RFI 054
Pebble Project EIS

Request for Information

Title/Subject:	**Dry Stack Tailings**
Requestor:	**AECOM**
Date Transmitted:	**7/9/18**
Recipient:	**Pebble Limited Partnership**
Response Requested by:	**7/20/18**
Rationale:	**Scoping comments raised concern that the tailings storage facility dams could fail. To address the concern for dam failures, some commenters suggested that a “dry stack” tailings disposal alternative should be analyzed and recent mining NEPA documents such as Donlin Gold EIS analyzed dry stack as a reasonable alternative. Additionally, the Mount Polley Panel Report suggests surface storage using filtered tailings technology (dry stack) is a prime candidate for best available tailings technology.** **Additional information is needed to evaluate the technical and economic feasibility of this option for NEPA purposes. The information will be used to develop and screen a reasonable range of alternatives for Chapter 2 of the EIS.**
Describe the Information Requested and Level of Detail:	**1) What equipment and energy input would be needed to filter the processed tailings at the proposed Pebble throughput rate of 180,000 tons per day?** **2) What would the confidence be in maintaining continuous dry stack operations year round in consideration of filtering, handling and disposal, given seasonal weather and possible clay content changes?** **3) Would there be fine tailings with high clay content that might not be efficiently filterable; what percentage of the total would these be; and where would they be disposed?** **4) Would there be different issues with filtering, handling, and disposal of the bulk vs pyritic tailings?** **5) What major support facility and operation additions would need to be considered under a dry stack scenario (e.g., embankments, water retention ponds, back-up slurry tailings storage facility, seepage collection systems, dust control, ongoing reclamation)?** **6) What would be the ultimate volume differences: 1) between dry stack tailings and the currently proposed bulk and pyritic tailings; and 2) between onsite water storage requirements of a dry stack scenario and the currently proposed water management ponds?** **7) What would be the type/quantity of mobile equipment and/or conveyors needed to transport and place tailings in a dry stack? How would material handling change during winter versus summer?** **8) How would waste rock storage be different under a dry stack scenario than the currently proposed plan?** **9) How would interim reclamation and final closure be different than the currently proposed plan under a dry stack scenario?** **10) How would the dry stack cost compare with the current plan in terms of full life cycle through to closure and post-closure including design,**

	construction, operations, maintenance and surveillance?

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 054 – Tailings_Filtration_Technical_Report.pdf**
Date Returned to USACE:	Click here to enter text.

AECOM Intake Form

Date Response was Received:	**9/5/2018**
Received by:	**AECOM**
Describe any Follow-up Related to this RFI:	**None at this time. This RFI response will be reviewed by the third party NEPA contractor's tailings and mining engineers to independently test the conceptual design and assertions made by PLP about the feasibility of the dry stack method. The review will be documented in a technical memorandum.**

From: James Fueg, Pebble Limited Partnership

To: Shane McCoy, US Army Corps of Engineers

Date: September 5th, 2018

PLP staff and consultants have prepared the following responses to the AECOM Request for Information (RFI) 054 on the Environmental Impact Statement (EIS) for the Pebble Project (Pebble).

A summary of RFI 054 is presented below:

> ***Rationale:*** *Scoping comments raised concern that the tailings storage facility dams could fail. To address the concern for dam failures, some commenters suggested that a "dry stack" tailings disposal alternative should be analyzed and recent mining NEPA documents such as Donlin Gold EIS analyzed dry stack as a reasonable alternative. Additionally, the Mount Polley Panel Report suggests surface storage using filtered tailings technology (dry stack) is a prime candidate for best available tailings technology.*
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> 7. *What would be the type/quantity of mobile equipment and/or conveyors needed to transport and place tailings in a dry stack? How would material handling change during winter versus summer?*
> 8. *How would waste rock storage be different under a dry stack scenario than the currently proposed plan?*

9. *How would interim reclamation and final closure be different than the currently proposed plan under a dry stack scenario?*
10. *How would the dry stack cost compare with the current plan in terms of full life cycle through to closure and post-closure including design, construction, operations, maintenance and surveillance?*

1.0 RFI RESPONSE

1.1 RFI 054 – 1

"What equipment and energy input would be needed to filter the processed tailings at the proposed Pebble throughput rate of 180,000 tons per day."

Tailings will be produced at the Pebble Project at a throughput of 180,000 tons per day (tpd). Approximately 86% (~155,000 tpd) of tailings will be produced as bulk tailings, with the remainder being produced as pyritic tailings. Only the bulk tailings have been considered eligible for filtration due to the high percentage of fines and geochemical properties of the pyritic tailings.

Filtration of the bulk tailings would require a number of filter presses working in parallel to mechanically dewater the tailings to the desired solids content (assumed 80-85% solids content by material weight).

Only commercially available filter presses have been assumed for filtered tailings operations at Pebble for the purposes of this RFI. Figure 1.1 compares Pebble to a range of operational filtered tailings projects and studies. Operations with production rates less than 30,000 tpd and those in cold climates typically use trucking and placement to dispose of filtered tailings rather than conveyors. High throughput operations in warmer climates such as La Coipa and Karara use mobile stacking equipment (i.e. conveyors) to reduce the operating cost.

Filtered tailings stacks are in operation at cold region mines including Pogo and Greens Creek in Alaska and Raglan in Quebec. Filtered tailings stacks at Minto and Bellekeno in the Yukon are in closure.

High throughput filtration and studies currently in development include Peñasquito, Kisladag and Rosemont. These large-scale operations are in warm climates and use mobile stacking conveyors, spreaders and trippers to place material within the filtered tailings facility. Filtered tailings will be co-disposed with coarse waste rock at Peñasquito, while Kisladag and Rosemont filtered tailings will be placed and compacted, and subsequently contained within coarse waste rock buttresses. Dozers are used to spread the filtered tailings as required.

