KCB Consultants Ltd.

January 17, 2020

Resolution Copper Mining LLC
P.O. Box 1944
Superior, Arizona
85273

Ms. Victoria Peacey
Senior Manager – Permitting and Approvals

Dear Ms. Peacey:

Resolution Copper Project
Skunk Camp Tailings Storage Facility Filtered Tailings Analysis
Conceptual Filtered Tailings Impoundment Layout and Staging
Doc. # CCC.03-81600-EX-LTR-00010 – Rev. 1

1 INTRODUCTION

KCB Consultants Ltd. (KCBCL) presented considerations for the application of filtered tailings for the Resolution Copper Project at the Skunk Camp site on September 3, 2019 to the Resolution 404 Workgroup during their Meeting #3. During this meeting, EPA representatives requested an action item for Resolution Copper Mining LLC (RCM) to review options to transition from a conventional slurry tailings storage facility (TSF) to a filtered tailings stack to assess whether filtered tailings disposal (if feasible) could reduce the footprint of the Skunk Camp TSF. The purpose of transitioning from a conventional facility to a filtered tailings facility is to allow adequate time for the possible successful development of this technology at the scale of the Resolution Copper Project.

A follow-up meeting was held on October 16, 2019 to review results of the assessment.

This technical letter presents two conceptual options for transitioning from conventional slurry deposition for Non-Potentially Acid Generating (NPAG) scavenger tailings (in early years) to filtered tailings (in later years) for the proposed Skunk Camp site, assuming that filtered tailings disposal has already demonstrated to be feasible at the scale of the Resolution Copper Project.

Key objectives of the conceptual options are to:

- manage the Potentially Acid Generating (PAG) pyrite tailings by depositing the tailings subaqueously in segregated lined cells and physical isolated behind a downstream embankment;
- manage the NPAG scavenger tailings by:
    - conventional slurry placement (cycloning and thickening), as included in the Draft Environmental Impact Statement (DEIS) (USFS 2019) for the first 10-15 years;

KCB Consultants Ltd.
2 North Central Avenue, 18th Floor ▪ Phoenix Arizona 85004 ▪ USA
t 602.283.1006 ▪ www.kcbconsultants.com

- filtered tailings stacking for the years that follow to the end of operations; and

- provide required tailings and design storm storage volumes (72-hr PMF) to meet the project's design criteria.

2 CONSIDERATIONS FOR FILTERED TAILINGS FOR THE RESOLUTION PROJECT

- Processing, transport and placement:
  - Filter plant and transport (e.g. conveyors) for project would be precedent setting as there are currently no filtered tailings operations in the world at tonnage rates higher than 30,000 tons per day (tpd). Most filtered tailings operate at 1,000 tpd to 10,000 tpd in flatter areas and/or where adequate backup storage is available. The management approach has only been tried and proven at these lower production rates and has not been proven or commercially available at the scale of the Resolution Copper proposed mine (> 120,000 tpd).
  - There is only one example of a filtered tailings facility that has a production above 20,000 tpd, Karara as referenced from EPA. Karara Mining Limited in Western Australia is operating a filtered stack at 30,000 metric tonnes per day in a very arid environment in flat terrain (Amoah 2019). The project still requires back-up slurry storage as well as back-up transportation methods. Given the Resolution project is an order of magnitude larger in scale and located in mountainous terrain, following the same approach as Karara, additional contingency (e.g., filter presses, slurry storage, etc.) should be incorporated into the design along with back up slurry storage.
- Storm water management for filtered piles:
  - Surface of the filtered tailings would be sloped such that storm water would not pond on the pile to maintain as dry a surface as possible and not re-wet the tailings, directing surface runoff to designated collection areas, so it can be pumped into the pyrite cell.
- Seepage management:
  - Filtered tailings would produce less seepage into the foundation than the wet tailings options. However, seepage would still need to be managed.
- Dust management:
  - Filtered tailings would be deposited "dry" in windrows from a walking stalker conveyor, spread and compacted in place. The dry filtered tailings are susceptible to dusting prior to compaction (and potentially require temporary covers), so the tailings should be compacted with a smooth drum roller as soon as possible after deposition. Due to the production or pace at which the filtered tailings are placed, the risk of dust during wind events and not meeting air quality requirements would be high and likely more frequent than at a thickened tailings facility. This would result in increased requirements for protection of the tailings surface from dust generation.

- Transportation:
  - Filtered tailings would be transported from the Filter Plant to the TSF on conveyors. Conveyors need gradual slopes/terrain and simple deposition geometry for reliable operations and consistent deposition, as they need to move continuously and "walk" over the terrain while depositing. This is particularly important on the outer structural zone to ensure stability and prevent risk of tailings failure. The more complex the topography and deposition plan, the higher the risk of not meeting construction and operational requirements, requiring re-handling, back-up storage and/or alternate placement.

