Klohn Crippen Berger

Resolution Copper Mining LLC

Resolution Copper Project

DEIS Design for Alternative 3B Near West Modified Proposed Action (High-density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell)

Doc. # CCC.03-26000-EX-REP-00005 - Rev. 0

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June 2018

Klohn Crippen Berger

June 8, 2018

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

Ms. Vicky Peacey
Senior Manager – Permitting and Approvals

Dear Ms. Peacey:

Resolution Copper Project
DEIS Design for Alternative 3B - Near West Modified Proposed Action
(High-density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell)
Doc. # CCC.03-26000-EX-REP-00005 – Rev. 0

We are pleased to provide the Draft Environmental Impact Statement (DEIS) Design for the Tailings Storage Facility (TSF) Alternative 3B - Near West Modified Proposed Action (High-density thickened NPAG Scavenger and Segregated PAG Pyrite Cell) for the Resolution Copper Project.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

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

KP:dl

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Resolution Copper Mining LLC

Resolution Copper Project

DEIS Design for Alternative 3A Near West Modified Proposed Action (High-density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell)

Doc. # CCC.03-26000-EX-REP-00005 - Rev. 0

EXECUTIVE SUMMARY

Resolution Copper Mining LLC (RC) is proposing to develop the Resolution Copper project (the Project), an underground copper mine, using the block cave mining method. The mine site is approximately two miles east of the town of Superior in the Pioneer Mining District, Pinal County, Arizona. The project mine plan includes generation of approximately 1.37 billion tons (Bt) of tailings over a 41-year mine life.

the Tonto National Forest (the Forest) is currently in the "alternatives development" portion of the NEPA process which the Forest will use as a component of the Project's environmental impact statement (EIS). A number of tailings storage facility (TSF) designs are currently being assessed and will be included in the draft EIS (DEIS). This report summarizes the Alternative 3B – Near West Modified Proposed Action (High-density thickened NPAG Scavenger and Segregated PAG Pyrite Cell).

Key elements of Alternative 3B are summarized below. East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain the same as currently described in the General Plan of Operations (GPO).

- The TSF would be located at the Near West site which is located within the Superior Basin entirely on Forest land, approximately 4 miles southwest of the town of Superior, and 4 miles south of the Superstition Wilderness Area. After site preparation, including removal of alluvial sediments, it would be founded on bedrock. The site is primarily used for livestock grazing, ranching, and road access to recreational areas. The Arizona Trail passes approximately ¾ mile east of where it follows Rice Water and Whitford Canyons into Reevis Canyon. Vegetation comprises mainly desert shrubs and cacti. The TSF would occupy the area of land bounded by Potts Canyon to the east, Roblas Canyon to the west and Queen Creek to the south.
- Alternative 3B would use a modified centerline-raised compacted cycloned sand embankment to enhance geotechnical resiliency and ability to handle operational upsets. A portion of the non-potentially acid generating (NPAG) scavenger (scavenger) tailings would be cycloned to create two products: cycloned (underflow) sand used to construct the embankment; and finer overflow tailings deposited into the TSF.
- Potentially acid generating (PAG) pyrite (pyrite) tailings would be discharged subaqueously from a floating barge or pipelines directly into the reclaim pond, to maintain pyrite tailings saturation during operations for the benefit of water quality.
- A segregated pyrite tailings cell would be built within the TSF footprint (potentially contained by engineered low-permeability layers[1]) and separated from the scavenger tailings by splitter berms. The pyrite tailings cell would be placed over the low permeability bedrock foundation

[1] Low-permeability containment details could comprise of one or more of the following: geomembrane liner, compacted fine tailings, asphalt core, slurry bentonite, cemented paste tailings, etc.

(Gila Conglomerate) where practical. The reclaim pond would be maintained within the pyrite tailings cell keep the pyrite tailings saturated to better control water quality concerns.

- Additional thickening and thin-lift deposition of the scavenger tailings that are not cycloned and the cyclone overflow would be done to reduce the volume of water entrained in the tailings and bleed water that must be reclaimed. This would reduce seepage into the foundation to manage downstream water issues. This approach would also reduce make-up water requirements by reducing losses at the TSF and prevent formation of a pond in the scavenger tailings cell.
- A series of mitigation measures intended to reduce downstream water quality impacts would be utilized, potentially including: selective engineered low-permeability layers; additional seepage collection dams; lined seepage collection ponds; slurry walls; pump back systems; stream diversion systems and cut-off walls. These mitigation measures and environmental protections will be refined between the DEIS and final EIS if this is the selected alternative.
- To reduce the potential for tailings spills, a modified tailings corridor utilizing a gently sloping route with no drop boxes would be incorporated into the design. There would also be no tunnels or at-grade crossings along the route. A cable stay bridge would be utilized to cross Potts Canyon and the Arizona Scenic Trail. A separate report is included for the Tailings Corridor design (RC 2016b).
- Pyrite tailings would be pumped to the TSF rather than flow by gravity to increase reliability and reduced potential for pipeline upsets (i.e. sanding of the lines) and associated spills.