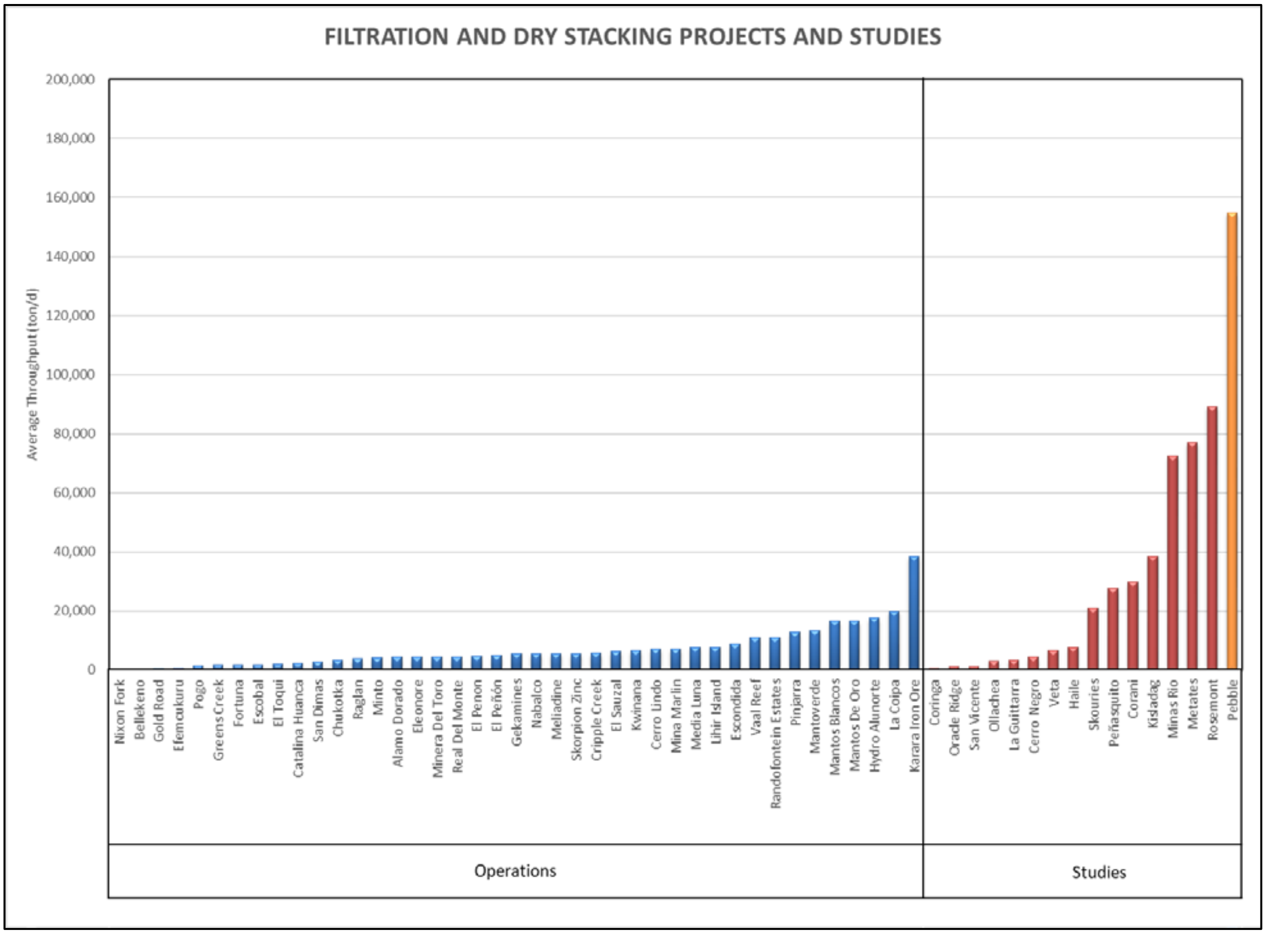

Figure 1.1 Filtered Tailings Operational Projects and Proposed Projects

Thickening and filtration performance is typically directly related to the aluminosilicate content. Figure 1.2 presents the mineralogy for the Pebble West samples. The aluminosilicate groups represent approximately 30% of the samples on average which is very high for a tailings filtration application.

