

June 30, 2015
Project No.: 1193-005-C

Mr. Kent Christensen, P.Eng. – General Manager
Huckleberry Mines Limited
PO Box 3000
Houston BC, V0J 1Z0

Dear Mr. Christensen,

Re: Letter of Assurance Request, Huckleberry Mine, BC

On February 3, 2015, the British Columbia (BC) Ministry of Energy and Mines (MEM) Chief Inspector of Mines issued a request for all mines in B.C. to address the conditions that the Expert Panel concluded in their report (IEEIRP, 2015) had contributed to the incident at the Mt. Polley tailings storage facility. The request required that Huckleberry Mines Ltd. (HML) *“undertake an assessment to determine if the dam(s) associated with your tailings storage facility/facilities may be at risk due to:*

- 1. Undrained shear failure of silt and clay foundations;*
- 2. Water balance adequacy; and*
- 3. Filter adequacy.”*

Fourteen specific sub-issues (questions) were noted under these three topics; all are addressed in the following sections of this letter.

Per your request, BGC Engineering Inc. (BGC), as the Engineer of Record (EOR)¹, has prepared this letter summarizing relevant technical information and responses in support of HML’s letter of assurance. It relies upon information supplied by mine staff, BGC reports and in some cases, draws upon information provided by third parties. BGC understands that this letter will be appended to support the response to Items 1 through 3 of the Chief Inspector’s letter.

It is noted that BGC has not provided commentary on the final two items in the MEM letter for which the Chief Mine Inspector has also requested a response, specifically:

- Is your mine implementing the “Toward Sustainable Mining” initiative of the Mining Association of Canada? Are there any plans to do so?
- Does your mine have an Independent Tailings Dam Review Board (ITRB) in place? Is one planned?

It is understood that HML will address these questions in its letter of response.

¹ Scope of this assignment, including owner responsibilities, was specified in June 5, 2015 letter forward to HML.

BACKGROUND

Huckleberry Mine is located in west central BC, approximately 85 km southwest of Houston. The mine is owned and operated by HML. The mine is in its nineteenth year of production, which began in the fall of 1997. The operation comprises conventional open pit mining and flotation process operations with conventional slurry tailings stored in on-land impoundments.

There are three separate tailings management facilities (TMF's) at the Huckleberry site: East Zone Pit (EZP) impoundment, TMF-2, and TMF-3 (Figure 1-1). The TMF impoundments are contained by natural topography and five main dams: East Pit Plug Dam (EPPD); TMF-2 Dam, Orica Saddle Dam, and East Dam; and TMF-3 Dam, respectively. The East Dam does not currently impound any water or tailings; it is therefore not discussed further herein.

The TMF-2 impoundment was the first tailings and waste rock storage facility developed for the mine and was used from 1997 until 2008. In 2008, tailings deposition was directed to the EZP (contained by the EPPD); the TMF-2 impoundment was subsequently drained of its free water pond and is no longer used for any active tailings placement. By 2013, the EZP was filled to its design limit, with capacity reserved for tailings storage in upset conditions, and tailings deposition was directed to TMF-3, which began in August 2013. TMF-3 will provide tailings and waste rock storage through current mine life ending 2021 and it is undergoing its first raise in 2015.



Figure 1-1. Aerial view of the Huckleberry Mine site (October 2014). Approximate limits of the three tailings impoundments (East to West: East Zone Pit, TMF-2, and TMF-3) indicated.

AGRA Earth and Environmental (AGRA) performed the initial design and site investigation (SI) for Huckleberry Mine, served as EOR, and performed construction monitoring for the first impoundment (TMF-2) from 1997 to 2000. In 2000, AMEC acquired AGRA and assumed EOR responsibilities. AMEC subsequently designed and monitored construction to the final

elevation of EZP and TMF-2 and for the first phase of construction for TMF-3. BGC assumed the role of EOR in 2013.

MEM INFORMATION REQUESTS

The numbering scheme provided with the responses herein is consistent with the numbering scheme laid out in the MEM request letter.