The main benefits of Alternative 3B are:

- The use of a compacted cycloned sand embankment provides greater operational flexibility, robustness and geotechnical resiliency by creating a free-draining, compacted, non-liquefiable structural shell.
- The adoption of an adaptive series of seepage mitigation measures further reduces impacts on downstream receptors.
- The volume of seepage losses from the TSF that reach downstream receptors would be reduced through segregated storage of pyrite tailings in a low-permeability cell and thickening and thin-lift drying of the scavenger tailings.

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1 INTRODUCTION

1.1 General

Resolution Copper Mining LLC (RC) is proposing to develop the Resolution Copper project (the Project), an underground copper mine, using the block cave mining method. The mine site is approximately two miles east of the town of Superior in the Pioneer Mining District, Pinal County, Arizona. The project mine plan includes generation of approximately 1.37 billion tons (Bt) of tailings over a 41-year mine life.

RC submitted a General Plan of Operations (GPO) (RC 2016a) for the Project to the Tonto National Forest (the Forest). The subsequent issue of a Notice of Intent by the Forest (GPO 2016) triggered the beginning of the Forest's environmental analysis of the Project, in accordance with the National Environmental Policy Act (NEPA). The analysis will ultimately lead to the issuance of a Record of Decision on the Project by the Forest.

The Forest is currently in the "alternatives development" portion of the NEPA process which the Forest will use as a component of the Project's environmental impact statement (EIS). Klohn Crippen Berger Ltd. (KCB) has been commissioned by RC to prepare select tailings storage facility (TSF) designs to support the alternatives development process and the draft EIS (DEIS). The alternatives being considered are:

- Alternative 1 – No Action;
- Alternative 2 – Near West GPO Proposed Action (not to be considered further in the DEIS, but included for comparison);
- Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – "wet");
- Alternative 3B – Near West Modified Proposed Action (High-density thickened NPAG[2] Scavenger and Segregated PAG[3] Pyrite Cell);
- Alternative 4 – Silver King Filtered;
- Alternative 5 – Peg Leg Lined;
- Alternative 6 – Peg Leg Unlined;

Two additional Alternatives for review by the Forest are:

- Alternative 7 – Peg Leg, Combined; and
- Alternative 8 – Skunk Camp.

[2] The Forest use the term (Non-Potentially Acid Generating) NPAG tailings to refer to scavenger tailings described in the GPO (RC 2016a).
[3] The Forest uses (Potentially Acid Generating) PAG tailings to refer to cleaner tailings described in the GPO (RC 2016a), also referred to as pyrite tailings.

Alternative 3B utilizes a modified centerline raised cycloned sand embankment generated from the non-potentially acid generating (NPAG) scavenger (scavenger) tailings. The scavenger tailings deposited within the impoundment would be thickened and deposited in thin lifts to encourage drying through evaporation and limit the amount of water that enters the facility. This approach for scavenger tailings deposition would reduce the amount of water that are entrained within the tailings compared to an alternative with less thickened tailings, prevent formation of a pond on the scavenger tailings beach, and maximize evaporation; thus, minimizing seepage from the scavenger beach.

The potentially acid generating (PAG) pyrite (pyrite) tailings would be deposited subaqueously and stored in a segregated low-permeability cell located in the interior of the impoundment.

The scope of the Alternative 3B DEIS design is to provide a basis for comparing impacts from TSF alternatives. The design and report is tailored to meet the Forest's requirements for the EIS comparisons.

1.2 Key Elements of Alternative 3B

Key elements of Alternative 3B are summarized below. East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain the same as currently described in the GPO (RC 2016a), refer to Figure 1.1.