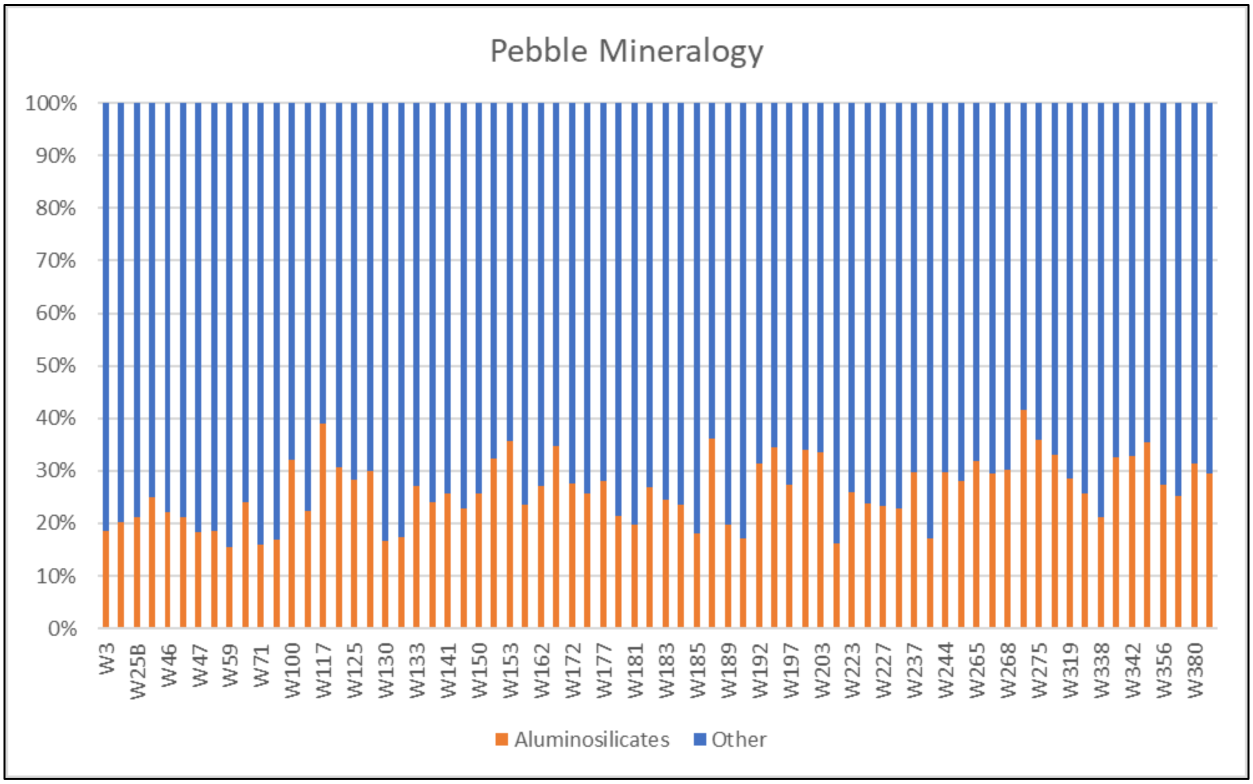

Figure 1.2 Pebble West Samples Mineralogy

Thickening the tailings as much as practicable prior to filtering provides a benefit for samples with high clay content. This leads to selecting a high compression thickener, rather than a high rate or paste thickener. Figure 1.3 presents the expected hourly filter throughput for a large, market-ready filter versus the total aluminosilicate content after thickening in a high-compression thickener. The clay content of Pebble is amongst the highest for considered filtered tailings studies. The challenges and technical risk for filtering and stacking tailings at the size and complexity of the Pebble project are unprecedented and, as such, an approach which considers filtered tailings management is impracticable for the Pebble site.

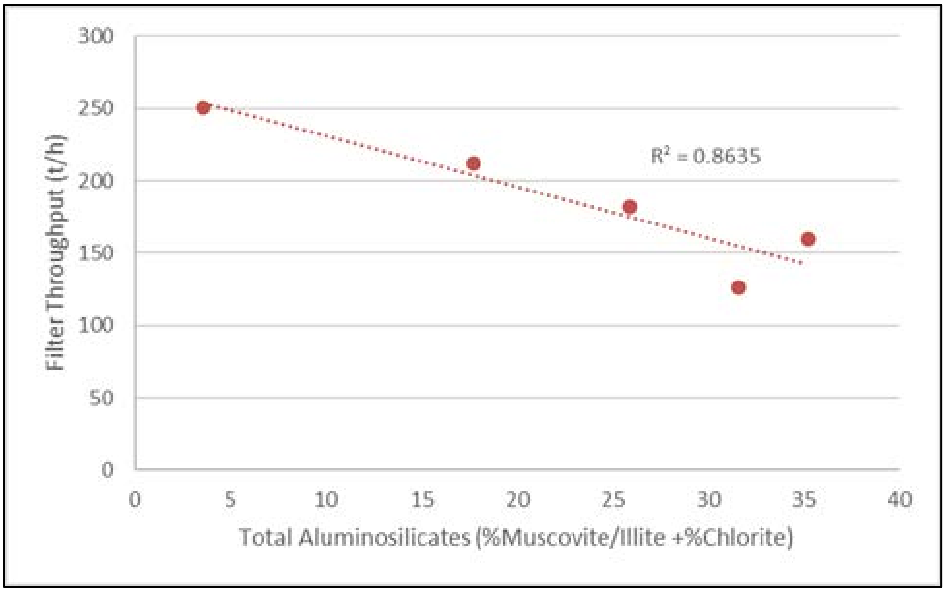

Figure 1.3 Expected Hourly Filter Throughput

The following equipment would be required to treat the average bulk filtered tailings throughput of 155,000 tpd based on the aluminosilicate content:

- 4 x 215 ft. diameter high-compression thickeners, each with duty/standby underflow pumps (in addition to the thickeners included in the current concept)
- 8 lines of 8 filters installed, each with ~10,800 ft^2 of filtration area and 1.5 – 2 inch chambers and inflatable membranes for squeezing the filter cake
- Each filter will operate at a nominal throughput of 140 t/h at an average utilization of 85%
- Each filter line will include two large filter feed tanks with 3 hours residence time (16 tanks total)
- Each filter will have a dedicated filter feed pump and discharge feeder
- Common filter services, including membrane pressing air, blowing air, filtrate return services and water services
- 4 truck loading stations with mass flow bins with an approximate residence time of 2 hours
- 4 emergency bypass systems to covered stockpiles with reclaim into the truck loading stations in the event of truck downtime

Energy consumption to thicken, filter and convey material to the storage bins is expected to be 2.5–3 kWh/t, equivalent to an average operating load of 19-23 MW. Additional heating power of approximately 10 MW will be required for the nominated buildings (e.g. mass flow bins, etc). Connected power is likely to be substantially higher than the nominal demand, at approximately 30 MW, accounting for the cyclical demand from filtration. Additional power generation facilities will be required to supply this additional demand

The thickener will consume approximately 50 g/t of flocculant on average, which equates to 9 tons of flocculant per day.

Each filter cloth is expected to last approximately 1,000 cycles, which corresponds to approximately 800 new cloths per day. This is significantly less than the industry standard of approx. 3,000 cycles and is because of the high clay content in the Pebble bulk tailings. Maintenance logistics and disposing of used cloths would be a significant logistical challenge and is not considered practicable.

Other consumables include wet ends, piping, and valves. A new wet end and set of filter feed valves will be required every 2 – 3 days, on average, to keep the 64 filters operating.

Major equipment emissions are expected to be limited to front-end loaders for rehandling, dozing of stockpiles, forklifts, mobile cranes, bobcats and light vehicles. Average fuel consumption rates are anticipated to be approximately 2,500 gallons per day (gpd). The HVAC system is anticipated to require approximately 828,000 cubic feet (cf) of natural gas per day. Power generation for the tailings thickening and filtration facility will require approximately 5,000,000 cubic feet (cf) of natural gas per day. Total carbon dioxide (CO_2) emissions for the Filter Plant are estimated to be approximately 75 tpd.

The Pebble project would represent almost four times more throughput than the largest filtered tailings project currently in operation (Karara Iron Ore Mine). The scale of Pebble is also more than twice the throughput of the proposed Rosemont project, and in a more challenging environment. The Pebble tailings filtration plant would require a labour force increase in excess of 250 people to operate and maintain the filter plant. This does not include the additional labour force required for the trucking, placement, spreading and compaction of the filtered tailings in the TSF.

1.2 RFI 054 – 2

"What would the confidence be in maintaining continuous dry stack operations year round in consideration of filtering, handling and disposal, given seasonal weather and possible clay content changes?"

A Filter Plant utilization of 75% has been assumed for the filtered tailings concept, allowing for maintenance, downtime, filter cloth replacement, and/or filtration issues with high clay content materials. Bulk tailings will be disposed of in a separate conventional tailings storage facility as slurry tailings during these periods.