1. Undrained Shear Failure of Silt and Clay Foundations

- a. *"Including a determination with respect to whether or not similar foundation conditions exist below the dam(s) on your site"*

In regards to *"the presence of weak glaciolacustrine soils in the dam foundation"* cited as the chief cause of failure at Mount Polley in the MEM request letter, the historical information pertinent to that specific material is summarized below:

TMF-2 Dam:

The TMF-2 impoundment has only a small pond on the upper surface. It is not used for any tailings deposition at the current time. The MZO Pit expansion has created a groundwater sink within TMF-2 and is a local low point for water collection.

Based on the SI performed and the design documented in AGRA (1997), Section 4.3 noted that the TMF-2 Dam foundation conditions consisted of topsoil over glacial till (basal and ablation) overlying bedrock. No glaciolacustrine soils were noted.

Orica Saddle Dam:

The Orica Saddle Dam provides containment for tailings within the (currently de-watered) TMF-2 impoundment. No drilling was performed within the footprint of the Orica Saddle Dam. However, a summary of the Orica Saddle Dam included in AMEC (2008) notes that *"foundation preparation was satisfactorily completed with the till core constructed on dry, competent bedrock"*. As such, no glaciolacustrine soils were encountered.

EPPD:

The West Cell of the EZP (contained by the EPPD) is used sporadically for tailings deposition and for the containment of process water for use by the mill. Based on the SI and design documented in AMEC (2008b), the EPPD foundation conditions consist of glacial till (basal and ablation) overlying bedrock. No glaciolacustrine soils were noted.

TMF-3 Dam:

The TMF-3 impoundment is currently used for active tailings deposition; water is reclaimed to the West Cell of the EZP.

AMEC (2011) summarizes results of SI performed in support of TMF-3 dam design. Section 2.1.2 notes that surficial geological conditions comprised of *"till mantling bedrock on lower slopes and in the main basin area"*. Foundation conditions included thin topsoil, glacial till (basal and ablation) and local gravel, sand and silt overlying bedrock. Glaciolacustrine silt and

clay were encountered at the project site; however the report noted the *“dam alignment is located to avoid these problematic foundation conditions”*. Section 3.7 of AMEC (2011) does not indicate any glaciolacustrine soils in the foundation conditions under the dam.

b. “Whether or not sufficient site investigation has been completed to have confidence in this determination”

The following provides a summary of the SI performed at each of the dams. BGC was not involved in the project at the time of the SI programs, but notes that the SI programs were sufficient as they were used for the dam designs developed by qualified professionals registered in B.C. Despite this, additional holes will be drilled in 2015 (additional details provided in *d.*). The purpose of the 2015 SI program was initially to install piezometers to monitor pore pressures within the dam footprints. However, the continuous core returned by a sonic rig will be used to confirm and enhance the current understanding of the foundation conditions. In areas where bedrock has not been encountered, six boreholes are planned to confirm soil types and depths for the TMF-2, EPPD and TMF-3 dams.

TMF-2:

SI performed for the TMF-2 dam included 30 test pits and eight boreholes (AGRA, 1997). The dam was completed to its final elevation in 2007 and the impoundment was subsequently de-watered.

EPPD:

The initial SI for the EPPD was performed by Knight Piésold in 1993/1994. The SI report is not available to BGC; however, results are summarized in the AMEC SI report compiled for the 2007 SI program (AMEC, 2008), which included 15 boreholes (11 ODEX and four diamond drilling method) and nine test pits. The dam was completed to its final elevation in 2013. Seven additional boreholes (with piezometers) are currently planned for 2015.

TMF-3:

The TMF-3 SI was performed by AMEC in 2010 and reported in AMEC (2010) and (2011b); the program included 33 test pits and 17 boreholes, along with four geophysical survey lines. The dam is currently undergoing its first raise; annual raises are scheduled to be performed to 2021. At present, 11 additional boreholes (with piezometers) are planned for 2015.

c. “If present, whether or not the dam design properly accounts for these materials”

As noted above, the previous SI work did not encounter glaciolacustrine soils within any of the dam foundations and as such, their designs did not require consideration of these materials. Should glaciolacustrine soils be encountered during the 2015 SI program, the stability of the dam in question would be re-assessed in consideration of their presence and the design updated to account for the interpreted foundation conditions. At present, 26 (24 mentioned previously plus two at the East Dam) additional boreholes (by the sonic drilling method) are planned for 2015 to install 54 piezometers and provide further confidence in the geological interpretation done by AGRA and carried forward by AMEC (2012).

d. "If any gaps have been identified, a plan and schedule for additional sub-surface investigation."