- The TSF would be located at the Near West site which is located within the Superior Basin entirely on Forest land, approximately 4 miles southwest of the town of Superior, and 4 miles south of the Superstition Wilderness Area. After site preparation, including removal of alluvial sediments, it would be founded on bedrock. The site is primarily used for livestock grazing, ranching, and road access to recreational areas. The Arizona Trail passes approximately ¾ mile east of where it follows Rice Water and Whitford Canyons into Reevis Canyon. Vegetation comprises mainly desert shrubs and cacti. The TSF would occupy the area of land bounded by Potts Canyon to the east, Roblas Canyon to the west and Queen Creek to the south.
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- A segregated pyrite tailings cell would be built within the TSF footprint (potentially contained by engineered low-permeability layers[4]) and separated from the scavenger tailings by splitter berms. The pyrite tailings cell would be placed over the low permeability bedrock foundation (Gila Conglomerate) where practical. The reclaim pond would be maintained within the pyrite tailings cell keep the pyrite tailings saturated to better control water quality concerns.
- Additional thickening and thin-lift deposition of the scavenger tailings that are not cycloned and the cyclone overflow would be done to reduce the volume of water entrained in the tailings and bleed water that must be reclaimed. This would reduce seepage into the foundation to manage downstream water issues. This approach would also reduce make-up water requirements by reducing losses at the TSF and prevent formation of a pond in the scavenger tailings cell.
- A series of mitigation measures intended to reduce downstream water quality impacts would be utilized, potentially including: selective engineered low-permeability layers; additional seepage collection dams; lined seepage collection ponds; slurry walls; pump back systems; stream diversion systems and cut-off walls. These mitigation measures and environmental protections will be refined between the DEIS and final EIS if this is the selected alternative.
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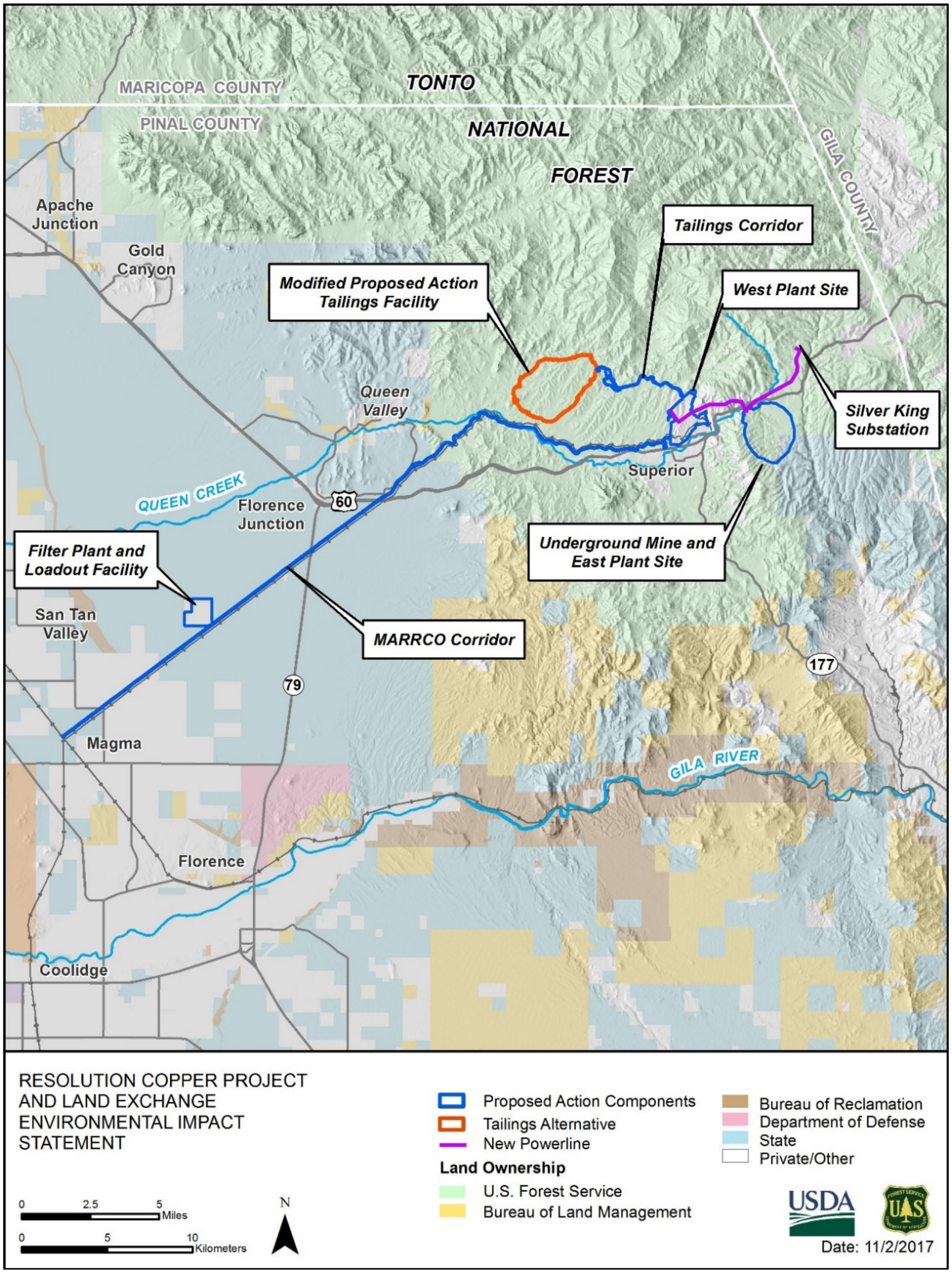
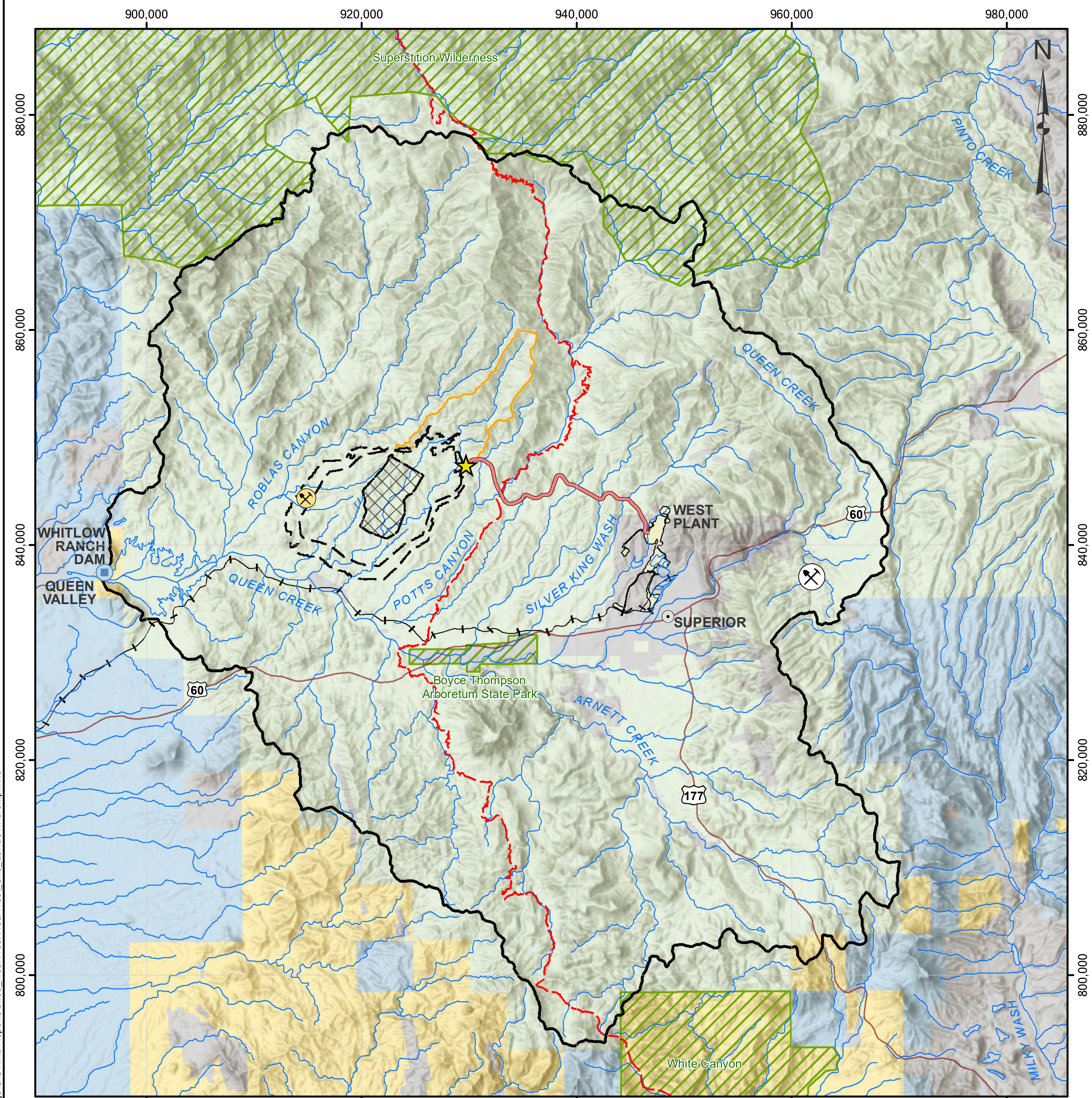
- Pyrite tailings would be pumped to the TSF rather than flow by gravity to increase reliability and reduced potential for pipeline upsets (i.e. sanding of the lines) and associated spills.

