

The EKATI Long Lake Containment Facility: History & Future of Processed Kimberlite Disposal

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Abstract

The EKATI Diamond Mine, North West Territories, Canada is owned and operated by BHP Billiton Canada Inc. In the mid-1990s, the Long Lake Containment Facility (LLCF) was designed and permitted to receive processed kimberlite. The LLCF was constructed in the early 2000s and has been continuously used for over ten years. This paper describes the design of the LLCF: five cells separated by permeable dikes with deposition into three of the cells and the remaining two being used for water quality “polishing” to meet discharge criteria. The paper also describes the nature of the processed kimberlite (tailings) as it has been deposited over the past ten years: a very fine material that forms low angle beaches above pool elevation and steeper slopes below water. Then the paper proceeds to describe a major evaluation of alternatives for expanding the LLCF and using mined out open pits to augment capacity. Reasons for selecting the preferred approach which is currently being implemented are discussed.

The EKATI Diamond Mine Long Lake Containment Facility

BHP Billiton Canada Inc (BBCI) owns and operates the EKATI Diamond Mine in the Northwest Territories, Canada (Figure 1).



Figure 1: The EKATI Diamond Mine, Northwest Territories, Canada

The Long Lake Containment Facility (LLCF) was designed in 1995. The facility encompasses what were once a series of lake, now separated by dikes (Figure 2.) The original design provided for deposition of Fine Processed Kimberlite (FPK) into four of the five cells that comprise the LLCF (Cells A, B, C and D). Deposition has been and is currently into three of the cells, Cells A, B, and C. Cells D and E are used as polishing (dilution) ponds to assist in achieving discharge water quality standards established by local authorities in the mine's water license.

Subtending Cells B, C, and D are permeable through-flow dikes that provide for the passage of water, but not suspended solids. Subtending Cell E is an impermeable core dam that includes thermoclines that keep the core frozen.



Figure 2: The Long Lake Containment Facility at start of operation

The 1995 design has been implemented successfully since construction and start of deposition at the LLCF. The 1995 design report notes that once the LLCF reaches capacity, FPK would be deposited in one or more of the mined-out open pits.

Deposition into Cell A was for many years undertaken from a lower access road along the north side of the cell (Figure 3.). In 2009, a new access road and discharge system was constructed at a higher elevation in order to increase the capacity of the cell. As Cell A drains directly into Cell C, there is little to no water pooling in Cell A. At most there is a channel of flowing water from the discharge spigots and across the beaches to Cell C.

Deposition into Cell B was originally undertaken from an access road along the east side of the cell (Figure 4.). Once the deposited materials reached the crest of this access road, a new access road and distribution system were constructed on the west side of the cell at a higher elevation. Deposition from the west side is in progress, and is anticipated to be continued for another year or so. A pool of water generally stands along the east side of Cell B and drains via the permeable dike and a culvert to Cell C.

Deposition from Cell C has been from the east side. A significant pool occurs to the south and west sides of Cell C. The elevation of the pool fluctuates with the spring freshet inflow. Water seeps through the dike during the summer, and into Cell D (Figure 5) where there is a barge that returns water to the plant.

