



INDEPENDENT ENVIRONMENTAL MONITORING AGENCY

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May 5, 2009

Violet Camsell-Blondin
Chairperson
Wek'eezhi Land and Water Board
Box 32
Wekweeti NT
X0E 1W0

Re: Intervention on Interim Closure and Reclamation Plan

Dear Ms. Camsell-Blondin

The Agency is pleased to submit the attached intervention for the scheduled public hearing on BHP Billiton's Interim Closure and Reclamation Plan.

The Agency will be represented at the hearing by Tony Pearse and Kevin O'Reilly. We anticipate that it will take approximately 20-30 minutes to make a presentation of our intervention and we would be pleased to answer any questions you or other parties may have.

Should you have any questions regarding our intervention, please feel free to contact our Manager, Kevin O'Reilly, at our office in Yellowknife.

Sincerely,

Bill Ross
Chairperson

cc. Agency Society Members
Bruce Hanna, Fisheries and Oceans
Anne Wilson, Environment Canada





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BHPB Ekati Diamond Mine

Interim Closure and Reclamation Plan

Independent Environmental Monitoring Agency's

Submission to the

Wek'eezhii Land and Water Board

May 25-26, 2009



Independent Environmental Monitoring Agency

Submission to

Wek'eezhii Land and Water Board Public Hearing

on the Ekati Diamond Mine

Interim Closure and Reclamation Plan

May 25-26, 2009

1. Introduction

This public hearing has been called to review the latest version of BHPB's *Interim Closure and Reclamation Plan (ICRP)*. The Independent Environmental Monitoring Agency (Agency) is pleased to be part of this event because we view the closure planning for the Ekati project as a critical exercise, and a key area of interest of our society members, particularly our Aboriginal members who have been, and remain, intimately concerned about the potential long-term effects of this mine on the environment.

As you know, this Agency was created through the 1997 *Environmental Agreement* between Canada, Government of NWT and BHP Diamonds (now BHP Billiton) to serve as an independent public watchdog for how environmental management at Ekati is conducted by both the company and government regulatory agencies. We have a broad mandate in this regard, and we are committed to a diligent review of all environmental matters related to the project as it unfolds.

This Board should know that our experience since we began in 1997 has been that overall the company has been an effective manager of its environmental programs, and that the mine has been constructed and operated in a manner generally consistent with the 1995 *Environmental Impact Statement* predictions about its effects.

We are now about half way through the active mine life, and as we move into this latter phase, there is a need to be increasingly attentive to the plans being developed for closure and reclamation of the site. In our view, closure planning for Ekati should now be the overriding focus for all parties. This is the process that will establish the conditions for the site and the legacy left behind long after the company has left, and it is important for obvious reasons to get it right. That is why we are all here today.

By law, and by the company's own policy, it is required to have a current plan for the permanent (or temporary) closure of its project. The existing *Interim Abandonment & Restoration Plan* was written in 2000, and approved by the Mackenzie Valley Land and Water Board in 2002. The content of that plan is now nine years old with what is happening at the mine site.

During this time both the mine and the *Life of Mine Plan* have changed, as has the regulatory regime for the project. Initially approved by the NWT Water Board, inherited by the Mackenzie Valley Land and Water Board in 2000, this project came under the purview of the Wek'eezhii Land and Water Board (WLWB) in 2006. One of this Board's first tasks was to set up a more systematic process for the review of the closure plan in order to help both the regulators and the company work through the requirements in a more collaborative fashion. The result was the WLWB's Working Group process that, while a lengthy one, has now resulted in the evolution of a plan that more closely meets the closure needs of the site and the regulators. The current version of the *ICRP* was submitted to this Board in January 2007. The Working Group process resulted in the draft being revised and submitted for approval in December 2008. The December 2008 draft is much improved over the original submission, and all parties are to be commended for their hard work to this point.

This *ICRP* is now in the final phase of the Board's approval process.

Despite the improvements in the December 2008 draft, a number of important changes are still required. We are in an unusual situation here. All parties agree that revisions to the December draft are required. All parties agree that some of these changes are required at this time, while others can be left to the next update of the *ICRP*, purportedly in three years or so from now. The consensus is, however, that the version in front of the Board at this hearing is not yet in finished form.

At this point there seems to be some uncertainty about the approval process ahead. We would like to propose the following steps for the post-hearing phase:

1. This Board provides direction to BHPB to finalize the current draft of the *ICRP* in accordance with both BHPB's commitments (April 14, 2009 *ICRP Information Request Response*) and other issues as addressed in the hearing;
2. BHPB then finalizes the draft and submits this to the Board within approximately three months;
3. The intervenors have a last opportunity to comment on the finalized draft *ICRP*; and,
4. The Board then makes its decision on the *Plan's* acceptability.

In what follows we describe the issues that ought to be incorporated into a revision of the current draft and, separately, other issues of importance that will need serious consideration in the next revision of the *ICRP*.

First, BHPB has committed in its April 14, 2009 *ICRP Information Request Response* to revise the current draft of the *ICRP* in a number of areas. We support this proposal. There are, however, two serious issues that also need to be addressed before the current *ICRP* can be finalized. These include:

- a) a requirement to allow fish passage into Cell E and the pit lakes, and to establish shallow zones in pit lakes; and,
- b) adequacy of reclamation research plans.

A concluding section deals with timing of the revisions and updates of the *ICRP*.

2.0 Finalizing the Current Version of the ICRP

2.1 Pit Lakes and Fish Habitat

A significant outstanding issue with respect to the acceptability of the current *ICRP* is BHPB's proposal not to restore the pit lakes for fish use or travel. BHPB's view is that it is under no obligation to reclaim the pit lakes, or cell E in the Long Lake Containment Facility (LLCF), to the point where they are useable by fish or even safe for use by fish.