[4] Low-permeability containment details could comprise of one or more of the following: geomembrane liner, compacted fine tailings, asphalt core, slurry bentonite, cemented paste tailings, etc.

Figure 1.1 Site Location and Land Ownership Overview





LEGEND

- RESOLUTION OREBODY
- ALTERNATIVE 3B: NEAR WEST TSF
- PYRITE CELL
- TSF - WEST PLANT ACCESS ROUTE
- SUPERIOR BASIN
- TSF UPSTREAM CATCHMENT
- WEST PLANT
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- WILDERNESS AREA OR STATE PARK
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- WHITLOW RANCH DAM
- OLD BOMBOY MINE
- TOWN
- HIGHWAY
- RAILWAY
- RIVER OR MAJOR DRAINAGE

LAND OWNERSHIP

- BUREAU OF LAND MANAGEMENT
- BUREAU OF RECLAMATION
- COUNTY
- INDIAN RESERVATION
- LOCAL OR STATE PARKS
- MILITARY
- NATIONAL PARKS
- PRIVATE
- STATE TRUST LAND
- STATE WILDLIFE AREA
- UNITED STATES FOREST SERVICE

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. HILLSHADE PROVIDED BY ESRI
3. LANDUSE FROM THE ARIZONA BUREAU OF LAND MANAGEMENT (1:100,000) CURRENT AS OF DEC 19TH, 2012.

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DEIS DESIGN FOR ALTERNATIVE 3B - NEAR WEST MODIFIED PROPOSED ACTION (HIGH-DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE: SITE LOCATION AND LAND OWNERSHIP DETAILS

PROJECT No. M09441A20

FIG No. 1.2

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1.3 Previous Studies

There are several previous studies that are relevant to, and utilized in, the Alternative 3B design which include:

- The Alternative Portfolio for Alternative 3B (Forest 2018) provides a high-level overview of the conceptual design. This document was produced before much of the modeling or analysis presented in this report were complete.
- An embankment design alternatives trade-off to identify the preferred embankment design (KCB 2017a).
- A subsurface site investigation (SI) that included drilling and pit trenches was completed at the Near West site in 2016/2017.
    - KCB prepared a Geotechnical Site Characterization (KCB 2017b) based on the geotechnical information collected during the SI and subsequent laboratory testing.
    - Montgomery and Associates (M&A) observed and documented the hydrogeological SI (M&A 2017a) and prepared a hydrogeological site characterization report (M&A 2017b).
    - Duke Hydrochem collected samples of foundation rock units from the SI and tested them for geochemical characterization to support solute transport modeling (Duke 2017a).
- Geochemical characterization of scavenger and pyrite tailings (Duke Hydrochem 2016 and 2017b).
- Site-specific seismic hazard assessment conducted by Lettis Consultants International, Inc. (LCI) in 2017 (LCI 2017).

Aspects of these studies are discussed in this report. Reference should be made to the original reports for further information.