During spring freshet (one to two months) and the later summer, autumn rainy season (three to four months),filtered tailings placement and compaction will be challenging due to trafficability issues for haul truck and support equipment access.

This has been encountered at the Greens Creek Mine and has been managed by temporarily stockpiling tailings during wet weather to minimize additional moisture absorption during wet periods, or drying during warm periods. The tailings are then spread and compacted once the conditions allow for adequate placement and compaction of the material (ADOEC, 2003). This is only possible due to the low throughput at Greens Creek (approx. 1,150 tpd of filtered tailings production).

Tailings density targets would be challenging to achieve during winter months, when the temperatures fall below freezing, due to surface freezing of material (this issue has been encountered at the Pogo Mine where during winter months, placed filtered tailings fell below 80% of the target design density of the tailings) (Sumitomo, 2014). Further preventing snow inclusion within the compacted mass will likely prove impossible, further reducing the compacted density.

The Pebble throughput is 4 times higher than the largest operational or historic facility that has employed filtered tailings (Karara Iron Ore Mine @ 35,000 tpd).

The combined challenges of unprecedented scale, clay content, precipitation, and winter conditions point to filtered tailings being an impracticable solution for Pebble.

Figures 1.4 and 1.5 contextualize Pebble in comparison to a range of existing operational mines (Figure 1.4) and to those that employ filtered tailings (Figure 1.5).

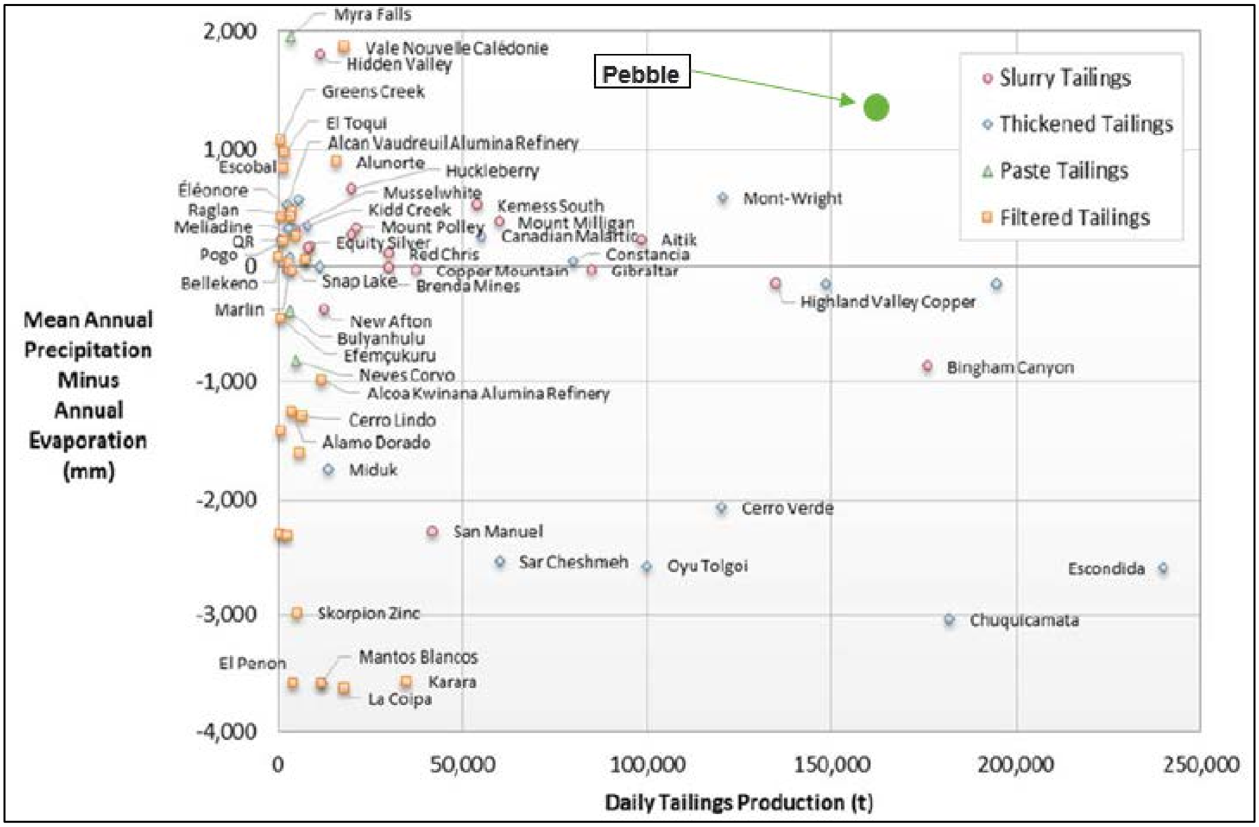

Figure 1.4 Tailings Throughput vs Mean Annual Net Precipitation (KCB, 2017)