Following from the findings of the Expert Panel Review, BGC is undertaking additional detailed review of site ground conditions, including published geological literature and available SI data, regarding the regional and local Quaternary geological conditions with the objective of identifying any targets for further investigation for the three TMF's. Targets identified will be added to the currently planned 2015 SI program noted previously for later this summer. Drilling for the 2015 SI program is scheduled to commence in mid-July. As noted above, the geological review may identify additional boreholes to be completed in 2015 for this purpose. A BGC representative will be on site to log all drill core and supervise piezometer installations. Should glaciolacustrine soils be encountered, samples will be collected for testing to characterize the material; additional drilling may be performed to constrain their extent if any are found. A different drill rig may be used to obtain 'undisturbed' samples for testing, if required. The geological review, SI results (logs and laboratory testing) and piezometer installation records will be compiled into a summary report to be submitted to HML once the program is complete.

2. Water Balance Adequacy

a. Including the total volume of surplus mine site water² (if any) stored in the tailings storage facility

The TMF-3 impoundment has three ponds, the decant (immediately upstream of the dam), the reclaim (where the reclaim barge is situated) and the old NAG Quarry pond, where tailing deposition most recently occurred. The decant and NAG Quarry ponds drain, or are pumped into, the reclaim pond, which requires a minimum volume of approximately 100,000 m³ to support reclaim barge operation. Water is transferred from TMF-3 reclaim pond to the West Cell of the EZP, from which it is pumped to the mill head tank via the West Cell barge pumps. A minimum operating pond volume of 2.1 million (M) m³ is prescribed for the West Cell to operate the barge pumps (HML, 2013). As of June 1, based on data provided by HML, the volume of water stored within the two active impoundments is as follows:

- TMF-3 pond volume = 575,000 m³; comprised of 50,000 m³, 121,000 m³ and 404,000 m³ in the decant, reclaim, NAG ponds, respectively, resulting in a surplus volume of 475,000 m³. Complete removal of remnant water in each pond subject to practical issues including gravity drainage and pump location.
- West Cell pond volume = 1.97 Mm³; the pond volume within the West Cell does not exceed the prescribed minimum operating pond volume and therefore, does not hold any surplus. It is noted that this volume is below the prescribed minimum; however, the barge is still functional.

The TMF-2 impoundment is considered inactive; it is maintained in a drained state by sumps and pumps to facilitate mining of the MZO Pit and as such, does not hold any surplus water.

² No definition of surplus water was provided by MEM.

b. "The volume of surplus mine water that has been added to the facility over each of the past five years"

At present, about 0.475 Mm³ of surplus water is stored within the TMF-3, as noted in a. A good indication of whether surplus water is accumulating inside the active TMFs, is how much surplus mine water has been discharged from the TMF's to the environment over the past five years. The Tahtsa Reach Outfall (TRO) is the main water discharge point from the mine site. TRO discharge volumes for the past five years have been provided by HML and are summarized in Table 1.

Table 1. Annual Tahtsa Reach Outfall Discharge Volumes.

Year	TRO Annual Discharge Volume (m ³)
2014	3,169,603
2013 ¹	1,309,602
2012	2,964,555
2011	4,976,852
2010	4,801,286

Note:

1. In 2013 tailings deposition terminated in the West Cell and was re-directed to TMF-3.

The mine is authorized to discharge 5 Mm³/year at a maximum rate of 20,000 m³/day via the TRO per Permit PE-14483. As can be seen from Table 1, the total volumes discharged are below the annual amount allowed for in the permit. While the full discharge amount was almost reached in 2010 and 2011, the trend over the last five years is a decrease in the volume of water discharged from site.

c. "Any plans that are in place or that are under development to release surplus mine water to the environment"