3 DEPOSITION STRATEGY AND STAGING

3.1 General

Assuming filtered technology can be successfully developed and is commercially available for the Resolution Copper scale and environment, for the first 10-15 years of operations, scavenger tailings and pyrite tailings would be managed with cycloning and thickening for the scavenger tailings, similar to the design presented in the DEIS. From Year 10 or 15 onwards, the pyrite tailings would continue to be managed behind a full downstream embankment and under a water cover to prevent and minimize oxidation and risk of acid rock drainage, but the scavenger tailings would be filtered and stacked. The following relevant key features are maintained from the DEIS design:

- Upstream non-contact water would be diverted as much as practical.
- The pyrite tailings would be stored in two pyrite cells within the ultimate impoundment; both cells would eventually be encapsulated by the scavenger tailings. The pyrite cells embankments would be constructed in the downstream-raised methodology using the scavenger tailings (either cyclone sand and/or filtered tailings). The pyrite cell would include an engineered low-permeability layer for vertical and lateral hydrologic containment.
- Ultimately, the scavenger tailings would be impounded by a cross-valley, centerline-constructed, structural shell (constructed of cycloned sand or filtered tailings - referred to as the main embankment in the DEIS).

3.2 Conceptual Options to Transition to Filtered Tailings

Operationally, raising filtered tailings stacks around or on top of existing conventional tailings storage facilities presents challenges related to trafficability and constructability. For this reason, two highly conceptual options for transitioning to filtered tailings were developed for this analysis.

Option 1 (see Figure 1)

For the first 15 years:

- Scavenger tailings would be cycloned to produce cyclone sand for embankment construction.

- Pyrite tailings would be subaqueously deposited in a low-permeability lined cell in the north of the site, contained by a downstream raised cycloned sand dam.
- Uncycloned scavenger tailings and cyclone overflow would be deposited in a cell on the east side of the site, contained by a centerline raised cycloned sand dam.

For the remainder of the life of mine:

- Scavenger tailings would be filtered and stacked in the south of the site. A portion of the tailings would be used for structural zones that contain the pyrite tailings or the ultimate downstream slope of the ultimate TSF.
- Pyrite tailings would continue to be subaqueously deposited in a low-permeability lined cell in the north of the site and then within the center of the impoundment, contained by a downstream raised filtered scavenger tailings structural zone.

Option 2 (see Figure 2)

For the first 10 years, the TSF would be constructed in the same configuration proposed in the DEIS:

- Scavenger tailings would be cycloned to produce cyclone sand for embankment construction.
- Pyrite tailings would be subaqueously deposited in a low-permeability lined cell in the Pyrite Cell 1 (from the DEIS design), contained by a downstream raised cycloned sand dam.
- Uncycloned scavenger tailings and cyclone overflow would be deposited in the south of site, contained by a centerline raised cycloned sand dam (which will form the base of the Main Embankment).

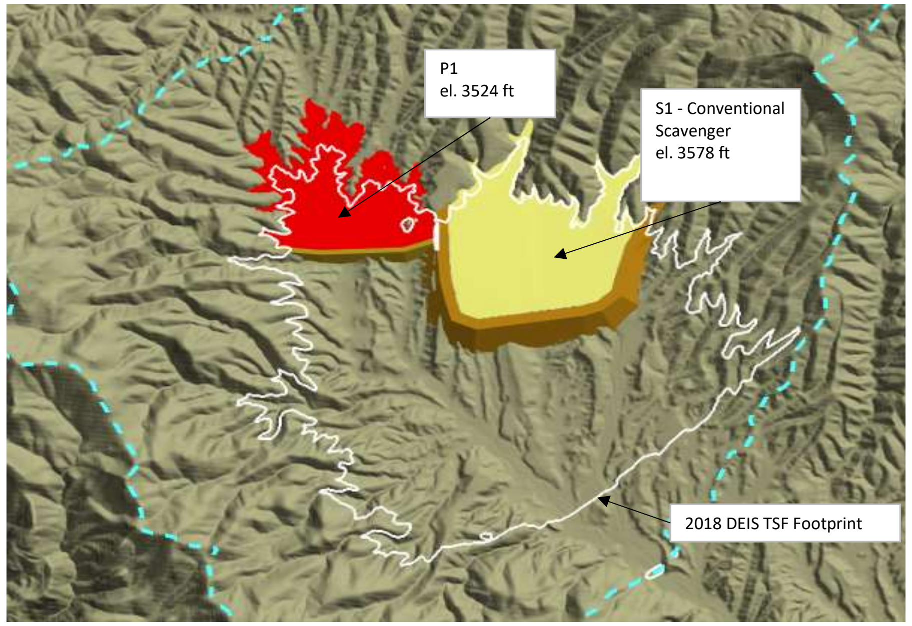
For the next 10 years (Year 10 to Year 20):

- Scavenger tailings would be filtered and stacked in the north and east of the site. The Year 0-10 scavenger tailings cell would need to be allowed to drain in order to be trafficable prior to stacking filtered tailings on top. A portion of the tailings would be used for structural zones that contain the pyrite tailings.
- Pyrite tailings would continue to be subaqueously deposited in DEIS Pyrite Cell 1, then the DEIS Pyrite Cell 2 (starting in Year 15), a low-permeability lined cell within the center of the impoundment, contained by downstream-raised dams (constructed from filtered scavenger tailings). Pyrite Cell 1 would be covered with scavenger tailings (either slurry or filtered tailings).