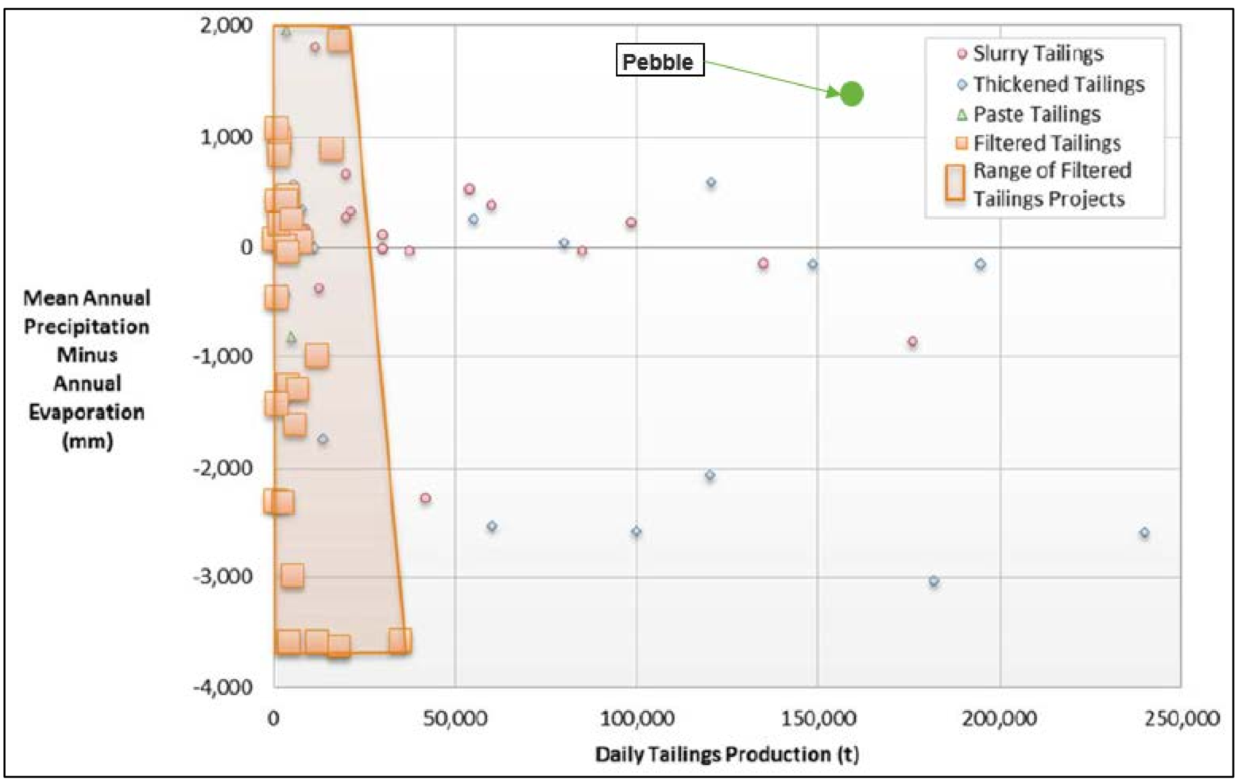

Figure 1.5 Range of Filtered Tailings Facilities in Operation (KCB, 2017)

1.3 RFI 054 – 3

"Would there be fine tailings with high clay content that might not be efficiently filterable; what percentage of the total would these be; and where would they be disposed?"

Mineralogy data presented in Figure 1.2 indicate that all variability samples have a consistently high amount of aluminosilicates. Consequently, there is insufficient variation within the set of samples from Pebble West to provide an opportunity to filter only some ore types but not others. Therefore all ore types will need to be treated similarly and disposed of in the same location.

All ore types are expected to filter poorly and filtration rates are likely to be slow (as shown on Figure 1.3). Furthermore, it is a risk that the high clay content blinds the filter cloth and reduces the cloth life to significantly less than industry standards (<1,000 cycles per cloth as opposed to the nominal design life of ~3,000 cycles per cloth).

Pebble size distributions from grind establishment testwork at 180 µm are presented in Figure 1.6. The green line represents the expected size distribution for the finer grind P80 of 135 µm.

A size separation at 15 – 20 µm could be performed to improve filtration rates, which would result in 30 – 40% of the tailings material having to be stored separately in a separate TSF. A size separation at fine sizes (15 µm or less) would require thousands of very small cyclones operating at low feed solids density, has not previously been attempted at this scale anywhere in the world and is not practicable.

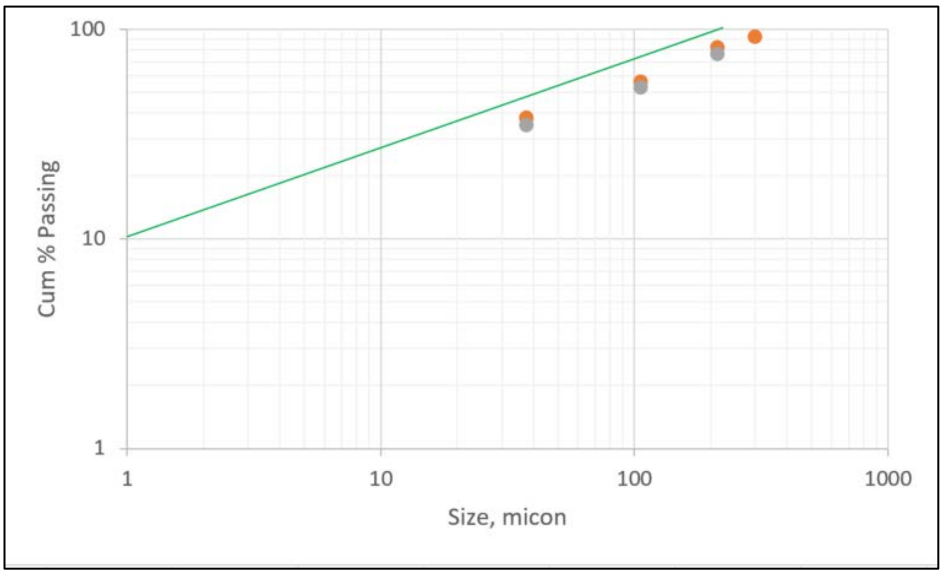

Figure 1.6 Pebble Size Distribution Data

The Filter Plant may occasionally be unable to keep up with the tailings stream due to poorer than expected filterability or filter plant maintenance (e.g. high frequency of filter cloth replacement). Tailings will be disposed of in a separate conventional slurry tailings storage facility during these periods (assumed 75% utilization of the Filter Plant).

The clay content of Pebble is amongst the highest for considered filtered tailings studies. The challenges and technical risk for filtering and stacking tailings at the size and complexity of the Pebble project are unprecedented and, as such, an approach which considers filtered tailings management is impracticable for the Pebble site.

1.4 RFI 054 – 4

"Would there be different issues with filtering, handling, and disposal of the bulk vs pyritic tailings?"

Pyritic tailings are not considered eligible for filtered tailings production due to the higher ARD generation potential and higher content of clay-sized particles, therefore only bulk tailings would be considered for filtered tailings production. Further, the pyritic tailings will be returned to the pit at closure, thus alleviating the long-term stability risk for this facility.

1.5 RFI 054 – 5

"What major support facility and operation additions would need to be considered under a dry stack scenario (e.g., embankments, water retention ponds, back-up slurry tailings storage facility, seepage collection systems, dust control, ongoing reclamation)?"

Potential filtered tailings storage facilities have been identified at the NFK West location (Site G) and NFK North location (Site K) for the purposes of responding to this RFI. A filtered tailings storage facility at either Site G or Site K would require a number of ancillary facilities to enable successful operations.

Fill berms will be required to enhance stability of the filtered tailings stack. At Site G, these berms would be required at the existing locations of the south and main embankments. At Site K, likely three, or perhaps four, sides of the facility would require embankments.