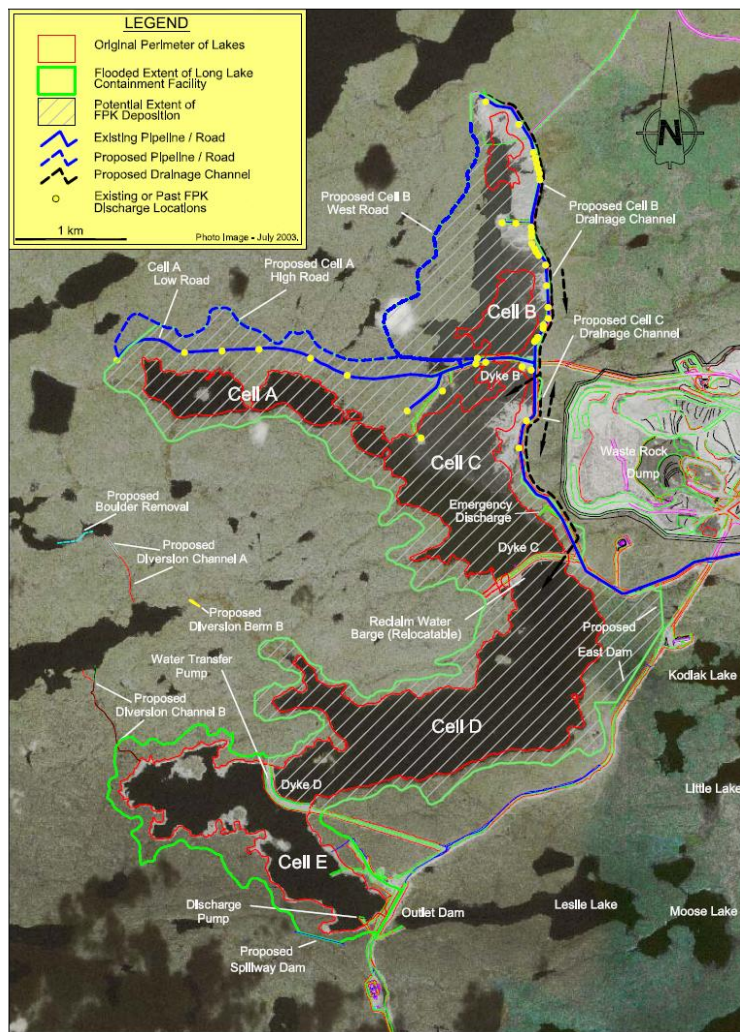


Figure 3: The Long Lake Containment Facility in 2010



Figure 4: Deposition into Cell B



Figure 5: The Cell D Dike D

Continued Use of the LLCF

The LLCF as currently configured does not contain sufficient capacity for the mine life. Accordingly alternatives for expanding the capacity of the LLCF were evaluated—see Figure 6 for general layouts of these alternatives.

In terms of the original water licence use of Cell D is permitted for ongoing deposition. However would potentially affect the polishing capacity of the cell. Construction of a new intermediate dike to provide for two polishing cells would be expensive (potentially more than \$25 M) and technically challenging.

Expansion of Cell B to the east was eliminated due to the large watershed catchment area to the east of the cell. Providing for long-term, post-closure flow of upgradient runoff would involve construction of swales across the surface to provide for the runoff from the large subtended catchment area.

Accordingly, the recommended approach to increasing the capacity of the LLCF included raising the elevation of Dike C by about two meters and constructing a new access road and deposition system along the west side of Cell C and the south side of Cell A. In addition, if required expansion of Cell C to the east is also envisaged.

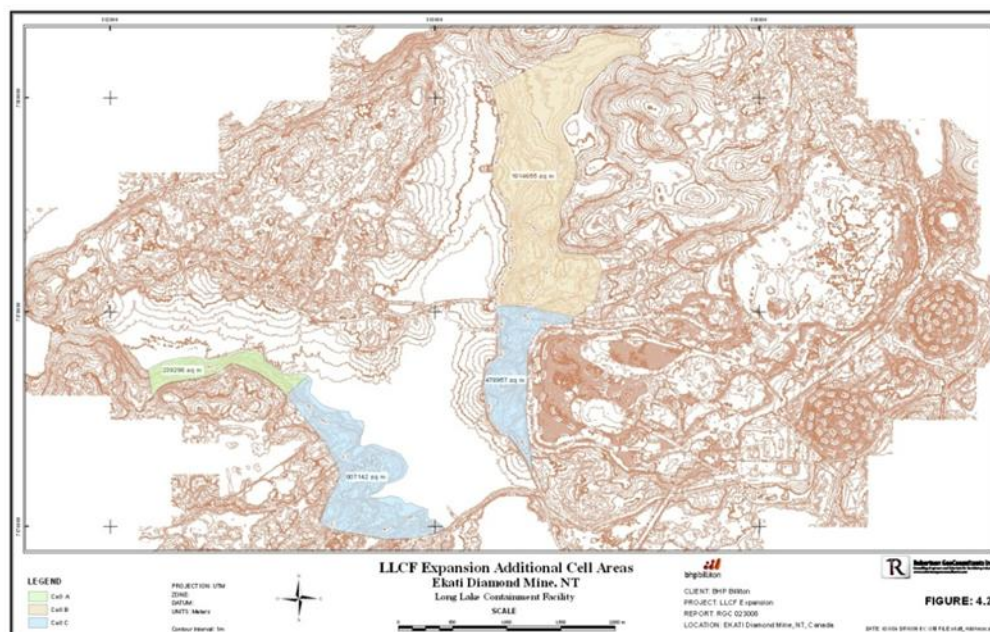


Figure 6: Possible LLCF Expansion Alternatives

Beartooth Pit

In addition to expanding the LLCF, use of one of the mined-out pits at the site was evaluated as an option for ongoing deposition of FPK. The Beartooth Pit (Figure 7) was evaluated as it is available, currently permitted to receive underground mine waters, and mining of the underground workings beneath the pit are no longer mined. This pit would provide additional capacity to the end of the current mine life.



Figure 7: The Beartooth Open Pit in Winter

Figure 8 shows a possible layout for the discharge system, and a possible return water system that may be installed once the elevation of water in the pit increases to the point that safe access along ramps into the pit is feasible.



Schematic of Beartooth Pit Storage Concept Option 1: UG Mine Water and PK to Beartooth Pit (2010 to 2014) and Reclaim Water (2011 to 2014)

Figure 8: The Beartooth Pit Possible Deposition and Return Water Approaches

There are two large pits, the Koala and the Panda Pits (Figure 9.) Underground mining is currently ongoing beneath these pits and therefore it is impractical to use them at this time. Once underground mining stops, deposition into these two pits could be undertaken in the event that additional capacity is required.