As evidenced through the proceedings of the *ICRP* Working Group and submissions made to the WLWB from Working Group members, including ourselves, the company is alone in this view. All other parties apparently take the view that the proper reclamation objective for the pits and cell E is to at least provide opportunities for fish travel through them and, further, to promote the development of ecological conditions such that fish might once again inhabit the pit lakes. These objectives are consistent with company's overarching goal of returning the site to a functioning ecosystem. While the draft *ICRP* proposes that 'permanent' barriers will be constructed at the outlets and inflows of the pit lakes to prevent fish from moving into them, BHPB then agreed that these will be temporary, and will change the wording in the *ICRP* to reflect this.¹ BHPB changed its position again with the April 14, 2009 submission of its response to the Board's Information Request where it now states that the fish barriers are to be 'permanent'. If another party (such as DFO) wants to remove these after BHPB has left the site it will be up to it.²

BHPB's position not to reclaim the pit lakes to the standard of functioning fish habitat is a significant regressive step from the currently approved 2000 *Abandonment and Restoration Plan*. This states that 'a productive post-closure lake will be developed in accordance with the Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories (DIAND, 1990).' It also states that the constructed littoral zone will include '...fish refuge and spawning areas.'³ In other words, the intent for pit lakes to serve as fish habitat post-closure was clear, and the Mackenzie Valley Land and Water Board approved the *Plan* on that basis.

BHPB argues now that the loss of fish lake habitat as an impact of the mine has been compensated for through previous arrangements with DFO, and so nothing further is required in the way of restoring fish habitat at closure. This is explained in detail in the

¹ *ICRP* Working Group Final Meeting Transcripts. p.50.

² *ICRP*. p 5-28 [also BHPB's April 14 *ICRP* Information Request Response]

³ *Abandonment and Restoration Plan*, February 2000. p.20.

company's February 13, 2009 letter to the Board in which the 1996 *Compensation Agreement* with DFO is used as the basis for this position.

In the Agency's view arrangements made by other agencies cannot fetter the discretion of the Board with regard to its jurisdiction over closure planning. It is under the sole jurisdiction of this Board to determine what constitutes an acceptable closure plan with regard to the aquatic environment. The relevant section in the *NWT Waters Act* reads:

15.(1) Subject to this Act and the regulations, the Board may include in a licence any conditions that it considers appropriate, including, without limiting the generality of the foregoing...

(e) conditions relating to any future closing or abandonment of the appurtenant undertaking.

The Board has set the conditions regarding acceptability of the *ICRP* in the water licences (see water licence MV2001L2-008 Part L s. 5 and water licence MV2003L2-0013 Part J s.4), and it thus has the authority and jurisdiction to direct changes to the *ICRP*, including where such changes may deal with fish or fish habitat.

It is also clear from the fish habitat and fish quality monitoring protocols established in the aquatic effects monitoring program (AEMP) of the Ekati water licences that the Board can exercise jurisdiction to manage and protect aquatic habitat (see water licence MV2001L2-008 Part K s. 4 (a) and water licence MV2003L2-0013 Part I s.3a).

We questioned BHPB during the Working Group proceedings about whether it had any technical information that would support excluding fish from entering the pit lakes or cell E. The response indicated that BHPB's concern was more about being relieved of all liability with respect to fish impacts than about any technical problems. While the company stated that it will not ensure that aquatic habitat will be restored, it will ensure that water moving downstream from these components will be of sufficient quality not to affect aquatic life.

We think BHPB should go the extra step and adopt closure objectives for the pits and LLCF regarding fish passage and creation of shallow zones that are consistent with, and not contrary to, the overall site closure goal—"to return the Ekati mine site to viable, and whenever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment." This is the right thing to do, it has the full support of our Aboriginal members, and it is consistent with the best mine restoration standards being used today by progressive mining companies. Suggested wording for such objectives has been provided previously by the Agency in our final verification letter dated February 11, 2009.

Impending revisions to the *ICRP*, according to BHPB's April 2009 *ICRP Information Request Response*, will now include the construction of shallow zones around the pit perimeters 'to provide safe access and egress areas at the pit perimeter for people and wildlife.' The shallow zones are a critical building block towards the establishment of

fish habitat and, therefore, we believe that the proper objective is to establish such zones in order to provide an opportunity for the re-establishment of aquatic habitat.

Recommendation

1. WLWB should direct BHPB to revise its closure objective for the pit lakes and cell E to accommodate fish passage and use through the construction of shallow zones with appropriate vegetation to facilitate a return of habitat suitable for fish, and to revise the current *ICRP* to reflect the appropriate closure methods.
2. WLWB should direct BHPB to retain and complete the full Task 7 in the approved Terms of Reference for the pit lakes studies.

2.2 Reclamation Research Plans

When a mining company initially develops its ideas for closure it is usually the case that some of the reclamation measures, especially for unique aspects of the project, have significant uncertainties associated with them. In other words, not everything about the mine and what might work as an effective closure approach is known ahead of time. It therefore becomes an important exercise to identify these uncertainties as early as possible, and then conduct the necessary research to answer the questions. This is the concept behind having the proponent prepare reclamation research plans for approval, and why provisions for doing this were included in the original water licence.

An important aspect of this exercise is that the research must be conducted early enough in the mine life such that the answers can arrive in time to inform the reclamation and closure work that needs to be done.

Therefore, in order to determine whether the company's proposed research is acceptable, we need to know both the content of the plans (i.e., what the research is and how it will be carried out) and the timing of the research.

The company's reclamation research plans have been refined and improved as a result of the working group process. The content and timing of the plans need to be presented in sufficient detail and clarity to understand how and exactly when BHPB will conduct the proposed research tasks. This issue was revisited in the last meeting of the working group which spent some time discussing how to improve the structure of the plans and increase the detail of the proposed research tasks, particularly for those that are to take place over the next three years. A revised framework for both the reclamation research plans and the engineering studies was agreed upon. BHPB proposed to redo two of the plans using the revised framework as a tool to increase the detail, flow and clarity.

