RFI 094
Pebble Project EIS

Request for Information

Title/Subject:	**Alternative Option to Develop Pebble East Using Underground Mining**
Requestor:	**AECOM**
Date Transmitted:	**10/10/2018**
Recipient:	**Pebble Limited Partnership (PLP)**
Response Requested by:	**10/16/2018**
Rationale:	Cooperating agency comments on draft Appendix B distributed in September 2018 request analysis of an alternate mine location at the Pebble deposit: *We recommend consideration of an alternate mine location at the Pebble deposit itself, which would entail underground mining Pebble East.* *Underground mining and underground mining combined with surface mining are each dismissed because: "This option is not practicable using existing technology for the portion of the deposit that is proposed to be mined." This rationale assumes that to be considered as an option underground mining would have to be conducted in the same part of the Pebble deposit in which surface mining is proposed. Since ore that is minable by surface mining methods would not be mined by underground methods, the underground mining options would have to be planned for deeper parts of the deposit that would probably be mined using underground mining methods. Consequently, Options MNG-002 and 003 should not be dismissed but should consider underground mining in areas other than the surface minable area that is proposed as Option MNG-001.*
Describe the Information Requested and Level of Detail:	Please address the option of mining Pebble East instead of Pebble West, including using underground mining methods. Please address the feasibility of underground mining and underground mining combined with surface mining. The following topics should be addressed, at a minimum: • Technical feasibility (including can underground mining be conducted without first mining Pebble West, can mining be conducted using solely underground methods, would surface mining combined with underground mining still be required, can the underground mine roof be stable with respect to subsidence?), • Economic feasibility (including is the mineralized distribution within the ore deposit conducive to underground mining?), • Comparison of environmental impacts (including impacts to Waters of the US).

Recipient Response Form

Date Received from USACE:	Click here to enter text.
Response from Recipient (Describe Information Requested to the Level of Detail Requested; Provide Attachments as Needed):	Click here to enter text.
List Number and Type of Response Attachments:	**RFI 094 Pebble East Underground.pdf**

Date Returned to USACE:	Click here to enter text.

AECOM Intake Form

Date Response was Received:	**10/19/2018**
Received by:	**AECOM**
Describe any Follow-up Related to this RFI:	**None at this time**

From: James Fueg, Pebble Limited Partnership

To: Shane McCoy, US Army Corps of Engineers

Date: October 18th, 2018

The questions presented in RFI 094 on underground mining of Pebble East are addressed below:

Please address the option of mining Pebble East instead of Pebble West, including using underground mining methods.

Please address the feasibility of underground mining and underground mining combined with surface mining. The following topics should be addressed, at a minimum:

- *Technical feasibility (including can underground mining be conducted without first mining Pebble West, can mining be conducted using solely underground methods, would surface mining combined with underground mining still be required, can the underground mine roof be stable with respect to subsidence?),*
- *Economic feasibility (including is the mineralized distribution within the ore deposit conducive to underground mining?),*

Comparison of environmental impacts (including impacts to Waters of the US).

1) The Pebble East deposit could be mined using surface mining techniques to recover 1.3 billion tons of ore without first mining the Pebble West deposit, but this approach would require pre-stripping 2000 feet of waste prior to accessing the ore. For this scenario, PLP's screening-level analysis shows that the associated strip ratio would be at least 1:3 (ore:waste), generating approximately 4 billion tons of waste rock, much of it potentially acid generating (PAG) and/or metal leaching (ML) that would require permanent storage. This waste rock storage facility (WRSF) would likely be located to the south of the open pit (as shown in the layout presented for RFI062 Expanded Development Scenario), with additional waste stored to the northeast of the pit if required. These facilities and associated infrastructure would have a footprint of approximately 3200 acres and directly impact approximately 1200 acres of additional wetlands. Water management for the WRSFs (collection, storage, treatment) would further increase the overall project footprint.

   Due to the required stripping the open pit footprint would be much larger than the proposed project (estimated at 2500 acres versus 608 acres) and would extend significantly into the Upper Talarik Creek (UTC) watershed. Additional direct impacts to wetlands are estimated at about 1600 acres (versus 207 acres for the proposed project), depending on the final pit design. The deeper pit would require longer and more extensive dewatering, resulting in a wider indirect impact zone associated with the dewatering.

   Ancillary infrastructure such as power generation, water treatment, camp facilities, etc. would further add to the project footprint, although PLP did not attempt to quantify the impacted wetlands area. Waste rock mining and transport, as well as the longer ore haul associated with

the deeper pit, would substantially increase the amount of equipment required for mining, with an associated increase in fuel requirements (estimated at approximately 50 million gallons per year) and spares.

PLP did not further quantify environmental impacts for this scenario since the relative wetland impacts associated with the pit and waste rock management would be disproportionately higher (approximately 2800 acres) than the proposed project (207 acres) for the same target amount of ore (1.3 billion tons). PLP did not investigate the economics in detail. However, it is highly unlikely that this scenario would be economically viable given the significant cost increases related to pre-stripping and waste rock storage without an accompanying revenue stream from Pebble West being mined in the early years.