A tailings storage facility (TSF) would be required to store slurry bulk tailings during periods of Filter Plant unavailability (due to maintenance or operational downtime) or tailings not eligible for filtration. Approximately 25% of the total bulk tailings (approximately 275 million tons) will either not filter to the required specification or will require separate storage during periods of Filter Plant downtime or unavailability. This additional TSF would require support facilities such as seepage collection system, diversion ditches, etc.

A separate water management pond would be required to store runoff and seepage from the filtered tailings TSF. This pond would need to be larger than the current water management pond as there would be no water storage available in the filtered tailings TSF and a much smaller supernatant pond would be present in the bulk slurry tailings TSF. An alternative would be to increase the size of the currently proposed Main Water Management Pond.

A fleet of water trucks would be required for dust suppression operations for the exposed filtered tailings. A fleet of dozers will also be required during winter months for snow clearing from the surface of the filtered tailings. This snow would be considered as mine contact water and would require management and treatment as such.

Seepage from the TSFs would be collected and routed to seepage collection ponds, located downstream of the TSF embankments or filtered tailings TSF berms. Collected seepage and runoff would be pumped from here to the Main Water Management Pond for recycle to the mill, or for treatment and release.

Tailings disposal at Site K would require additional seepage control measures as compared to tailings disposal in Site G as managing seepage in this arrangement is more challenging due to the topography of this area. Site K seepage control measures may include a lined TSF basin (HDPE liner) and/or a slurry cutoff wall downstream of the TSF. Seepage and runoff collection ponds would be required to the north and south of a proposed Site K TSF to limit discharge of mine contact water to the North Fork Koktuli and Upper Talarik drainage areas.

A filtered tailings TSF in either location would allow for ongoing concurrent reclamation of the downstream face of the filtered tailings stack and downstream shell zone during operations. The slurry tailings TSF reclamation strategy would be consistent with the currently proposed strategy.

1.6 RFI 054 – 6

"What would be the ultimate volume differences: 1) between dry stack tailings and the currently proposed bulk and pyritic tailings; and 2) between onsite water storage requirements of a dry stack scenario and the currently proposed water management ponds?"

1.6.1 RFI 054 – 6(1)

The current assumption for the bulk tailings is that they will have a dry density of approximately 90 pounds per cubic foot (pcf) (consolidating to approximately 100 pcf post-closure). Filtered tailings, at optimum placement and compaction, are assumed to have a dry density of approximately 100 pcf. Long-term, post-closure, there are anticipated to be no differences in ultimate volume of the filtered tailings and currently proposed conventional tailings. However, a larger volume of quarried rock would be required to construct the additional TSF required to store slurry tailings during Filter Plant downtime (25% of total bulk tailings throughput).

1.6.2 RFI 054 – 6(2)

The total volume of water managed with a filtered tailings solution will be similar to that with the current proposal but the system will be significantly more "flashy". In the proposed system, some transient water will be held in the TSF as the tailings settle and as the water seeps through the main embankment. With filtered tailings, this transient water will report immediately to the water management system. As a result the water management pond will be larger than the current arrangement to accommodate this transient water and to store the water currently sitting within the pond in the TSF.. Filtered tailings storage at Site K would require two additional water management ponds, one to the north, and one to the south.

A conceptual general arrangement for the filtered tailings TSF and water management pond is shown on Figure 1.7 for a TSF at Site G, and Figure 1.8 for a TSF at Site K.