On March 6, 2009, the WLWB directed BHPB to modify two of its 26 reclamation research plans that accompany the *ICRP* (#14 Stabilization of EFPK in the LLCF and #16 Establishing of Self-Sustaining Plant Communities in the LLCF). This followed from the February 13 Advisory Document prepared by Board staff that proposed the modification of two plans as one option so that 'this will allow reviewers a chance to see the proposed

level of detail that the remainder of the plans will be completed to following the public hearing' (*emphasis added*).

In our review of the two plans subsequently modified by BHPB, we have found while there has been a significant improvement in the presentation and format, we remain concerned about the content and timing of the two model plans. We are also concerned with the narrow scope of the research in that some options may not be considered. This means we still lack comfort about how effectively the remaining plans and engineering studies will be modified if these are used as the basis for proceeding.

We are of the view that more information on the details of tasks yet to be done is required in the two revised plans submitted. Importantly, *Plan #14* also does not deal with options for managing the EFPK other than leaving this material in the LLCF. While we have many concerns with *Plan #16* regarding revegetation of the LLCF, the most important issue is that the research set out does not address the critical issue of how to measure the sustainability of these efforts. We expected to see research related to species diversity, biomass accumulation, nutrient cycling, or percentage cover. In other words, the research does not explicitly address the need to develop revegetation closure criteria.

We briefly describe here our concerns with the two plans, and provide a more detailed critique of these in Appendix 1.

2.2.1 Plan #14 —Reclamation of Extra-Fine Processed Kimberlite (EFPK)

Research Plan #14 is intended to address uncertainties about the reclamation of the EFPK slurries in LLCF. EFPK does not behave like ordinary sand-size mine tailings—it behaves as a fluid, having a density only slightly higher than milk. Managing such material has been challenge for the company during operations, and it likely will be an even bigger problem post-closure. The problem is how to keep this highly mobile, easily disturbed material in place, and ensure that it cannot escape into the downstream environment and adversely affect aquatic habitat and life.

Appendix 1 provides more background on the nature of the problems, particularly for reclamation and closure, associated with EFPK. Unfortunately, the *ICRP* itself is largely silent on the reclamation issues associated with these clay slurries. In addressing this subject, *ICRP* simply states that 'EFPK that collects in the ponds during operations will be confined to the pond bottoms where it will consolidate over time.'⁴

This assumption is at odds with what we know about EFPK, outlined in more detail in Appendix 1. The company has conducted field work, including the LLCF tailings study, to better identify the physical and settling characteristics of the kimberlite fines to improve operations, and continuing this work as it proposes to do will no doubt help to refine our understanding of PK behaviour in the LLCF.

⁴ *ICRP*. p.5-136.

However, there is little evidence that we are any closer to understanding how to keep these materials secure in the long-term.

The research objective stated in Research Plan #14 partly gets at this question by stating that its purpose is “develop an understanding of the expected behaviour of EFPK in the LLCF and evaluate how to maintain EFPK containment within the LLCF post-closure.” However, only two of the eight identified research activities are focused on ‘stabilization methods’ for EFPK.

Task #6 proposes ‘to evaluate measures to stabilize the EFPK’ through a ‘desktop evaluation and literature review’ to ‘determine the need for and, if necessary, design future field trials.’ Task #6 also mentions that the measures may include a water cap, sand or rip-rap cover.

From the information provided about EFPK characteristics in Appendix 1 it hardly seems possible that desktop research and literature reviews could produce any useable information to design stabilization measures in the sub-arctic Ekati environment, or that riprap covers would be effective in ‘capping’ clay slurries.

Task #8 proposes only that a ‘field trial program’ will be undertaken to evaluate EFPK stabilization measures if it is determined to be needed under Task #6 (*emphasis added*). Again, the information described in Appendix 1 would indicate that field experiments with clay slurry reclamation will almost certainly be required, and will be the key task to answer the crucial question about long-term EFPK stability. But, stating only that a field trial program will be conducted, without any details, is not a description of a research plan.

At this point in the mine life, we should know what the field investigation is going to look like, where and how it will be done, what data it will collect so as to inform the design of the closure approach, and when it will be completed such that the reclamation measure can be implemented in a timely fashion. A key question, unidentified and unaddressed in the research plan relates to the susceptibility of the stored EFPK to extreme storm events. What thickness of water cover would be necessary to prevent mobilization of the EFPK by wind-generated turbulence from, say, a 1:200 year storm event?

Another serious drawback to Plan #14 is that it assumes that the EFPK left permanently in the LLCF is the only closure option. For some years now, the Agency has advanced the notion to this Board and the company that the use of exhausted pits for the disposal of kimberlite tailings is a serious alternative that needs to be considered in the closure plan. The reason in part is that meromictic pits would provide a much greater range of potential water cover thickness to sequester the EFPK, and would be much more physically stable, than the LLCF.

The key objective here for closure is to determine what thickness of a water layer would be sufficient to keep the EFPK immobilized (whether in a pit or the LLCF). A close

examination of this list of tasks for Plan #14 shows that they will not be able to deliver the answer.

Recommendation

3. The Board direct BHPB to revise Research Plan #14 to include consideration of treatment or management of EFPK outside the LLCF.

2.2.2 Plan #16—Establishment of Self-Sustaining Plant Communities in LLCF

BHPB is proposing that parts of the LLCF, essentially the mid zones between the impoundment edges and the central wetted portions, will be revegetated at closure. Plan #16 properly identifies the uncertainties:

- what methods and procedures are needed to successfully establish an erosion-controlling plant cover;
- what is the effect of grazers on revegetation success without fencing, and will temporary measures be required to protect plants from grazing during the early phase;
- what will be the long-term fertilizer requirements to maintain stable plant community;
- what will the successional trends be and what plant community might evolve over the long-term; and,
- what are appropriate closure criteria that would reasonably ensure sustainability of the revegetated landscape.