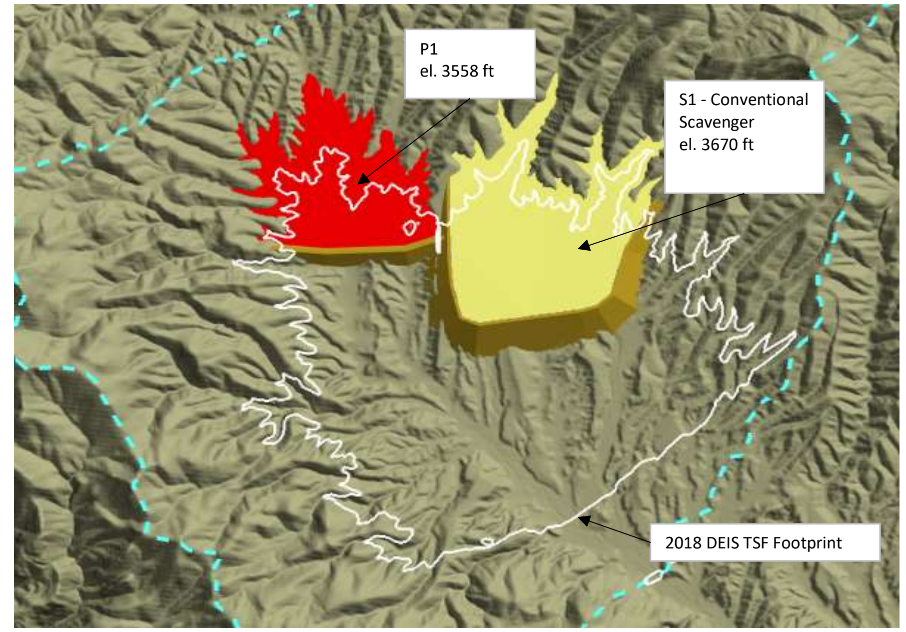
For the remainder of the life of mine:

- Scavenger tailings would be filtered and stacked in the south of the site (a top the conventional Year 0-10 scavenger tailings cell). A portion of the tailings would be used for structural zones that contain the pyrite tailings or the ultimate downstream slope.
- Pyrite tailings would continue to be subaqueously deposited in Pyrite Cell 2 within the center of the impoundment, contained by a downstream raised filtered scavenger tailings structural zone.