BGC has been engaged by HML to prepare an updated site wide water balance, including the contributions from all three TMF's. The model will evaluate the site water management strategy, including daily/monthly pond volumes and flows, required to provide a sustainable water balance for the site, including wet years. The assessment (proposed for August/September 2015) may determine additional seasonal discharge volumes, timing and/or locations may be needed above currently permitted allowances.

d. "Recommended beach width(s), and the ability of the mine to maintain these widths"

Minimum beach widths are not required to satisfy the stability or hydraulic design criteria for the dams; the designs do not rely on the presence of a beach. However, BGC recommends developing beaches across all dams, as a measure of good practice to minimize seepage and increase the robustness of the dams. In its present de-watered state, this is far exceeded for the TMF-2 Dam. The EPPD, while still active, currently maintains a beach that is approximately 150 m to 400 m, with the variability in beach length being a result of the geometry of the East Cell (Figure 1-1). For TMF-3, a beach along the entire length of the dam has not yet been

developed. However, infrastructure will be in place to develop an above-water tailings beach in 2015.

- e. *"The ability of the TSF embankments to undergo deformation without the release of water (i.e. the adequacy of the recommended beach width)"*

The dam design considers deformation given two conditions: consolidation and deformation under normal loading, and deformation due to earthquakes. Deformation from normal loading caused by dam construction and tailings deposition is being monitored by regular surveys performed by site staff. Deformation due to normal loading is not expected to be significant, and if unexpected on-going deformation occurs during the operational life of the mine, equipment and material can be made available to fix any deficiencies in dam height. Deformation due to earthquake loading has been evaluated for the design earthquake (AMEC, 2011). The dam height is set such that freeboard would be maintained should the predicted deformation occur with the pond at maximum level (i.e. with inflow design flood stored).

- f. *"Provisions and contingencies that are in place to account for wet years"*

As noted under Item c., BGC will be preparing an updated site wide water balance that will include the impact of "wet years" of precipitation. The implications of these wet years on water discharge requirements and associated timing will be detailed in the final water balance report scheduled for later submission to HML.

Site water is managed in the West Cell (EZP) where stored for use in the mill and discharged via the TRO as needed. The mine has not discharged the full permitted amount in four of the last five years, indicating there is capacity to handle additional inflow under the current permit, should a wet year occur. If contingency water storage is required, both the NAG-2 Quarry and the MZO Pit are potential options.

- g. *"If any gaps have been identified, a plan and schedule for addressing these issues."*

As noted under Item c., BGC will be submitting an updated site wide water balance in August/September 2015 and the associated conclusions and recommendations will be provided for consideration by HML. The recommendations provided therein will inform strategies on water handling in conditions ranging from dry to wet years.

3. Filter Adequacy

- a. *"Including the beach width and filter specifications necessary to prevent potential piping"*

Filter adequacy is not predicated on the existence of tailings beach upstream from the dam. Numerous successful dams in the world are designed and operated with reservoir water in direct contact with the upstream face of the dam. While creating beaches is strongly encouraged to reduce seepage gradients, the dams are not designed to rely on their presence to prevent piping.

The potential piping failure mechanism in dam cores is controlled by the use of properly designed filters and drains. The filters for the TMF-2, Orica Saddle Dam, EPPD, and TMF-3

dams were designed by qualified professional engineers according to internationally accepted standards. The following references were used in the dam filter design: USACE (2004), ICOLD (1994), Sherard (1979), and Sherard (1989). Based on these accepted filter criteria, BGC is confident in the dams' filter designs with respect to preventing potential piping.

b. "Whether or not the filter has been constructed in accordance with the design"

The TMF-2 dam, EPPD dam, Orica Saddle dam, and a portion of the TMF-3 dam were constructed prior to BGC assuming the role of EOR in 2013. The construction monitoring of these facilities was carried out under the supervision of the EOR at the time; a qualified professional engineer registered within the province, who noted that the filters were constructed in accordance with the design to his satisfaction. BGC has reviewed some of the reports (those available to BGC) documenting the construction and sees no reason to disagree with the approval by the previous EOR.

c. "If any gaps have been identified, a plan and schedule for addressing these issues."

No current gaps have been identified regarding filter adequacy.