To address these questions, Plan #16 proposes to carry out a ‘pilot study’ in the north end of cell B, starting in 2013 when tailings disposal ceases in that location and going to 2019 when all tailings disposal in LLCF is finished. The Plan rightly states that the objective is to determine what kind of a self-sustaining plant community can be established in the LLCF. The problem is that nowhere is it described what this means. How will we know when an ecologically appropriate self-sustaining plant community has been established on the LLCF, and the reclamation obligation of the company has been satisfied? Without such definition we can have no criteria for success, and without the criteria we will never know the answer to this question. We had expected to see matters such as species diversity, biomass accumulation, percentage cover, nutrient cycling and similar matters presented to begin to assess the sustainability of vegetation covers.

Five short-term tasks are identified, to be followed by one long-term pilot revegetation study. As described in Appendix 1, these are all short on details about how they will be carried out.

The most important task is the proposed pilot study to be conducted in cell B. A number of topics are identified to assess the stocking, growth and survival requirements of plant communities in the Central and Water Interface zones of the LLCF, but no details about how these will be designed or carried out are provided.

Presumably this pilot project, commencing at a time when full-scale reclamation of cell B should be occurring, will take some years to deliver the answers needed to design the revegetation and reclamation program. The provided schedule indicates that seven years will be required to complete the research. Subsequent to the revegetation studies, the *ICRP* indicates that it may then take at least two decades for a mature plant cover to establish.

We are concerned about the length of time being proposed here to conduct the trial studies in LLCF, design and implement the revegetation program, and then manage the replanted landscapes to a standard of self-sustaining plant communities. This apparent schedule puts full reclamation completion somewhere in the timeframe of year 2040. BHPB has recently indicated that deposition in the upper end of cell B has been terminated, following the tailings breach last year. This seems like an opportunity for early action on the pilot project, with design being done this summer and implementation in 2010. This would at least give a 3-year head start over current plans.

Recommendation

4. The Board direct BHPB to revise Research Plan #16 to include specific research aimed at measuring revegetation sustainability to develop appropriate closure criteria.

2.2.3 Conclusion regarding the Reclamation Research Plans

The question for the Board is what now to do with these two research plans? Since in the view of the Agency these are not yet at the level of detail to serve as templates for the remaining research plans, it seems inappropriate to approve them as they are, or for them to serve as examples of what is required for the other 24 research plans.

It may be that a different approach is required. Perhaps the Board could order a reconvening of the working group for a one-time, special session to work through, with BHPB and other interested parties, a detailed research plan. This activity, and the subsequent revisions of the remaining plans could, and should, in our view be done fairly quickly. There is an urgency for at least several of these plans to get developed, and to be implemented, in the very near future. We believe that it is possible to do this in time for BHPB to resubmit its research plans to the Board at the same time it resubmits the revised *ICRP*.

Recommendation

5. The Board reconvene the Working Group for a special session to work with BHPB to enhance one of its reclamation research plans as a basis for revising all the remaining reclamation research plans and engineering studies.

2.3 Minor Recommended Revisions for the Current *ICRP*

2.3.1 Wildlife Objectives

Reclamation objectives for wildlife are unresolved. BHPB has recently moved away from mine component-specific objectives for wildlife to a site-wide approach, stating that closure objectives and criteria should be addressed at the scale of the general claim block “to ensure that the WEMP continued through to end of closure”. The company’s argument is that the wildlife monitoring program (WEMP) will continue into closure, and can monitor wildlife patterns against those observed pre-development and during operations.

To the Agency this is contrary thinking—it is fitting the objective to fit the tool, instead of fitting the tool to accomplish the objective. All parties have previously agreed and, indeed, the Water Licence requires such an approach, that component-specific objectives for reclamation are required.

This means that BPHB’s proposed closure objective of having wildlife ‘using the Ekati claim block’, and the accompanying criterion of ‘wildlife observed using the Ekati claims block’ are not acceptable. The reason is that the objective is meaningless. Regardless of the condition of the mine components, there will always be wildlife using the claim block. Wildlife always will be observed on the claim block, but this does not mean that BPHB’s reclamation of the waste rock dumps, or roads, or the LLCF will be effective for wildlife protection or use.

The current WEMP is not up to this task—it does not provide objectives and measurable criteria to ensure that closure has returned any specific mine component to “viable, and wherever practicable, self sustaining ecosystems”. We will never know if reclamation has been successful from a wildlife perspective if we rely on the WEMP to tell us.

There should be clear wildlife use objectives for each mine component and some way of measuring such use to ensure that proper closure has taken place. Examples of more appropriate closure objectives might be:

- Indigenous wildlife species can safely use (name the component);
- Indigenous wildlife can move freely through (the component); or,
- The (component) does not pose an increased risk of injury or mortality to wildlife.

Examples of closure criteria might be:

- Wildlife are observed safely using the (the component)”;
- Wildlife are not deflected from moving freely across roads;
- The vegetation on waste rock piles or LLCF is safe for wildlife consumption; or

- Injury or mortality rates of caribou are not greater on the waste rock piles (or LLCF) compared to analogous landforms or habitat.

Recommendation

6. This version of the *ICRP* should be revised to set out component-specific objectives and closure criteria for wildlife.