2) Underground mining of Pebble East is theoretically possible, however a conclusive evaluation of the feasibility of underground mining at Pebble East would require the development of a 3500-foot-deep, 24-foot-diameter shaft, 2200 feet of lateral development, and significant underground work to confirm any design parameters. This work could not be completed from the surface using boreholes. Completion of this program would require the development of significant infrastructure including an access road from Iliamna, upgrades to the existing Williamsport – Pile Bay road, a diesel powerplant and fuel storage, and camp and other support facilities before a conclusive determination could be made.

   PLP has previously investigated the potential for an approximately 1.5 billion ton underground mine located in Pebble East as adjunct to a prior open pit at Pebble West. This information has been used to assess the environmental impacts associated with the stand-alone underground scenario but is not reflective of stand-alone underground economics.

   As previously demonstrated in RFI059 and 059a (Throughput Options) the mine would need to achieve a daily metal production rate roughly equivalent to a 180,000-ton per day surface mine at Pebble West to be economically feasible, without even considering the additional capital and operating costs associated with underground mining which could drive this number higher. Even with higher underground grades, this would require ore production of at least 90,000 tons per day. Stope and fill techniques, such as those utilized at mines like Pogo or Green's Creek, have a likely maximum production of around 20,000 tons per day. Furthermore, the costs associated with stope and fill mining are simply too high for the available grade at Pebble East to be economically extracted. As a result, the only feasible mining technique would be caving, most likely block caving as evaluated by PLP, or possibly sublevel caving.

   The block cave would result in a significant subsidence zone (Figure 1). Previous work utilized a cone defined by 55^0 from the horizontal, which is considered a reasonable assumption for this level of analysis. Portions of the subsidence zone could open into holes that are 1000 foot or deeper. The subsidence zone would have an area of approximately 2000 acres, of which approximately 1,300 acres are classified as wetlands and would extend well into the UTC watershed. The equivalent footprint for the proposed project pit is 608 acres, of which 207 are wetlands, with no direct impacts in the UTC watershed.

One of the principal benefits of block caving is the elimination of large waste rock quantities typically associated with open pit mining. PLP's proposed project, surface mining at Pebble West, already addresses this issue by proposing a pit that generates minor levels of waste with all PAG/ML waste being returned to the pit at closure. Due to the instability of the subsidence zone that would be associated with a block cave at Pebble East, it is highly unlikely that the pyritic tailings could be safely transferred into the subsidence zone for storage below water in a gravity well, resulting in a requirement to maintain the pyritic TSF in perpetuity.

Block caving will require dewatering the Pebble East area to a depth of 3500 feet to allow for mining. This will generate much larger quantities of dewatering water, requiring management and treatment, and result in a much larger zone of indirect impacts to surrounding wetlands during operations. Maintaining an inward flow of groundwater into the area of the lake in the subsidence zone and underground mine post-closure to prevent the potential for groundwater contamination will require long term active pumping of water from the access and ventilation shafts and treatment prior to release, with associated infrastructure requirements.

