Proposed Pebble Project
Preliminary Draft Environmental Impact Statement
Review Comments

Reviewer:	NARF Technical Team
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Section:	Section 3.15 Geohazards
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Comments

3.15.1 Earthquakes. 3.15.1.2 Ground Shaking. In the first paragraph, the U.S. Army Corps of Engineers (USACE) states, "*Larger, more infrequent seismic events, such as those with a 2,500-year return period (a 2 percent probability of exceedance in 50 years) are typically used for design of critical structures such as dams (ADNR 2017)*." While this may be Alaska Department of Natural Resources (ADNR) guidance, the current industry recognized guidance and most widely accepted description of best practices is available in recently updated guidance from the Canadian Dam Association (CDA) specific to mining dams such as those constructed for tailings storage facilities (TSFs).

Table 4.1 (below) from CDA's 2014 *Application of CDA Dam Safety Guidelines to Mining Dams* provides suggested target levels that can generally be applied to the Construction, Operation, and Transition Phases of a tailings storage facility (TSF). CDA suggests that these are intended for consideration and consultation between the owner and regulator, and that the owner may adopt, or regulations may require, more stringent criteria. The CDA also notes that for TSFs, crest deformations could be much larger compared to conventional dams and result in release of contents. They recommend that "criteria should be established for suitable deformations of a mining dam and the appropriate analyses undertaken to demonstrate the effect of an earthquake on the dam and determine if the deformation criteria are met."

Table 4.1: Target Levels for Earthquake Hazards, Standards-Based Assessments, for Construction, Operation, and Transition Phases (For Initial Consideration and Consultation Between Owner and Regulator) (From CDA 2014)

Dam Classification	Annual Exceedance Probability – Earthquakes (*Note 1*)
Low	1/100 AEP
Significant	Between 1/100 and 1/1,000
High	1/2,475 (*Note 2*)
Very High	1/2 Between 1/2,475 (*Note 2*) and 1/10,000 or MCE (*Note 3*)
Extreme	1/10,000 or MCE (*Note 3*)

Notes:

1. Mean values of the estimated range in AEP levels for earthquakes should be used. The earthquake(s) with the AEP as defined above is(are) then input as the contributory earthquake(s) to develop the Earthquake Design Ground Motion (EDGM) parameters as described in Section 6.5 of the *Dam Safety Guidelines* (CDA 2013).
2. This level has been selected for consistency with seismic design levels given in the National Building Code of Canada.
3. MCE has no associated AEP.

Acronyms: MCE – Maximum Credible Earthquake; AEP – annual exceedance probability

The environmental impact statement (EIS) should consider industry guidance concerning BMPs that may exceed regulatory requirements, which may not reflect more current or conservative approaches to BMPs. If it has not already been performed, an analysis of the maximum credible earthquake (MCE) should be completed, and the Preliminary Draft EIS text should be revised to include not only the 500- and 2,500-year earthquakes, but also for the 10,000-year or MCE, whichever is greater. The Preliminary Draft EIS also should have identified the hazard class of the TSF in this section relative to what is being proposed. In doing so CDA guidance also needs to be considered relative to ADNR requirements.

3.15.2 Geotechnical Conditions. 3.15.2.1. Mine Site. This section appears to be missing identification of lacustrine soils in the descriptions. Otherwise, it fails to state that these soils were not observed. This is particularly important with respect to the location of TSFs. While they are not necessarily highly relative to earthquakes, lacustrine soil layers are otherwise important and should be included in all descriptions of geotechnical conditions.

3.15.3 Unstable Slopes. The Preliminary Draft EIS describes colluvium and solifluction deposits and describes both deposits as subject to freeze-thaw activity. However, the Preliminary Draft EIS does not identify the potential environmental impacts that could results to TSFs and other

facilities related to the occurrence of these material types. Examples of freeze-thaw compromising TSF and pond liners, as well as other mine features, are common; therefore, it is important to identify these potential threats, evaluate them in the EIS, and propose mitigation measures for construction.