2.3.2 Soil Remediation Standard

The remediation standard proposed for hydrocarbon contamination of Ekati soils is identified in the *ICRP* as the ‘industrial’ standard. A number of intervenors, including the Agency, objected to this standard or requested further information, and proposed alternate standards as being more appropriate. To resolve this issue, BHPB submitted a memo from one of its consultants with its April 14, 2009 *ICRP Information Request Response* that reviewed different standards and concluded that the ‘agricultural’ standard was the most appropriate for the site.

In short, the Agency can accept this conclusion. In proposing the agricultural standard, the Rescan report noted that ‘a site assessment defining the extent of contamination (and complexity) and localized potential receptors would be required to confirm the applicable standard and whether values can be adopted from Tier 1, modified to Tier 2 values, or derived using a Tier 3 risk-based approach.’

Recommendation

7. This version of the *ICRP* should be revised to reflect the use of the agricultural standard for contaminated soil remediation at Ekati. The revision should include further details on how, when and by whom the site assessments might be conducted.

3.0 Next Revision of the *ICRP*

3.1 Pit Lake Water Quality and Reconnecting to Watershed

BHPB plans to pump freshwater from adjacent lakes into the open pits when mining is finished. The earliest pumping is scheduled for approximately 2015 (Fox pit), and will be conducted more or less continuously in the various empty pits until 2050 when the flooding of the Panda-Koala pits will be completed. The *ICRP* states that when pit water meets licence discharge criteria, water will be allowed to flow out of the pits and into the downstream receiving environment, thereby restoring hydrological connection in the watershed.

Information about the protocol for reconnecting the pits to the surface drainage is notably absent. For example, uncertainty exists about the water quality that will characterize the various pits once they are flooded and whether it will be acceptable for discharge into the downstream aquatic environment? The *ICRP* says only that reconnection will be established once water quality meets water licence criteria but does not address the question of what happens if criteria are not met by the time of pit overflow

Recommendation

8. BHPB should provide more description in the next version of *ICRP* about the procedures and protocols that will be used in re-establishing hydrological connection between the flooded pits and the receiving environment. Contingency plans for the possible outcomes of pit flooding should be included. If water treatment is an option, then the logistical and bonding requirements for this strategy should be also be described.
9. The next version of the *ICRP* should also resolve the question of whether or not Koala and Panda pits will remain hydrologically connected at depth, and what closure methods are going to be adopted. If BHPB cannot resolve this issue by that date (approximately 3 years from now), then it should describe in full the closure methods for both options.

3.2 Beartooth Pit Closure

Beartooth pit, now essentially mined out and ready for reclamation, would be an excellent example of progressive reclamation and a unique early opportunity to investigate pit flooding procedures and impacts, fish passage and habitat research, as well as alternative disposal options for kimberlite tailings or EFPK. The company has proposed to use this pit as temporary storage for underground minewater, and currently has a request before this Board for that purpose. It is being reviewed as a revision to the *Wastewater and Processed Kimberlite Management Plan*, and the Board has deferred a decision pending additional information from BHPB.

We raise this issue here as reminder of the important closure implications of this plan. Having an adjacent mined-out pit available to solve short-term operational water quality issues is obviously a significant benefit for a mining operator, but a short-term convenience does not necessarily equate to a long-term best practice.

The next available pit for these other purposes would be Fox in 2014. If Beartooth pit is used for processed kimberlite deposition early enough in mine life, it may also be possible to avoid using cell D for any tailings disposal, and provide an extra measure of protection for water coming out of the Long Lake Containment Facility.

In our view, there are very serious long-term trade-offs to be considered. This decision should be only taken with a rigorous analysis of the closure costs and benefits associated with the options. If more than one closure option is foreseeable at this time, then it is important that *ICRP* should describe these. BHPB responds that it has conducted an internal study to show that the pit was ‘the most cost effective and environmentally sound management plan for Ekati.’ While BHPB summarized the results in its February 18, 2009 *Verification Comment Table*, such limited information is not sufficient to understand the trade-offs. The study should be made available for review so that the Board can determine whether the trade-off analysis has been meaningfully carried out and the result defended.

Recommendation

10. The options for Beartooth pit closure should be fully described on the basis of available information, including the analysis and results in conducted in BHPB's 'internal study', in this version of the *ICRP*.
11. WLWB should not decide on BHPB's request to use of Beartooth pit for temporary mine water storage until the analysis in the preceding item is available for review.

4.0 Timing of *ICRP* Revisions and Renewal

The *ICRP* review process that seems to be in place is that BHPB is expected to make certain revisions to the current draft of the *ICRP* in the next few months, and other revisions in an updated plan to be submitted about three years from now.

In its April 14, 2009 document, BHPB provides a list showing what revisions will be made in the short term, and what will be delivered three years from now. We have some comments about this allocation.

Recommendation

12. This version of the *ICRP* should be revised in accordance with the April 14, 2009 submission by BHPB, as well as recommendations made in this and other submissions to the WLWB on the 'short-term' deficiencies. The *Plan* should then be resubmitted for approval by the Board no later than six months after the release of the Board's *Reasons for Decision* from the public hearing.
13. The next update of the *ICRP* should occur no later than three years from the approval date of this *ICRP*. This is, we understand, consistent with BHPB's own corporate *Closure Standard*.

APPENDIX 1

Detailed Critique of Reclamation Research Plans

1.0 *Reclamation Research Plan #14—Reclamation of Extra-Fine Processed Kimberlite (EFPK)*

1.1 Background on EFPK

This work is intended to address uncertainties about the reclamation of the extra-fine processed kimberlite slurries in LLCF. EFPK does not behave like ordinary sand-size mine tailings—it behaves as a fluid, having a density only slightly higher than milk. Managing such material has been a challenge for the company during operations, and it likely will be an even bigger problem post-closure. We are especially concerned that this material may escape from the LLCF at some future point and flow downstream, perhaps during a storm event or when an engineered structure fails. This would likely have a negative effect on fish and other aquatic life.