2 SITE CHARACTERIZATION

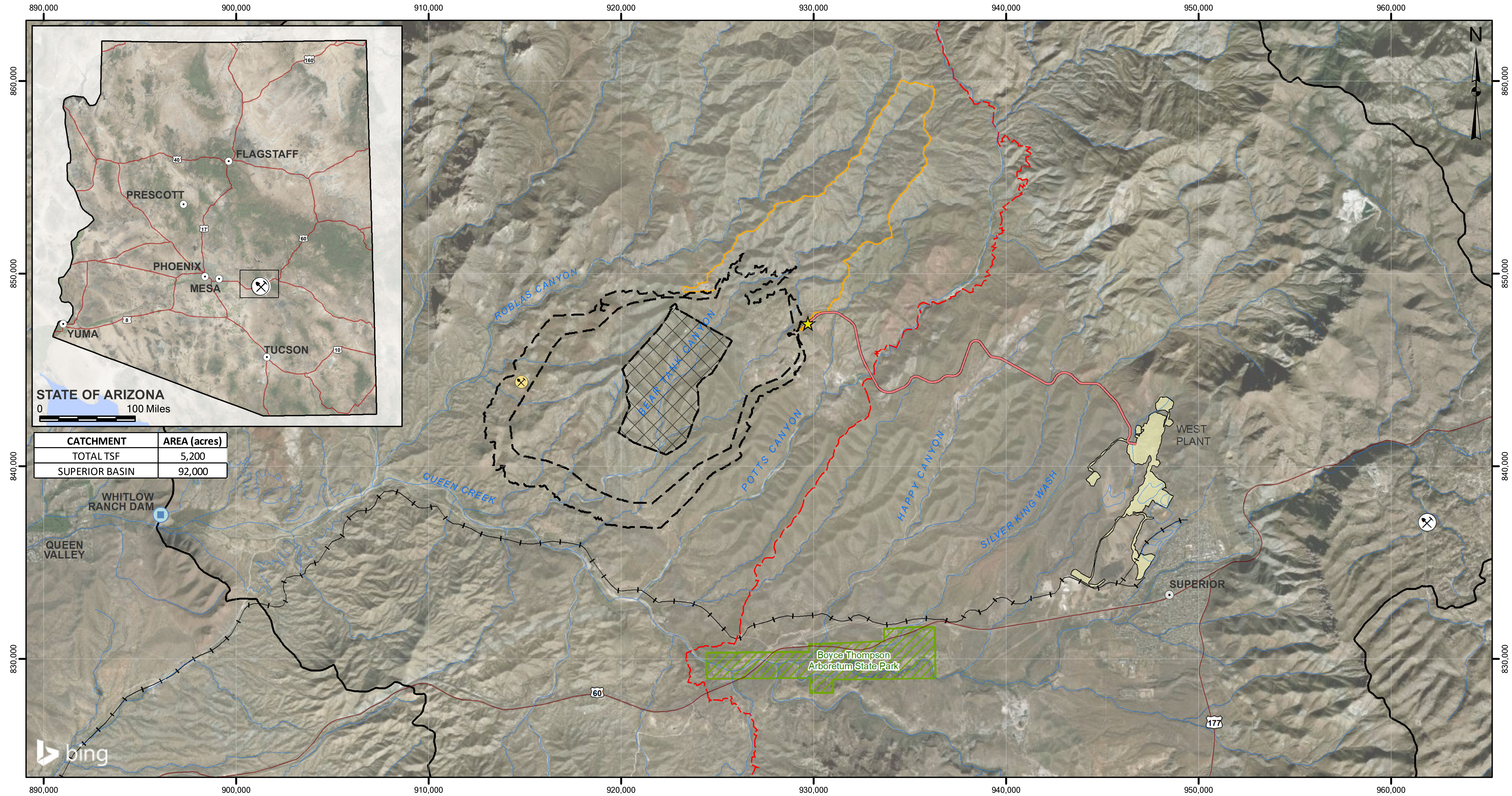
2.1 Setting & Topography

The Near West site is in the Superior Basin, which is drained by Queen Creek to the Whitlow Ranch Dam, refer to Figure 1.1 and Figure 2.1. The Superstition Mountains to the north of the site separate the site from the Superstition Wilderness Area.

The site is within the Basin and Range physiographic zone of Arizona (see Figure 2.2), near its northern boundary with the Central Highlands Transition physiographic zone, marked by the southern edge of the Superstition Mountains (Trapp and Reynolds 1995). The Basin and Range province is characterized by broad basins trending northwest-southeast, bounded by isolated mountain ranges composed of fault-block mountains formed during extensional faulting and crustal thinning (Rasmussen 2012). The Central Highlands Transition zone is a northwest trending escarpment marking the transition from the Colorado Plateau to the north with the Basin and Range province to the south. The Superior area is the northernmost extent of the Basin and Range province (Trapp and Reynolds 1995).

The Near West site is founded on a series of bedrock ridges and valleys up to 250 ft high, running north-south. The main valleys from east to west are Benson Canyon, Bear Tank Canyon and East Fork Roblas Canyon. The base elevation of the TSF area is approximately at 2,300 ft, and the northern extents rise up to 2,800 ft. The site is bounded on the east and west by Potts Canyon and Roblas Canyon, respectively, which reduces the size of the catchment area reporting to the TSF.

Within the TSF area, the valleys are ephemeral drainages, the bases of which are infilled with thin sand and gravel alluvial deposits. These streams flow north to south with slopes ranging typically from 3% to 5% and discharge to Queen Creek.



CATCHMENT	AREA (acres)
TOTAL TSF	5,200
SUPERIOR BASIN	92,000

LEGEND

- RESOLUTION OREBODY
- ALTERNATIVE 3B: NEAR WEST TSF
- PYRITE CELL
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- OLD BOMBOY MINE
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- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
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NOTES:
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2. IMAGERY PROVIDED BY ESRI/BING AERIAL IMAGERY
3. WATERSHEDS PROVIDED BY NATURAL RESOURCE CONSERVATION SERVICE.