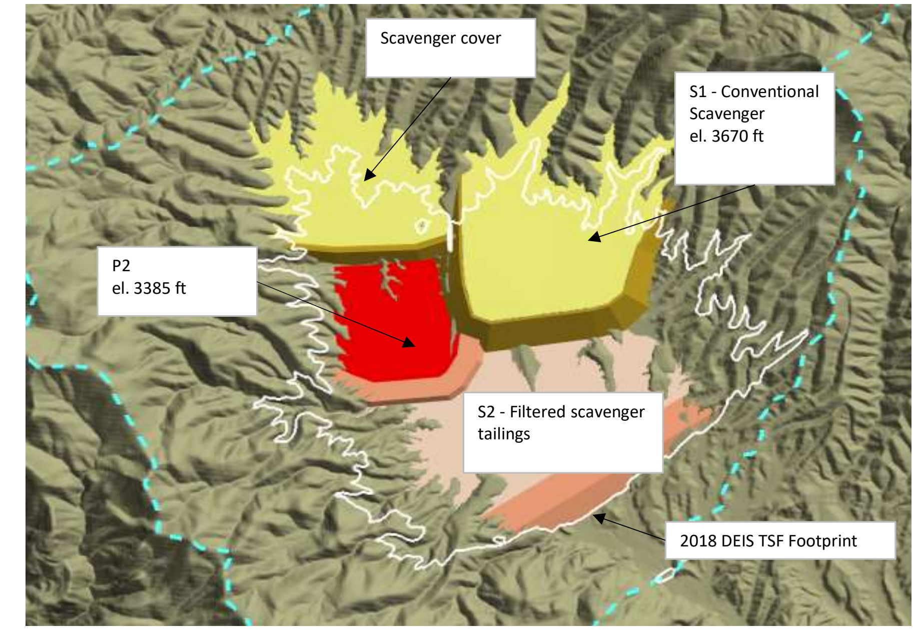
YEAR 10



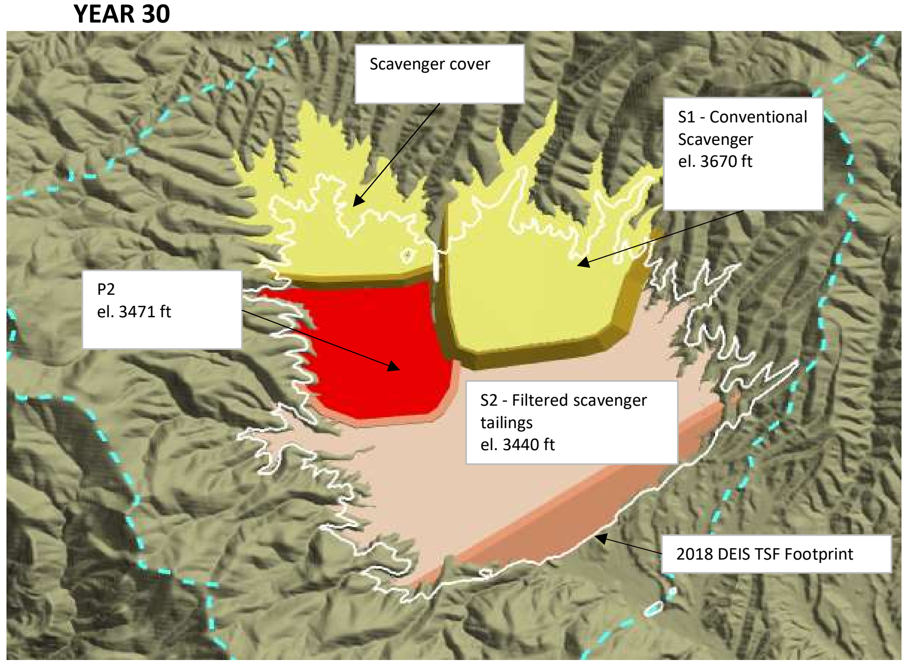
YEAR 15



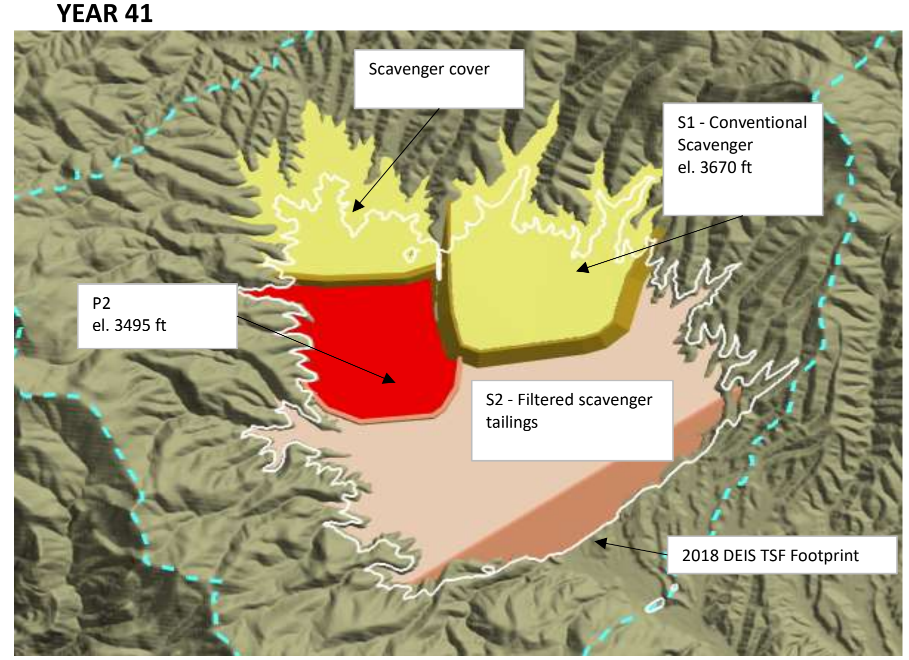
YEAR 20



YEAR 30



YEAR 41



LEGEND	
	SCAVENGER TAILINGS (CYCLONE OVERFLOW/TOTAL TAILINGS)
	PYRITE TAILINGS
	CYCLONED SAND EMBANKMENT
	FILTERED SCAVENGER TAILINGS (NON-STRUCTURAL)
	FILTERED SCAVENGER TAILINGS (STRUCTURAL)
	TOTAL TSF CATCHMENT AREA