The management and reclamation of these materials has been an issue since the Ekati mine first underwent environmental assessment and, subsequently, its first water licence hearing in 1996. At that time, lab studies commissioned by BHPB showed that settling and consolidation of these clay-rich ultra-fine materials would, for some kimberlites, take an inordinately long time. One sample of Fox tailings showed that 98% consolidation of a three metre column of suspended tailings would take over 4000 years.⁵ Whatever the real rate of settlement and consolidation in Long Lake, the reality is that EFPK occurs as large volumes of highly mobile clay slurries.

Expert evidence at the 1996 environmental assessment panel and the NWT Water Board hearings was presented to show that stabilization and permafrost aggradation in the tailings would be confounded by these clays, and that reclamation would be exceedingly difficult. Igor Holubec submitted a report to the panel that suggested the company could be looking at tailings ponds of up to 30% clay slurry, with depths up to 40 metres.⁶ He stated that freezing of these highly plastic clay slurries was complex because of the consolidation process and that there were no case histories available where such an undertaking had been performed with a high clay content in permafrost. He also went on to recommend that, as a result of the extraordinary challenges of keeping these materials in place in the LLCF, the company pump the slurry into an empty open pit when one becomes available.

⁵ EBA Consultants. *Wastewater and Tailings Management Plan Ekati Diamond Mine*. 1998. Cited in table 13.

⁶ Igor Holubec. Submission to the Water Technical Session, BHPB Diamond Mine Environmental Assessment Panel. Prepared on behalf of Government of Northwest Territories. February, 1996.

This early evidence of potential closure issues with EFPK has been the stimulus for the Agency's concern over the years about this topic. Subsequent operational experience in Long Lake bore out Holubec's predictions about the space problem, causing BHPB to rework its tailings management plan, as part of its planned review, to accommodate the storage volumes taken up by the Fox clay slurries. The use of flocculants, and chloride, in the processing plant appears to have substantially aided in the rate of settling of the clays, but not the consolidation.

This 'space' problem resulted in a special LLCF study done in 2004 by the company to improve operations, and the results of the study warn of some of the challenges facing reclamation managers. Here are some key findings:

- As a consequence of the increasing fines content, as well as ice entrainment and thaw effects, the PK beaches have poor stability, do not support traffic well, and can liquify when subjected to vibrating loads. This means hazardous conditions for construction on the beaches, limiting the beach zone over which safe access can be gained during the summer. The shorter the beaches, the less the area of beach that is safely accessible to construction equipment.
- On closure EFPK will be located along the main drainage route of the water flowing through LLCF and is expected to be highly susceptible to erosion. The placement and maintenance of stable durable heavy rip-rap lined channels over such deposits is of concern. One option to address this is to leave ponds or lakes in the lower end of each cell such that these deposits have a significant water cap, and hence flow velocities that are not erosive.
- Access on the beaches and ponds may be possible in winter, however the nature of the construction or reclamation measures that can be performed is restricted. For example, it is possible to place covers and fills, but regrading and excavation is often not practical. Summer access onto the lower beaches is hazardous.
- Fine PK is highly susceptible to erosion by water. Where small streams from side drainages are allowed to flow across the PK, it has been observed that the erosion of the fine PK is rapid and progressive. Such erosion results in the re-suspension of the PK and sediment plumes in the downstream receiving waters. This indicates that the routing of side drainage across the post closure PK surface is to be minimized to the maximum extent possible. Where it is unavoidable the construction of stable durable rip-rap lined channels is required, of a size large enough to tolerate frost deformations. The erodability of the PK also indicates that it is likely undesirable to reduce pond elevations in each cell after final PK deposition. Such lowering would expose the steeper underwater PK slopes and could result in rapid beach erosion from these slopes.⁷

⁷ Don Hayley & Andy Robertson. Ekati Mine Processed Kimberlite Containment Facility; Summary of Key Lessons Learned from 5 Year Review. October, 2004.

Because the *ICRP* is silent on these issues, they are presented here to remind the Board about the seriousness of the several challenges facing reclamation planners with respect to the EFPK ponds and the Water Interface Zone. The company has conducted field work, including the LLCF tailings study, to better identify the physical and settling characteristics of the kimberlite fines to improve operations, and continuing this work as it proposes to do will no doubt help to refine our understanding of PK behaviour in the LLCF.

However, there is little evidence that we are any closer to understanding how to keep these materials secure in the long-term. In addressing this subject, the *ICRP* simply states that ‘EFPK that collects in the ponds during operations will be confined to the pond bottoms where it will consolidate over time’ (pg. 5-136).

This is an assumption not supported by the information provided above. In our view, how to secure the EFPK from release into the post-closure downstream environment is a major issue for this mine and, thus, a key focus of a research program for this mine component. This is why, as early as 2004 the Agency suggested that BHPB seriously examine the option of depositing the EFPK into the bottom of a pit lake should the lake be meromectic.

1.2 Review of the Plan

The research objective stated in Research Plan #14 is to “develop an understanding of the expected behaviour of EFPK in the LLCF and evaluate how to maintain EFPK containment within the LLCF post-closure.” The second part of this statement is the key; the first part is the means to get there. A close examination of the proposed scope of work reveals that little information is provided on how the solution to stabilizing the EFPK will be reached. We are also concerned that BHPB has limited the scope of the research to leaving the EFPK in the LLCF.

Plan #14 goes on to describe some additional field investigations that have been done, or will be done in the next three years or so. Most of this is geared to obtaining more information about EFPK settling characteristics and distribution patterns within LLCF. Only two of the eight identified research activities are focused on ‘stabilization methods’ for EFPK.

