evaluation of fish movement and habitat use Aquatic progressive restoration pilot project Development of measurable closure criteria
2025 – 2028	Continued data collection and analysis Continued comparison of measured and predicted water quantity and quality data, assessment of implication to closure Additional research will be determined by findings of initial research tasks.

6 PROJECT TRACKING AND SCHEDULE

An overall timeline of the proposed reclamation research plan is presented in Figure E.1 below. Outcomes from select research tasks will be used to inform the development of closure options, criteria and/or the Final Closure and Reclamation Plan.

Certain research tasks will require completion (or collection of sufficient data) prior to the progressive closure/reclamation of some mine components in order to inform selected closure options and designs. The project milestone to which these research tasks are associated, and therefore require completion (either full in or in part) beforehand, is marked.

Figure E.1. Overview of the proposed reclamation research plan timeline.



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