NOT FOR CONSTRUCTION

TO BE READ WITH KCB CONSULTANTS LTD. REPORT DATED JANUARY 2020

CLIENT: RESOLUTION COPPER

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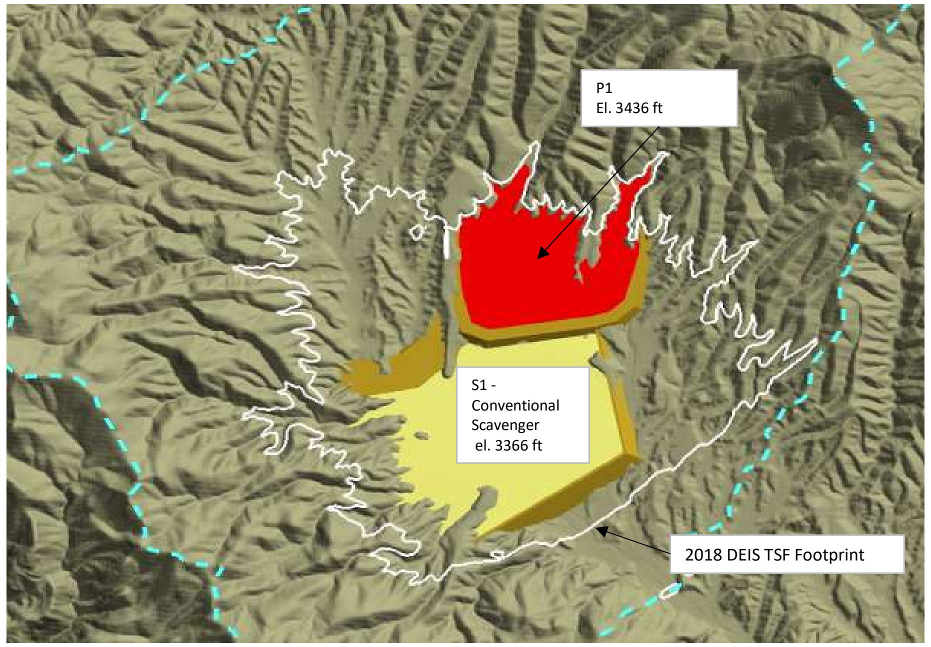
PROJECT: RESOLUTION COPPER PROJECT
404 WORKING GROUP ACTION ITEMS