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DEIS DESIGN FOR ALTERNATIVE 3B - NEAR WEST MODIFIED PROPOSED ACTION (HIGH-DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE
SITE LOCATION DETAILS

PROJECT No. M09441A20

FIG No. 2.1

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2.2 Land Use

The land management status for Near West and the surrounding area is shown on Figure 1.1 and Figure 1.2. The site is entirely on Forest land. Other key aspects of the Near West site, with respect to land-use, include the following:

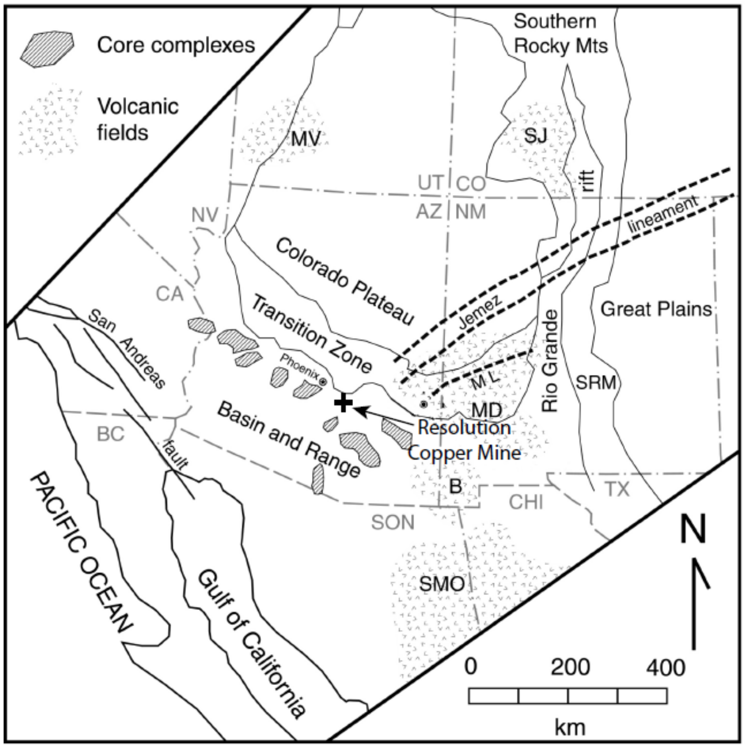
- The abandoned Bomboy Mine is located in the southwest corner of the site (see Figure 2.1). The mine consisted primarily of two tunnels and an upraise of 175 feet, connecting the back of the Main Tunnel to the ore vein cropping. In all, nearly 1,000 linear feet of mine development was completed between 1916 and 1971 (USGS 2018).
- The Arizona Trail passes approximately 3/4 mile east of the site through Rice Water Canyon and Whitford Canyon (see Figure 2.1).
- The site is bordered on the south by a section of private land and a railroad (which is owned by RC), beyond which lies Queen Creek and Highway 60 (both approximately 1/4 mile to 1/2 mile south of the site).
- The site is currently used primarily for livestock grazing, ranching and road access to recreational areas. Vegetation comprises mainly desert shrubs and cacti.
- There is one known cave present northwest of the site called Hawks Claw Cave (see Figure 2.3).

2.3 Seismicity

The Near West site is located in an area of low historic seismicity; 17 earthquakes within 124 miles are part of the seismic record that dates back to 1830. Only five of the recorded earthquakes have had a moment magnitude greater than 5. None of the recorded earthquakes have had a moment magnitude greater than 6.

A site-specific seismic hazard assessment was completed for the Near West site in 2017 (LCI 2017). That study calculated peak ground acceleration (PGA) and spectral acceleration at return periods up to 10,000-years and provided both uniform hazard spectra (UHS) and conditional mean spectra (CMS). The results indicated that the hazard from short period ground motions is controlled by the background seismicity (seismicity not associated with known faults) close to the site, whereas the distant San Andreas Fault (~250 miles from Near West, see Figure 2.2) influences the hazard for longer periods, similar to the period of most large earthfill structures. Earthquake design ground motions would be selected from this report for appropriate return period events.

Figure 2.2 Regional Seismic Zone (URS 2013)



Modified from: Drewes *et al.* (1985)

2.4 Regional Geology

The oldest rocks exposed in the area of the Near West site are facies of the early Proterozoic Pinal Schist (1.7 Ga) that forms the regional basement (Spencer and Richard 1995). Northeast of the site, most of the schist is pelitic, with compositional banding reflecting a combination of metamorphic differentiation and original bedding. This banding is tightly folded (isoclinal) at a small scale with fold axes parallel to the overall foliation plane (dips ~30 degrees to 60 degrees to the southeast) with granular differentiation of minerals. Southwest of the TSF, most of the schist is psammite facies, which transitions from an isoclinal folded and crenulated fabric in the west to a relatively planar fabric in the southeast due to complete transposition of the older fabric (Spencer and Richard 1995). The planar fabric also dips between 30 degrees and 60 degrees to the southeast.