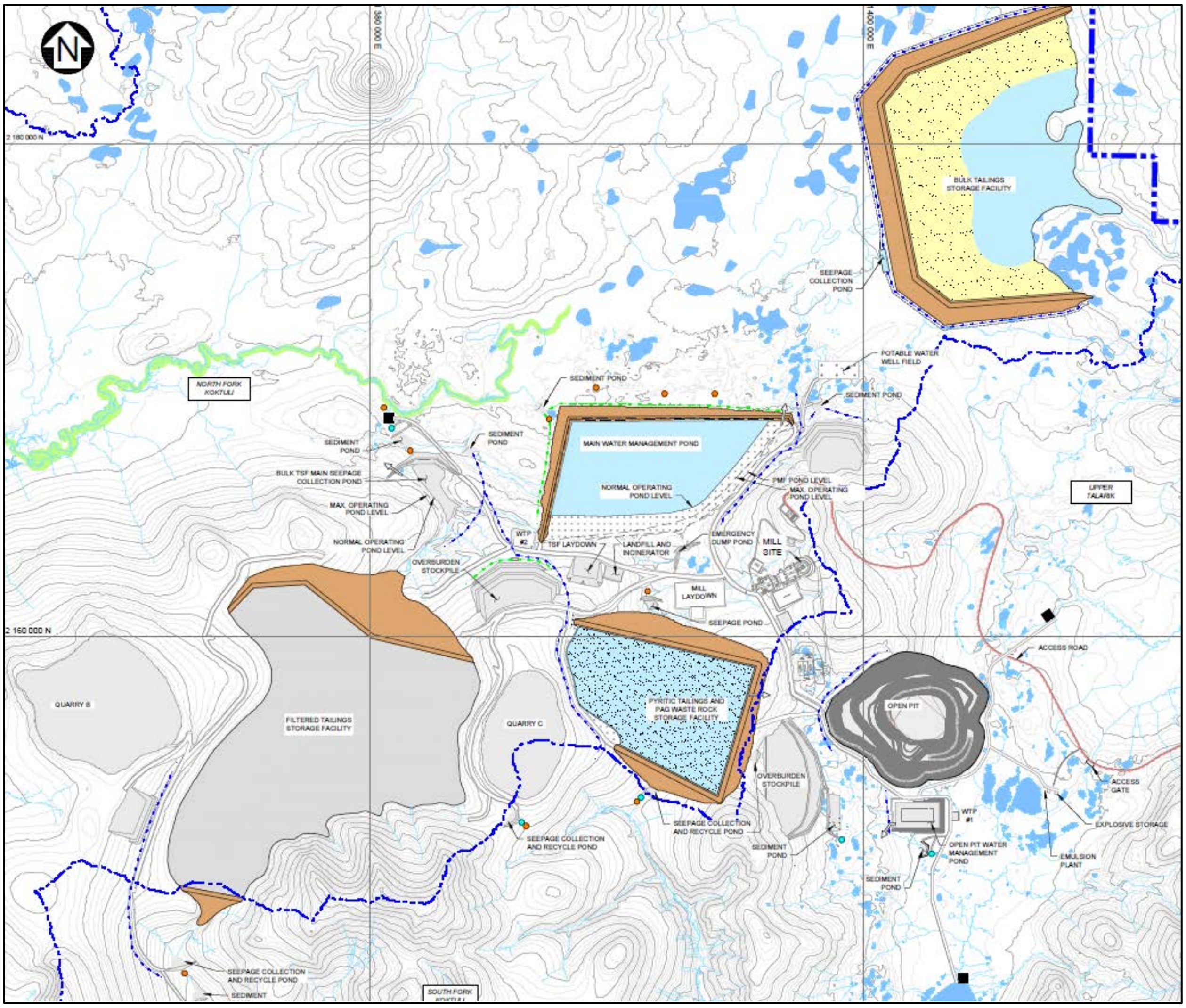

Figure 1.7 **Conceptual Filtered Tailings TSF General Arrangement (Site G)**

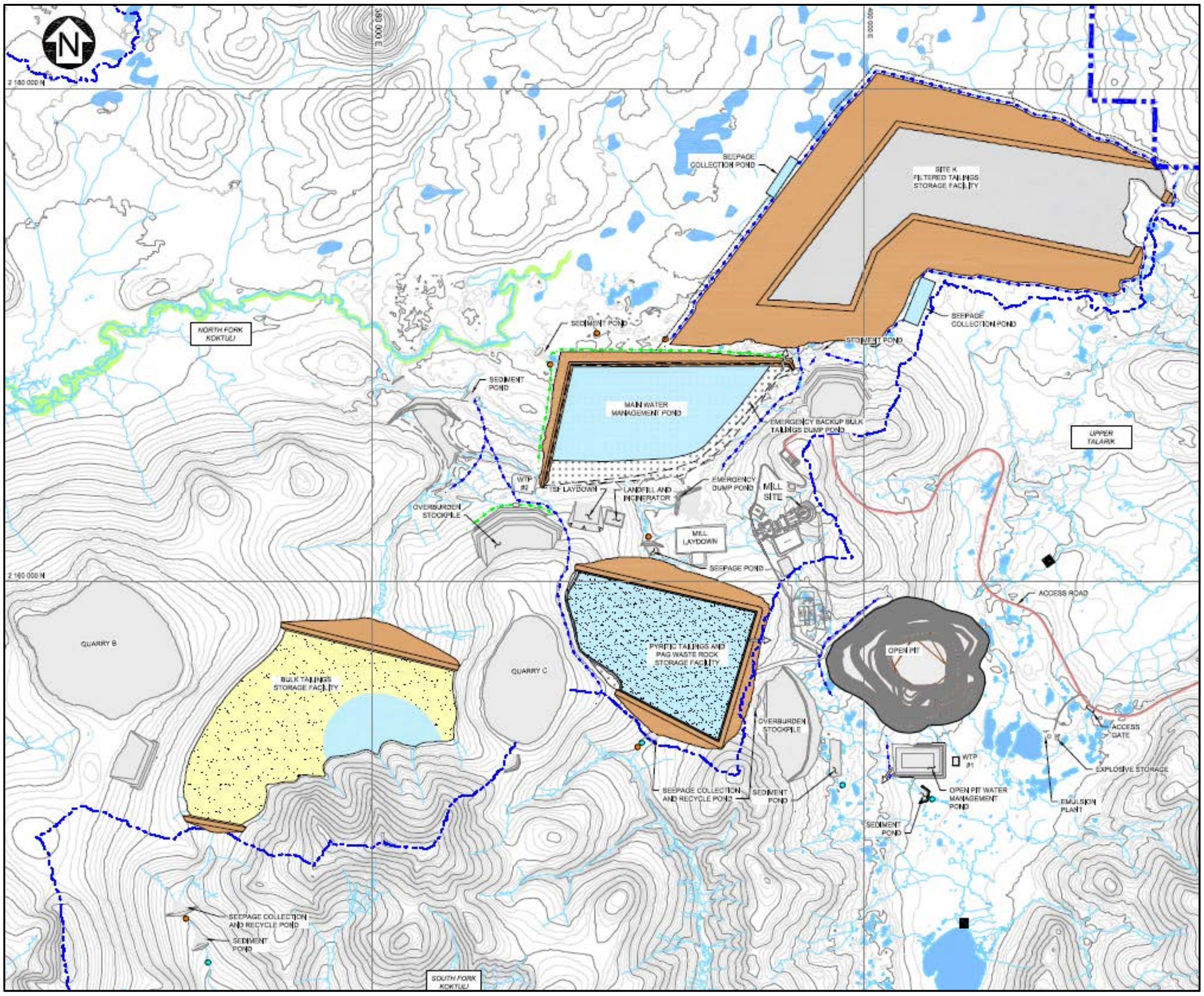

Figure 1.8 Conceptual Filtered Tailings TSF General Arrangement (Site K)

1.7 RFI 054 – 7

"What would be the type/quantity of mobile equipment and/or conveyors needed to transport and place tailings in a dry stack? How would material handling change during winter versus summer?"

Tailings would be delivered from the Filter Plant to the TSF by 100-ton conventional rear-dump haulage trucks. A fleet of approximately 70 haulage trucks will be required to meet Filter Plant production, (accounting for spare vehicles and vehicle maintenance downtime). These haul trucks would require low-bearing tires for trafficability on the surface of the filtered tailings. These haul trucks have an operating life of approx. 100,000 hrs and would require replacement after this point, i.e. once within the operational LOM.

Tailings would be spread using large tracked dozers and compacted using 15-ton vibratory compactors. Motor graders would be used as necessary to maintain the surface of the filtered tailings stack within the TSF with excavators required for reworking of material as required. Support equipment on the surface of the filtered tailings would also require low-bearing tires or tractor-type tracks. Support equipment has an operating life of 50,000 hrs and would require replacement at this point, i.e. three times within the operational LOM.

Water trucks may be required to spray the exposed filtered tailings for dust management in areas where deposition is not ongoing. Tailings would be deposited towards the downstream sides of the TSF (i.e. close to the TSF berm and downstream shell) during this period, when tailings can be optimally compacted. Tailings would be deposited towards the central or upstream areas of the TSF in winter months and sustained wet periods, and compacted to the maximum practical extent. Should trafficability become an issue and tailings placement not be possible, operations may cease or temporarily halt until conditions allow for on-going placement and compaction of the filtered tailings. An alternate strategy for severe weather conditions that prevents or limits tailings placement would be to deposit tailings in the slurry tailings TSF, although this has not been considered for this concept. The slurry tailings TSF would conceptually store filtered tailings during Filter Plant downtime, and tailings which do not meet filtration requirements only (approximately 25% of total bulk tailings).