TITLE: FILTERED TAILINGS OPTION 1: TAILINGS STAGING SUMMARY

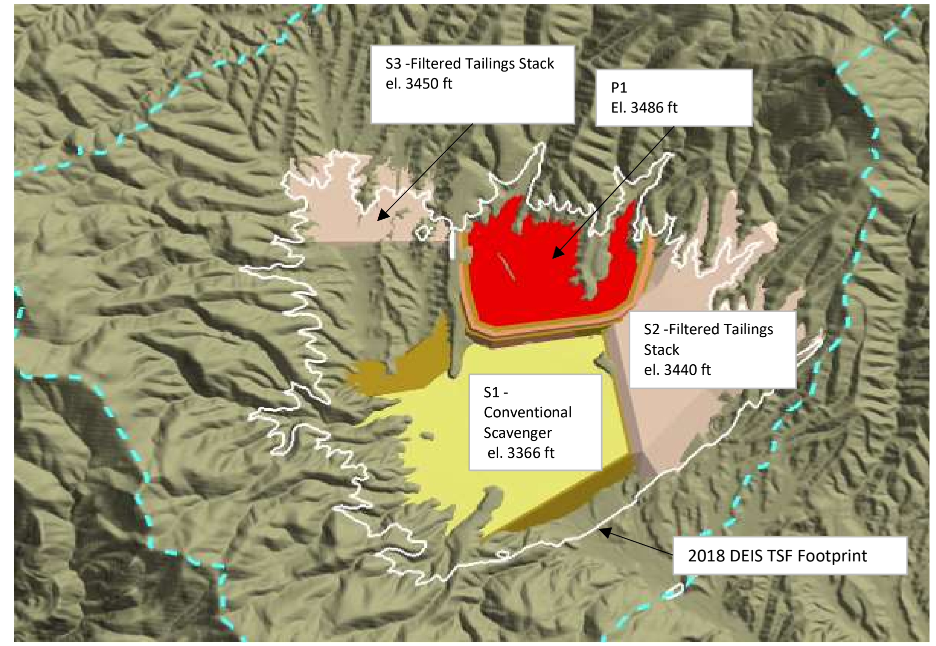
PROJECT No. UM09441A22

FIG No. 1

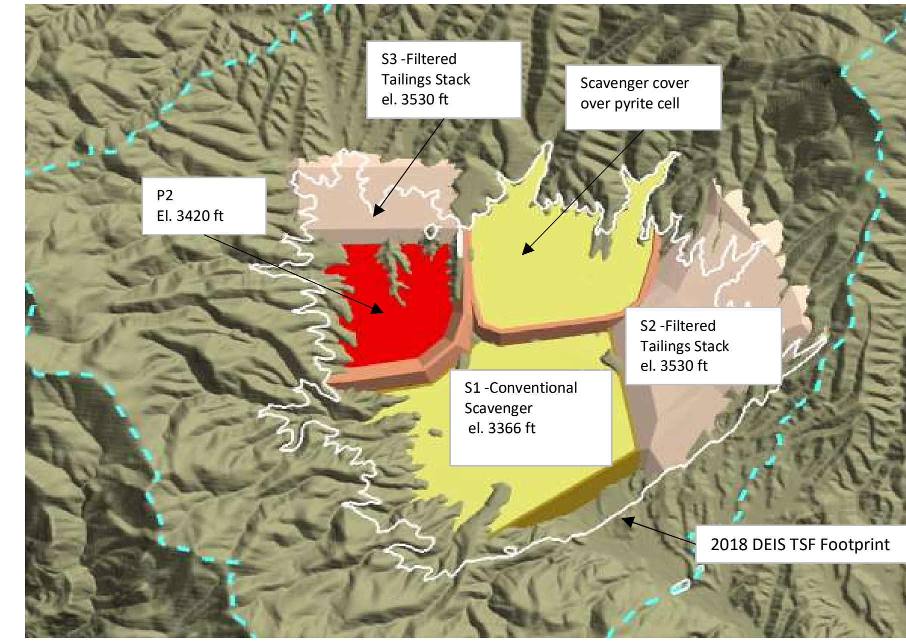
YEAR 10



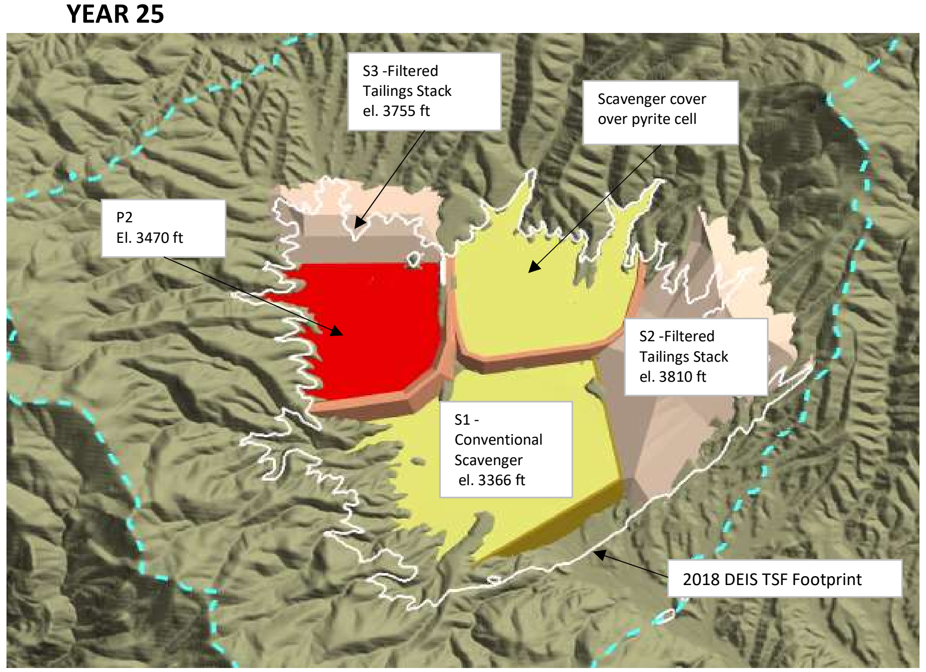
YEAR 15



YEAR 20



YEAR 25



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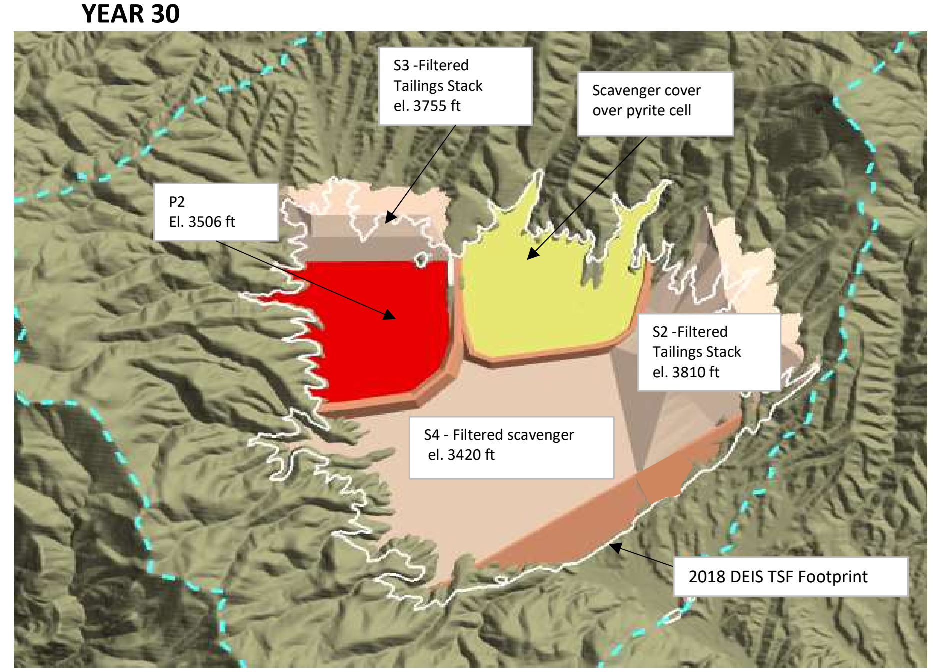
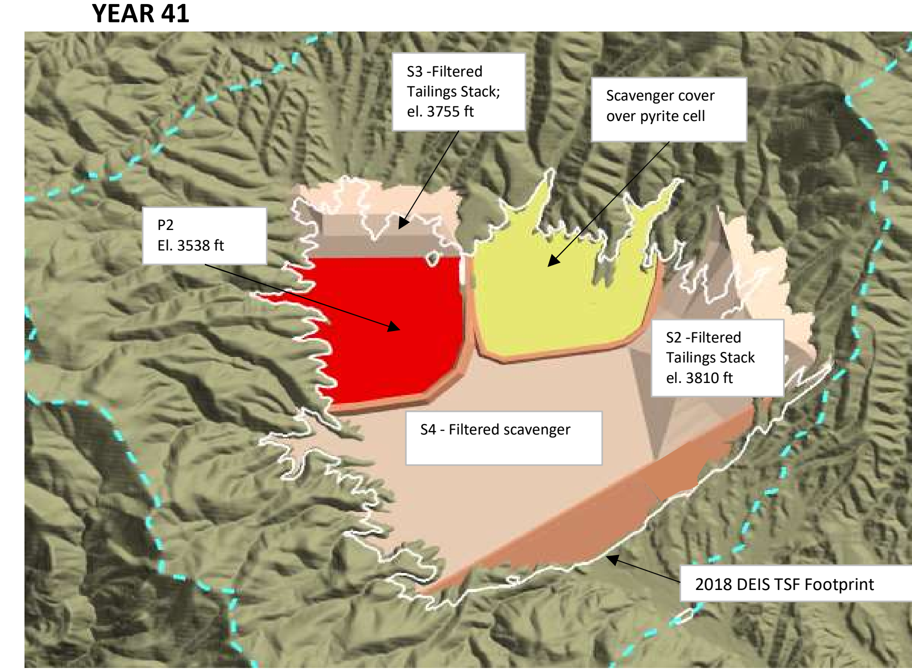


YEAR 41



LEGEND

- SCAVENGER TAILINGS (CYCLONE OVERFLOW/TOTAL TAILINGS)
- PYRITE TAILINGS
- CYCLONED SAND EMBANKMENT
- FILTERED SCAVENGER TAILINGS (NON-STRUCTURAL)
- FILTERED SCAVENGER TAILINGS (STRUCTURAL)
- TOTAL TSF CATCHMENT AREA

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CLIENT	RESOLUTION COPPER KCB Consultants Ltd.
PROJECT	RESOLUTION COPPER PROJECT 404 WORKING GROUP ACTION ITEMS
TITLE	FILTERED TAILINGS OPTION 2: TAILINGS STAGING SUMMARY
PROJECT No.	UM09441A22
FIG No.	2

4 SUMMARY OF RESULTS AND CONCLUSIONS

Both options presented would have a larger footprint than the DEIS TSF and may need additional back-up storage than what has been considered at this stage. Placement of filtered tailings at this scale would need large flat areas for conveyor placement which could