CLOSURE

BGC Engineering Inc. (BGC) prepared this document for the account of Huckleberry Mines Ltd. The material in it reflects the judgment of BGC staff in light of the information available to BGC at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

As a mutual protection to our client, the public, and ourselves, all documents and drawings are submitted for the confidential information of our client for a specific project. Authorization for any use and/or publication of this document or any data, statements, conclusions or abstracts from or regarding our documents and drawings, through any form of print or electronic media, including without limitation, posting or reproduction of same on any website, is reserved pending BGC's written approval. A signed and sealed copy of this document is on file at BGC. That copy is the record document, and takes precedence over any other copy or reproduction of this document.

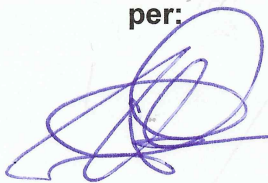
The responses provided herein are based on direct observations and reports prepared by BGC Engineering Inc., in association to information supplied directly by Huckleberry Mines Ltd. and other third parties. These third party data and related reports have not been independently verified by BGC and this limitation should be noted.

We trust the information provided herein addresses your current requirements. Please contact the undersigned should you have any comments or concerns.

Yours sincerely,

BGC ENGINEERING INC.

per:



30-JUNE-2015

James W. Cassie, M.Sc., P.Eng.
Principal Geotechnical Engineer

Reviewed by:

Iain Bruce, Ph.D., P.Eng.
Principal Geotechnical Engineer

JWC/IGB/rm/cs

REFERENCES

- AGRA Earth & Environmental Ltd. 1997. Huckleberry Project, Design Report, Tailings and Waste Management Facilities. Report prepared for Huckleberry Mines Ltd., Feb. 28, 1997, 87 pages plus drawings and appendices.
- AMEC Environment & Infrastructure. 2008a. Huckleberry Mine Tailings Management Facilities – 2007 Construction As-Built Report and Annual Review. Report prepared for Huckleberry Mines Ltd., April 23, 55 pages plus drawings and appendices
- AMEC Environment & Infrastructure. 2008b. Huckleberry Mine Project, East Pit Plug Dam Design Report, Huckleberry Mine, BC. Report prepared for Huckleberry Mines Ltd., April 4, 44 pages plus drawings and appendices.
- AMEC Environment & Infrastructure. 2010. Site Investigation Data Report, TMF-3 Project, Huckleberry Mine. Report prepared for Huckleberry Mines Ltd., April 4, 2008, 44 pages plus drawings and appendices.
- AMEC Environment & Infrastructure. 2011a. Huckleberry Mine Tailings Management Facilities – 2010 Construction As-Built Report and Annual Review.
- AMEC Environment & Infrastructure. 2011b. Huckleberry Mine Main Zone Optimization Project – TMF-3 Design Report. Report prepared for Huckleberry Mines Ltd., May 27, 113 pages plus drawings and appendices
- AMEC Environment & Infrastructure. 2012. Huckleberry Mine Tailings Management Facilities – 2011 Construction As-Built Report and Annual Review. Report prepared for Huckleberry Mines Ltd., X pages plus drawings and appendices.
- Huckleberry Mines Ltd. 2013. Operations, Maintenance & Surveillance. Report prepared July 31, 155 pages plus drawings and appendices.
- Independent Expert Engineering Investigation and Review Panel (IEEIRP). 2015. Report on Mount Polley Tailings Storage Facility Breach. January 30, Province of British Columbia.
- International Coalition of Large Dams. 1994. Embankment Dams - Granular Filters and Drains: Review and Recommendations. Bulletin 95, Paris.
- Sherard, J.L. 1979. Sinkholes in dams of coarse, broadly graded soils". Transactions, 13th International Conference on Large Dams, New Delhi, India, Vol. 2, pp. 25-35.
- Sherard, J.L., and Dunnigan, L.P. 1989. Critical filters for impervious soils. ASCE Journal of Geotechnical Engineering, Vol. 115, No.7, pp. 927-947.
- US Army Corps of Engineers. 2004. EN 1110-2-2300. General Design and Construction Considerations for Earth and Rock-Fill Dams. July 30.