1.8 RFI 054 – 8

"How would waste rock storage be different under a dry stack scenario than the currently proposed plan?"

The waste rock management strategy for a filtered bulk tailings scenario will be unchanged from the currently proposed concept. PAG waste rock will still be co-disposed of with the pyritic tailings in the Pyritic TSF during operations, and removed to backfill storage in the mined-out Open Pit at closure.

Quarried NAG rock will be used to construct the slurry TSF embankments and the filtered TSF buttress.

1.9 RFI 054 – 9

"How would interim reclamation and final closure be different than the currently proposed plan under a dry stack scenario?"

Filtered tailings may allow for concurrent reclamation of downstream slopes on the filtered tailings TSF. The closure and reclamation plans for all other facilities would be unchanged. The slurry TSF would be reclaimed in a similar manner to the currently proposed concept.

Long-term, post-closure, there would be negligible differences between the physical characteristics of the filtered tailings TSF, and the current concept of a drained tailings mass post-closure (anticipated final dry densities are estimated to be the same for both concepts). The water management pond for the filtered tailings TSF would still be required post-closure for pumping of seepage and contact water to the water treatment plant for treatment and release, similar to the current proposed concept.

1.10 RFI 054 – 10

"How would the dry stack cost compare with the current plan in terms of full life cycle through to closure and post-closure including design, construction, operations, maintenance and surveillance?"

Incremental costs for a filtered tailings concept compared to the currently proposed concept only have been considered at this time.

Additional quarried rock would be required for a filtered tailings facility to construct both the downstream shell zone and toe berm of the filtered tailings TSF and the bulk slurry tailings TSF. A second slurry pump system will also be required for the bulk slurry tailings TSF in addition to the slurry pump system to feed the Filter Plant. Operating costs include electricity consumption for the pump system

Both TSFs will require water management structures such as seepage collection ditches and water management ponds. A slurry cutoff wall and/or fully lined HDPE impoundment would be required for Site K as an additional seepage control measure to limit the potential for seepage to the North Fork Koktuli and Upper Talarik drainage areas.

Filtered tailings operations would require a Filter Plant that consists of the following components:

- Filters and ancillaries
- Additional thickeners and ancillaries
- Ore bins and Stockpile Systems
- Flocculant Plants
- Support Equipment (dozers, mobile cranes, forklifts, light vehicles, etc.)

Operating costs for the filter plant include equipment maintenance, electricity consumption, fuel consumption for mobile equipment, and labour costs.

Operating costs relating to the filtered tailings delivery include labour costs for haul truck operators, vehicle maintenance, and fuel consumption. Haul truck fuel consumption is anticipated to be approximately 24,500 gallons per day and CO_2 emissions are estimated to be approximately 270 tpd.

Operating costs relating to the filtered tailings spreading and compaction include labour costs for haul truck operators, vehicle maintenance, and fuel consumption. Support equipment fuel consumption is anticipated to be approx. 8,400 gallons per day and CO_2 emissions are estimated to be approximately 95 tpd.

The operating crew for the filter plant would number 250 people and 400 people for the for filtered tailings distribution.

Incremental life of mine costs of approximately $3.1 billion in capital costs and $5.5 billion in operating costs ($5.24 /ton) for Option 1 (filtered tailings storage at Site G with slurry tailings storage at Site K) have been assumed. This would decrease the project net present value (NPV_7) by $5.9 billion.

The Site K filtered tailings storage option would incur incremental capital costs of approximately $3.8 billion and incremental operating costs of $5.5 billion ($5.24/ton). This would decrease the project NPV_7 by $6.5 billion.

Both of these scenarios would render the project uneconomic. It should further be noted that neither of these capital estimates include contingency. For this level of study, it is not unreasonable to include contingency of 35% on the direct capital costs, which would increase the capital associated with Option 1 by up to $780 million and Option 2 by up to $950 million.

The incremental cost increases of both options are summarized on Table 1.1. Fuel consumption and total emissions are summarized on Table 1.2.

Table 1.1 Incremental Cost Increase Summary

	Option 1 Filtered Tailings at Site G	Option 2 Filtered Tailings at Site K
Initial Capital	$2.02B	$2.50B
Filter Plant	$0.83B	$0.83B
Ancillary Facilities	$0.13B	$0.13B
Filtered Tailings Delivery	$0.07B	$0.07B
Filtered Tailings Spread/Compact	$0.02B	$0.02B
TSF/WMP Facility Construction	$0.94B	$1.41B
Slurry Tailings Delivery System	$0.03B	$0.03B
Sustaining Capital	$0.20B	$0.20B
Indirects[2]	$0.890B	$1.08B
Operating Costs	$5.48B	$5.48B
TOTAL LOM COSTS	**$8.59B**	**$9.26B**
NPV[1]	**$5.87B**	**$6.54B**

NOTES:

1. NPV RATE OF 7% ASSUMED FOR THE PROJECT.
2. INDIRECTS OF 40% ASSUMED FOR CAPITAL COSTS ONLY.
3. EXCLUDES ANY CONTINGENCY. TOTAL MAY NOT SUM DUE TO ROUNDING OF CATEGORIES. ALL COSTS PROVIDED IN US DOLLARS (USD$).

Table 1.2 Fuel Consumption and Emissions

Item	Diesel Fuel Consumption (gpd)	Natural Gas Consumption (cf/d)	Carbon Dioxide (CO_2) Emissions (tpd)[1]
Filter Plant Support Equipment	2,500	-	27
Filter Plant Power Generation	-	4,760,000	48
Filter Plant HVAC System	-	828,000	48
Filtered Tailings Haul Truck Delivery	24,500	-	270
Filtered Tailings Spreading and Compaction	8,400	-	95
TOTAL	**35,400**	**5,588,000**	**440**

NOTES:

1. TOTAL EMISSIONS DOES NOT INCLUDE EMISSIONS ASSOCIATED WITH ELECTRICAL POWER GENERATION FOR THE PROCESS PLANT, FILTER PLANT OR WATER MANAGEMENT PUMPING SYSTEMS.

2.0 REFERENCES

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