Task #6 proposes ‘to evaluate measures to stabilize the EFPK’ through a ‘desktop evaluation and literature review’ to ‘determine the need for and, if necessary, design future field trials.’ Task #6 also mentions that the measures may include a water cap, sand or rip-rap cover. From the available information we have on the physical characteristics of the EFPK, these last two options seem less than viable. Similarly, desktop research and literature reviews are hardly likely to produce any useable information to design stabilization measures in the sub-arctic Ekati environment—almost assuredly field investigations will be required to produce meaningful results. This work should properly have been underway by now. BHPB’s proposal to now use Beartooth pit as a mine water storage sump would remove this very important option for experimenting now for the long-term storage of EFPK.

Task #8 proposes only that a ‘field trial program’ will be undertaken to evaluate EFPK stabilization measures “if it is determined to be needed under Task #6” [*emphasis added*].

There are two difficulties with Task #8. First, the Agency believes, based on what we now know about EFPK, that actual field trials will be required to identify an effective strategy. Second, stating only that a field trial program will be conducted, without any details, is not a description of a research task. At this point in the mine life, we should know what the field investigation is going to look like, where and how it will be done, what data it will collect so as to inform the design of the closure approach, and when it will be completed such that the reclamation measure can be implemented in a timely fashion. A key question, unidentified and unaddressed in the research plan relates to the susceptibility of the stored EFPK to extreme storm events. What thickness of water cover would be necessary to prevent mobilization of the EFPK by wind-generated turbulence from, say, a 1:200 year storm event?

Plan #14 focuses on the assumption that the EFPK will remain in the LLCF. For some years now, the Agency has advanced the notion to this Board and the company that the use of exhausted pits for the disposal of kimberlite tailings is a serious option that needs to be considered in the closure plan. The reason in part is that meromectic pits would provide a much greater range of potential water cover thickness to sequester the EFPK, and would be much more physically stable, than the LLCF.

Engineering Study #5 appears to address this question. It identifies four tasks, without any further details about how these will be done, as follows:

- measure the density of EFPK in LLCF;
- conduct short and long-term settling tests (presumably in a lab but not described);
- estimate volume of kimberlite tailings that could be placed in open pits; and,
- predict behaviour of tailings in flooded pit and effects on water quality.

Task 1 has been done—the density of EFPK is known. Settling tests (Task 2) were conducted at the beginning of the project. If they need to be redone, then the plan should explain why additional testing is required, what further needed information will be generated, and how the tests will be conducted. Task 3 is already known, or can be determined in short order. Task 4 is simply a prediction, not an actual measurement of tailings behaviour following discharge into an open pit. All this begs the question of why is this work not going to be completed until 2016, as proposed, instead of much sooner in 2010?

The key objective here for closure is to determine what thickness of a water layer would be sufficient to keep the EFPK immobilized (whether in a pit or the LLCF). A close examination of this list of tasks from both Reclamation Research Plan #14 and Engineering Study #5 shows that they will not be able to deliver the answer. On the other hand, discharging tailings this year into the finished Beartooth pit is exactly the type of experiment that could provide real world answers in a timely way. Unfortunately, this option may be foreclosed with the use of the pit for temporary minewater storage.

While we were pleased to see a better organized and more detailed research program around the critical issue of EFPK, the concerns we have raised relate to the content and timing and are substantive in nature.

We are also concerned about the timing of the proposed field trials for the water cover on the LLCF over the EFPK. This work is scheduled to begin in 2014. We wonder if it is possible to begin this work much earlier, perhaps even this upcoming summer. The field trials may have some bearing on the need or desirability of PK discharge into Cell D and the above information will be essential to making an informed decision.

The cost for Plan appears to be quite substantial at \$1-1.5 million but it is not clear whether this includes the field trials and what period of time is covered (the period of time is covered in the other revised Plan submitted on April 14, 2009).

2.0 Reclamation Research Plan #16—Establishment of Self-sustaining Plant Communities in LLCF

BHPB is proposing that parts of the LLCF, essentially the mid zones between the impoundment edges and the central wetted portions, will be revegetated at closure. The question is, with what plant communities? What plants can grow on kimberlite tailings on a self-sustaining basis? While it is certainly possible to grow plants on kimberlite, especially with the aid of fertiliser, will the vegetation persist? What are the early indicators of such persistence (sustainability) and how can these be used as closure criteria? Will such plants attract wildlife that will eat the plant cover and possibly destroy it? Should such plants act as a deterrent (or attractant) to wildlife, or be neutral in this regard? Will there be risks posed to wildlife if they are attracted to, and consume, the established plant populations? These are the kinds of questions that reclamation research plan #16 should attempt to answer.

Much work has been done by BHPB on some of these issues, as Plan #16 describes. Trial plots using various mixtures of soils and fertilizers were established in the upper reaches of cell B early in the history of the LLCF. These were maintained and monitored until approximately 2005 when the company revamped its LLCF operations and found it necessary to again discharge tailings into the area where the pilot plots had been set up. It appears that much information was gained during this early period about what plants can be established on the tailings, and what conditions will be necessary to ensure their permanence. The remaining uncertainties are identified as:

- what methods and procedures are needed to successfully establish an erosion-controlling plant cover;
- what is the effect of grazers on revegetation success without fencing, and will temporary measures be required to protect plants from grazing during the early phase;
- what will be the long-term fertilizer requirements to maintain stable plant community;
- what will the successional trends be and what plant community might evolve over the long-term; and
- what are appropriate closure criteria that would reasonably ensure sustainability of the revegetated landscape.

Plan #16 proposes to now carry out another pilot study in the north end of cell B starting in 2013 when tailings disposal ceases in that location, and going to 2019 when all tailings disposal in LLCF is finished. The plan rightly states that the objective is to determine what kind of a self-sustaining plant community can be established in the LLCF. The problem is that nowhere is it described what this means. How will we know when an ecologically appropriate, self-sustaining plant community has been established on the LLCF, and the reclamation obligations of the company have been satisfied? Without such definition we can have no criteria for success, and without the criteria we will never know the answer to this question. We had expected to see matters such as species diversity, biomass accumulation, percentage cover, nutrient cycling and similar matters presented to begin to assess the sustainability of vegetation covers.