be challenging given the complex and rough terrain of the site, particularly for Option 2 (see Figure 2). Based on learnings and experience from existing operations that attempted to increase capacity at a much smaller production tonnage than Resolution Copper, ample back-up storage would be required to address the risk of problems during construction and operations.

A summary of the results for both the options are included from Table 4.1 to Table 4.5. A qualitative comparison on the ease of transitioning of the two options is provided in Table 4.7.

Table 4.1 Option Tonnage Comparison

Stage	Mine Years	Scavenger Tailings (MTons)				Pyrite Tailings (MTons)	
		Cyclone Sand2	Total Scavenger or Overflow	Filtered Tailings		Pyrite Cell 1	Pyrite Cell 2
				Structural	Non-structural		
OPTION 1 (i.e. separate NPAG cell for Year 0 to 15)							
I	0 - 15	135	291	-	-	80	-
II	16 - 41	-	-	157	570	-	136
% of Total		10%	21%	11%	42%	6%	10%
OPTION 2 (i.e. DEIS configuration for Year 0 to 10)							
I	0 - 10	73	162	-	-	43	-
II	11 - 25	-	-	165	417	37	77
III	26- 41	-	-	34	308	-	64
% of Total		5%	12%	14%	53%	6%	10%

Table 4.2 Staging Summary – Option 1 (i.e., separate NPAG cell for Year 0 to 15)