Figure 9: The Three Open Pits. Beartooth in the Background

Closure Concepts

Current closure concepts for the LLCF (Figure 10) include creating beaches and pools. The beaches would be stabilized with rock berms and swales (Figure 11.).



Figure 10: The Current Closure Concept: Layout

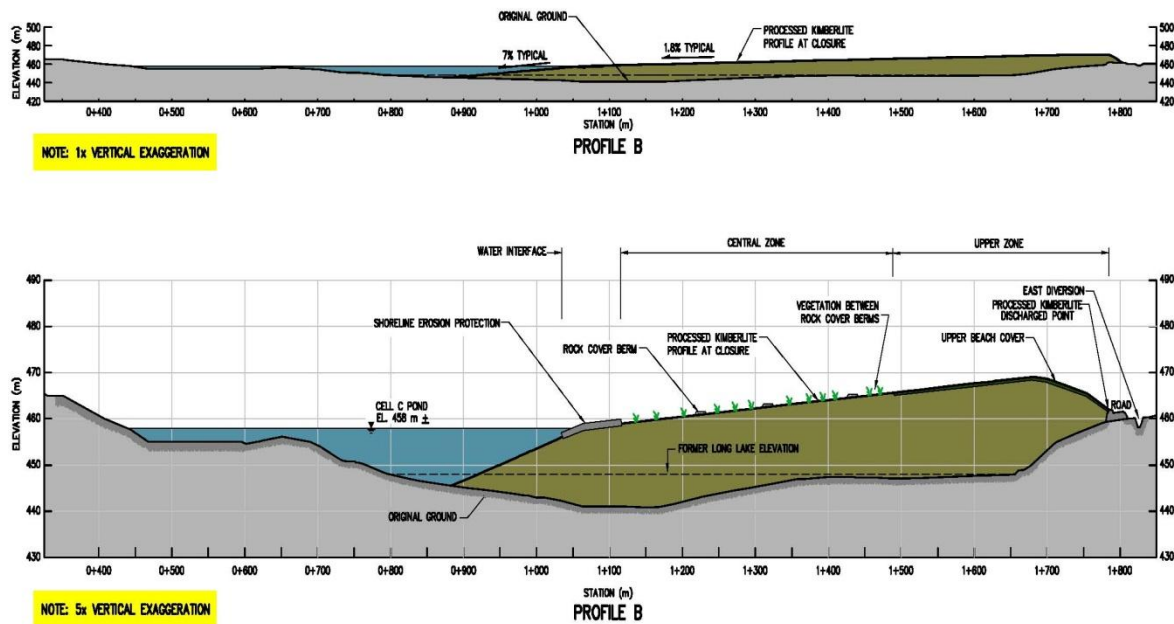


Figure 11: The Current Closure Concept: Beaches & Pools

In practice, the precise location of post-closure beaches and pools will depend on the beach profiles that develop. We used the computer code RIFT to model deposition of FPK. LIDAR surveys indicate beach profiles of complex form but varying in overall inclination from 1.3 to 3.8 percent, depending on particle distributions, deposition rates, and the timing of deposition (during summer as compared to when all is frozen in winter.)

One potential closure beach system is shown in the RIFT model results of Figure 12.

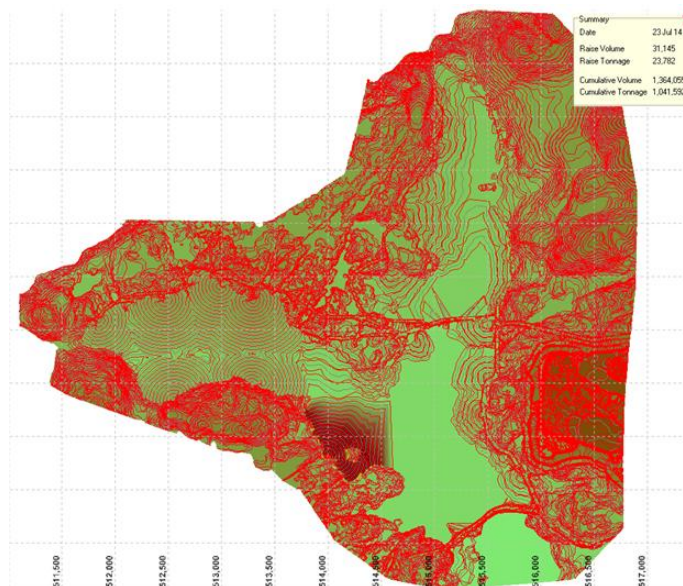


Figure 12: RIFT Model of Possible Closure Beaches

Conclusions

The LLCF has operated successfully for more than a decade. With some expansion of the LLCFK and the addition of one of the mine's open pits, FPK deposition may continue for the remainder of the estimated mine life.