Five short-term tasks are identified, to be followed by one long-term revegetation study. A closer look at each of these is required in order to determine whether adequate information has been presented.

Task #1 proposes to assess suitability of 'additional' tundra species for revegetation. In discussing the research already conducted, the *Plan* notes that past surveys conducted by the company in the surrounding region have identified tundra species with potential for revegetating selected areas of the LLCF.' It then concludes that 'additional species need to be tested.' There is no reason given for why the species already identified are not satisfactory, or what further investigations need to be conducted to satisfy the research objective here. The only additional information on this task is that field trials will be conducted if a suitable location on the LLCF can be found, or that greenhouse trials will be carried out. Since the LLCF appears to be committed for tailings discharge until at least 2013, we conclude that only the greenhouse option is available. No further details are provided.

The purpose of Task #2 is 'to provide seed and suitable stock for the pilot revegetation study'. This is to be done in the next three years, using those species already identified as candidates for the establishment of an early protective cover. The previous research task calls for identification of additional species of plants that could be used for reclamation. The effort going in to a seed bank and propagation research may have to be repeated for any new species identified in Task #1. Out-planting of six tundra species is scheduled for 2009 and 2010, and that 'research into the rearing of seedlings and development of practices to increase survival of out-planted seedlings will be directly applicable to revegetation of the LLCF. A 'rock pad reclamation study' is referenced, but there are no details about how this research will take place.

The plan states that 'direct seeding' will be the preferred method of plant establishment in the Water Interface Zone, and that 'seeding trials' will be initiated on site. No further information is provided about how these trials will be conducted.

Some lessons learned from the field trials appear to be contradictory. On page 4 of the Plan it is noted that the survival of tundra plant seedlings transplanted onto kimberlite was poor due to high mortality from burial by windblown kimberlite. This appears to contradict that conclusion on page 5 that seedling plugs have been identified as 'the most reliable method of

establishing native plants in processed kimberlite.’ Moreover, on page 6 it is stated that ‘drill seeding’ is preferred in the Central zone while ‘broadcast seeding’ is proposed for the Water Interface zone because of poor trafficability and favourable moisture conditions. This, too, is confounded by a statement on page 5 that states that ‘establishment of native plants from seed (other than native-grass cultivars proved unsuccessful due to unfavourable site conditions.’ It is impossible to discern from all this exactly what is being proposed, or what the best method for replanting the various parts of the LLCF may be. The lessons learned about powdery kimberlite blowing around and smothering plantings speaks to the probability of revegetation success and the possibility of impacts on tundra vegetation in the vicinity of the LLCF during and after reclamation.

Other lessons learned raise more questions. The plan states on page 6 that ‘sewage sludge could be used as a source of soil nutrients, if a practical application can be developed.’ We wonder why there is no research proposed to answer this question? It is also noted that fertilizer to maintain the plant cover will be required ‘for a period of time’. The pilot vegetation study to start in 2012 merely notes that one of the research components will be to ‘assess maintenance fertilizer requirements.’

Another lesson learned is that natural colonization by at least two species of plants was observed in the early studies in Cell B. If this occurred, then why is research being undertaken for the replanting and growth success of other species? We wonder whether further research is really necessary into plant succession or other possible species for revegetation unless this work is somehow tied to development of closure criteria to measure the success of revegetation.

Task #3 sets out to characterize ‘the expected plant community and the successional changes that might occur over time’, but then provides no detail on how this will be undertaken. Plant succession may be quite different if planted species will be different than the natural colonizers.

Task #6 proposes a pilot vegetation study to be conducted in cell B. A number of topics are identified as part of this study to assess the stocking, growth and survival requirements of plant communities in the Central and Water Interface zones of the LLCF. Presumably this pilot project will take some years to deliver the answers needed to design the revegetation and reclamation program. The provided schedule indicates that seven years will be required to complete the research. The *ICRP* provides no further information on the actual reclamation schedule of the LLCF, but presumably it will then be replanted in a manner consistent with the research results. Subsequent to the revegetation project, the *ICRP* indicates that it may then take at least two decades for a mature plant cover to establish.

The Agency is concerned about the length of time being proposed here to conduct the trial studies in LLCF, design and implement the revegetation program, and then manage the replanted landscapes to a standard of self-sustaining plant communities. This apparent schedule puts full reclamation completion somewhere in the timeframe of year 2040.

Although the Plan states on page 1 that an updated deposition plan for the LLCF shows that cell B will not be available until about 2013, BHPB has recently indicated that deposition in

the upper end of cell B has been terminated, following the tailings breach last year. We understand some remedial work is to be undertaken this summer in order to improve tailings stability. However, it appears to us that this is now an opportunity for an earlier resumption of vegetation field studies in this area, and that BHPB could get its pilot project design completed this summer with a view to implementing it in 2010. This would at least give a 3-year head start over current plans.

The section on linkages to other research and the *Life of Mine Plan* (page 17) does not mention any further work on the palatability of the species to be used during revegetation and to what degree this will attract or deter wildlife and whether these species may uptake materials hazardous to wildlife.

Finally, we are concerned about BHPB's proposed monitoring for LLCF reclamation. Their schedule supplied in Appendix 5.1-5 indicates a 10-year program, but doesn't say at what point this begins. This needs to be clarified in the next version of the *ICRP* and, as a critical principle for all mine reclamation work, such monitoring must be conducted to the point at which the reclamation criteria are achieved, however long this takes. For the LLCF this may well require significantly longer than 10 years. The extra time will be more certain if early reclamation research on closure criteria are not commenced very soon.