Stage I – Conventional Tailings Storage				
		Elevation (ft)	Height – toe to crest (ft)	Cumulative Volume Stored (Mcyd)
Year 15	Scavenger Embankment (S1)	3,670	448	355
	Pyrite Embankment (P1)	3,580	235	56
Stage II – Filtered Tailings Storage				
		Elevation (ft)	Height – toe to crest (ft)	Cumulative Volume Stored (Mcyd)
Year 20	Filtered Tailings Stack (S2)	3,291	207	139
	Pyrite Embankment (P2)	3,407	246	27
Year 30	Filtered Tailings Stack (S2)	3,440	356	418
	Pyrite Embankment (P2)	3,490	300	79
Year 41	Filtered Tailings Stack (S2)	3,484	400	523
	Pyrite Embankment (P2)	3,513	323	98

Table 4.3 Staging Summary – Option 2 (i.e., DEIS configuration for Year 0 to 10)

Stage I – Conventional Tailings Storage				
		Elevation(ft)	**Height – toe to crest (ft)**	**Volume Stored (Mcyd)**
Year 10	Scavenger Embankment (S1)	3,365	265	197
	Pyrite Embankment (P1)	3,480	223	30
Stage II – Filtered Tailings Storage				
		Elevation (ft)	**Height – toe to crest (ft)**	**Volume Stored (Mcyd)**
Year 20	Filtered Tailings Stack (S2)	3,540	290	115
	Filtered Tailings Stack (S3)	3,530	145	44
	Pyrite Embankment (P1)	3,519	262	56
	Pyrite Embankment (P2)	3,560	340	27
Stage III – Filtered Tailings Storage				
		Elevation (ft)	**Height – toe to crest (ft)**	**Volume Stored (Mcyd)**
Year 30	Filtered Tailings Stack (S2)	3,810	560	214
	Filtered Tailings Stack (S3)	3,755	370	84
	Pyrite Embankment (P2)	3,560	340	80
	Filtered Tailings Stack (S4)	3,420	337	140
Year 41	Filtered Tailings Stack (S2)	3,810	560	214
	Filtered Tailings Stack (S3)	3,755	370	84
	Filtered Tailings Stack (S4)	3,474	387	387
	Pyrite Embankment (P2)	3,560	340	98

Table 4.4 Comparison of Make-up Water Requirements

Life of Mine	Filtered Tailings Option 1	Filtered Tailings Option 2	DEIS Layout
Make-up water requirements(acre-ft)	262,000 (Note 2)	213,000 (Note 2)	545,000 (Note 1)

Notes: 1. Make-up requirements for the DEIS layout are taken from the Water Balance Tailings Alternatives report by Westland (2018).

2. Make-up requirements for filtered options are estimated by assuming the change in overall TSF water losses (relative to the DEIS layout) is attributed to the change in the amount of water entrained in the scavenger tailings (Equation 1 and 2). For this comparison, the filtered tailings solids content is assumed to be 88% whereas the assumed solids content in the DEIS is between 60 and 65%.

$$Water\ entrained\ (by\ mass) = \ (1 - solids\ content\ \%) * Tailings\ Tonnage(tons) - \boldsymbol{Equation\ 1}$$

$$Total\ make - up\ req._{filt.} = Total\ make - up\ req._{DEIS} + \left(Water\ entrained_{filt.} - Water\ entrained_{DEIS}\right) - \boldsymbol{Equation\ 2}$$

Table 4.5 Comparison of TSF impoundment footprints

	Filtered Tailings Option 1	Filtered Tailings Option 2	DEIS Layout
TSF Footprint – impoundment only (acre)	4,100	3,900	3,800

Table 4.6 Comparison of Peak Power Requirements

	Filtered Tailings Option 1 and 2	DEIS Layout	% Increase
Annual Peak Power Requirements (kW)	45,800	4,110	~1100%

Table 4.7 Considerations in Transition to Filtered Tailings Options

Consideration	Transition to Filtered Tailings Option 1 (i.e. separate NPAG cell for Year 0 to 15)	Transition to Filtered Tailings Option 2 (i.e. DEIS configuration for Year 0 to 10)
Ease of transitioning to filtered tailings	▪ Relatively easier to start placing filtered tailings compared to Option 2, because tailings can be conveyed and stacked within the southern, flatter portion of the site. ▪ However, this option would be harder to keep as a conventional facility if filtered tailings were not implemented.	▪ Option has flexibility to be maintained as a conventional facility. ▪ Transition to filtered tailings would be more challenging because the slurry scavenger tailings would need to be allowed to drain and consolidate to become trafficable before conveyors for filtered tailings would be used on the surface. Also, the areas initially used for filtered tailings is more rugged than the south of the site, potentially requiring double-handling of the filtered tailings in areas.
Storm water management	▪ Simpler geometry and easier compared to option 2.	▪ Multiple areas for filtered tailings and with more complex geometry will be more challenging for storm water management.

5 CLOSING

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Yours truly,

KCB CONSULTANTS LTD.

Kate Patterson, P.E., P.Eng.
Project Manager

KP:dl

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