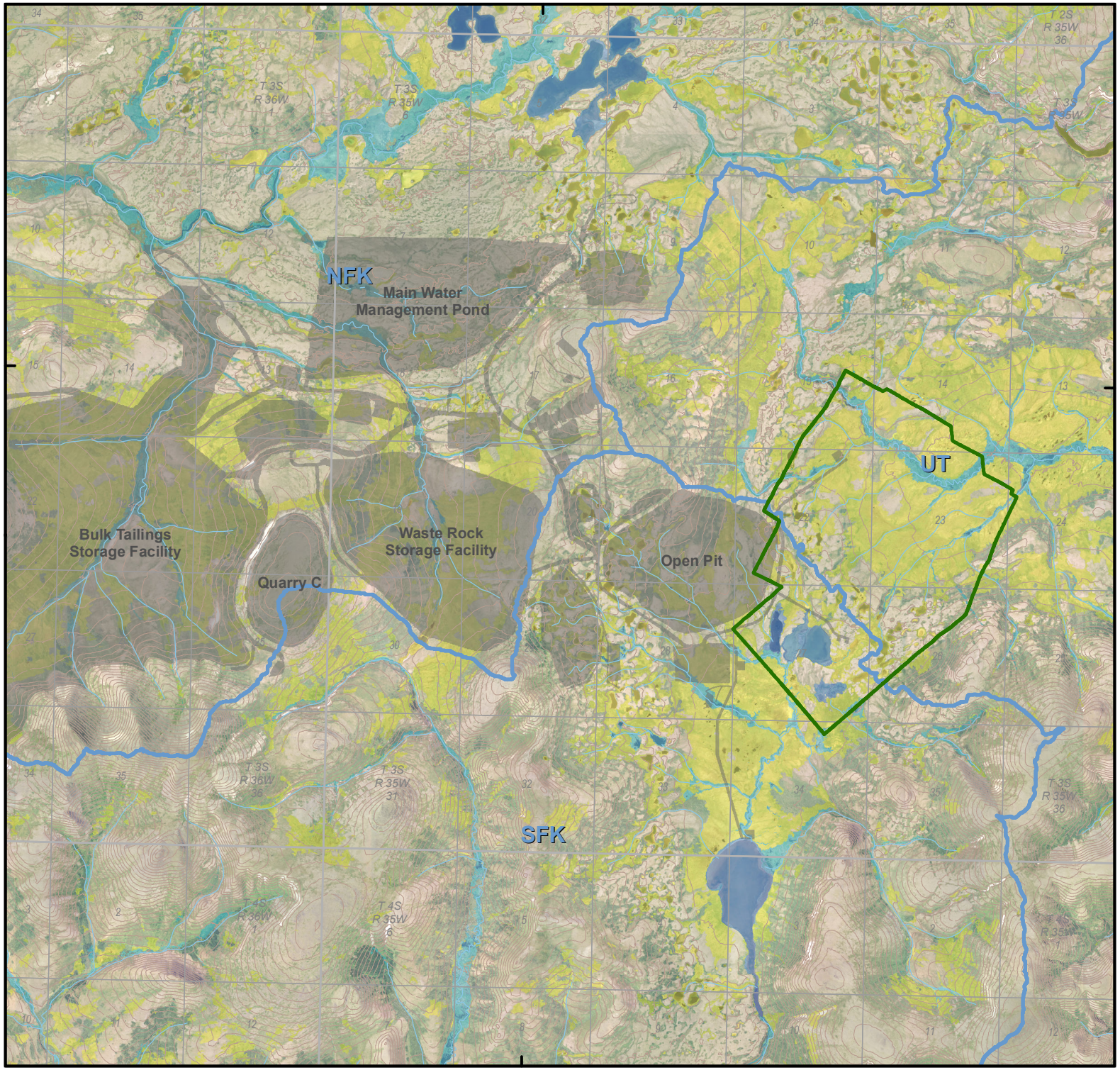
The substantial upfront costs and extended timeline associated with the development of infrastructure and underground access just to determine the feasibility of a block cave, coupled with the higher production costs associated with underground mining, would have a significant impact on project economics. While a financial model has not been developed, it is highly likely that development of a standalone underground block cave, without the prior development of a surface mine at Pebble West to provide upfront cashflow for the project, would not be economic, even at mining rates that can be achieved by a block caving operation.

The following table summarizes a comparison between PLP's Proposed Project and underground mining of Pebble East.

	Proposed Project	Pebble East Stand-alone Block Cave
Infrastructure Requirements	Similar	Similar
Pit/Subsidence Zone Footprint (acres)	608	2000
Pit/Subsidence Zone Wetlands Directly Impacted (Acres)	207	1300
Wetlands Indirect Impacts	As defined in RFI082	Significantly more acres
Watersheds Directly Impacted by Mining Operations	North Fork Koktuli South Fork Koktuli	North Fork Koktuli South Fork Koktuli Upper Talarik Creek
Dewatering Requirements	As defined in Water Management Plans	Significantly higher due to increased depth (additional 1500 feet)
Permanent Waste Rock Storage Facility	None	None
Pyritic Tailings Management at Closure	Place into pit	Maintain pyritic TSF in perpetuity
Post Closure Water Management	Treat and release from pit lake	Long-term pump from underground and treat and release
Economics as a Stand-alone Project	Robust return as demonstrated in RFI059	Not economic due to extended timeline and upfront costs to determine feasibility.

Based on the above analysis stand-alone underground mining at Pebble East would:

1) Require significant upfront development and associated impacts just to determine its feasibility.
2) Have a larger overall footprint and associated impacts, both during operations and post closure, due to the size of the subsidence zone and the requirement to maintain the pyritic TSF post closure.
3) Result in a closure scenario that would require significantly more active management through the long-term post closure phase, including long-term maintenance of the pyritic TSF and long-term pumping and treatment of water.
4) While the development of an underground mine at Pebble East may be economically feasible as a later add-on to surface mining at Pebble West, it is most likely not economically feasible as a stand-alone project without any surface mining.



THE pebble PARTNERSHIP

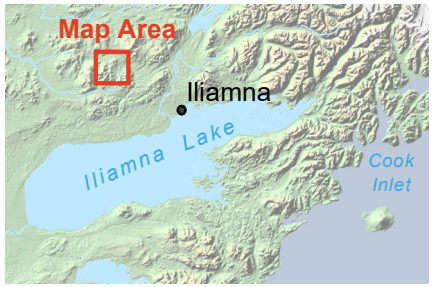
FIGURE 1

Block Cave Footprint

- Block Cave Footprint
- NFK, SFK, and UT Watershed Boundaries
- Current Mine Layout Design
- 50' Contour

Mapped Wetlands

- Lake
- River
- Wetland



Miles
0 1 2

Kilometers
0 1.5 3

N

Scale 1:63,360

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File:	Date: 10/16/2018
Version: x	Author: HDR