Pinal Schist is disconformably overlain by the middle Proterozoic Apache Group (1.4 Ga to 1.1 Ga), comprising Pioneer Shale, Dripping Springs Quartzite, and Mescal Limestone. Apache Group rocks are highly fractured and in places brecciated as a result of distributed extensional deformation during the Tertiary (Spencer and Richard 1995). During the middle Proterozoic (1.1 Ga), the Apache Group was intruded by a diabase unit, causing contact metamorphism. Diabase generally intrudes along sills; however, throughout the Apache Group (Hammer and Webster 1962). The Apache Group is depositionally overlain by Paleozoic rocks including Cambrian Bolsa Quartzite (500 Ma) and Mississippian Escabrosa Limestone (350 Ma) as well as other limestone units (Spencer and Richard

1995). No rocks with ages between the Mississippian (350 Ma) and the middle Tertiary (34 Ma) are found in the area except Laramide granitic intrusives, that are not present within the footprint of the TSF.

Tertiary age extensional faulting was accompanied by the deposition of middle Tertiary age volcanic tuffs and flows, including Apache Leap Tuff (21 Ma to 19 Ma: Dickinson 1991), poorly welded Tuff, Rhyolite, and Basalt. Tertiary Gila Conglomerate and sandstone overlie the volcanics, except at the contact of these units, where they are locally interbedded.

2.5 Site Geology

The foundation of the Near West site is primarily underlain by bedrock of different age and origin incised by narrow drainage channels infilled with alluvial, colluvial and undifferentiated sediments. The early-Proterozoic Pinal Schist brackets the north and south ends of the site, and is exposed between the embankment and Queen Creek, in the south. The schist is overlain by the middle Proterozoic aged Apache Group which consists of siltstone, quartzite, limestone and minor conglomerate and basalt. The Apache group is often intruded by similarly aged diabase. Younger, Paleozoic limestone and quartzite units overlie the Apache Group near the western edge and northwest corner of the site. Tertiary volcanic units include tuff, basalt, and perlitic rhyolite, the last of which forms steep cliffs and ridges in the northeast corner of site. The central and eastern portions of the TSF are dominated by Tertiary aged Gila Conglomerate which forms ridges oriented north to south, separated by creek channels; the Gila Conglomerate covers approximately 55% of the TSF footprint. The Gila Conglomerate grades downslope into bedded sandstone in the southeast corner near Potts Canyon. Bedrock is generally exposed at the surface, with the exception of alluvial sediments in stream channels, and “Old Alluvium” deposits concentrated at the south end of the site at lower elevations.

A summary of the primary bedrock and overburden units at the Near West site are summarized below, arranged in order of age (youngest to oldest). Their distribution across the site is shown on Figure 2.3. A more detailed characterization of each unit is provided in the site characterization report (KCB 2017b), and the engineering significance of each is discussion in Section 6.

Quaternary Deposits

The quaternary deposits are unconsolidated soil deposits, and comprise the following:

- Recent Alluvium (Qal): Found in active drainage channels throughout the TSF footprint. Comprised mostly of sand and gravel derived from various rock units. Some clean deposits but fines content can range up to 40% in some areas.
- Old Alluvium (Qoa): Present throughout the TSF footprint on raised terraces adjacent to active channels. Comprised mainly of gravel, sand and fines, and may include intermediate and high plasticity clay deposits.

- Old Lacustrine (Qoa-Lu): Present in the SE corner of the TSF footprint, adjacent to Potts Canyon. Similar in composition to the Qoa but with higher clay content. Clay layers can be 2 ft to 4 ft in thickness.
- Undifferentiated Quaternary Deposits (Qs). Found in low relief areas and in relatively small drainages within the TSF footprint. The composition of this unit is similar to the Qal but typically with higher fines content, ranging from approximately 30% to 50%.

Gila Sandstone (Tss)

The Gila Sandstone is located in the southeast corner of the TSF footprint adjacent to Potts Canyon. Dominantly fine grained, sub-horizontally bedded fine to medium grained sandstone, with some bentonitic clay layers up to 3 mm thick present in the upper 30 ft of the unit.

Gila Conglomerate (Tcg)

Gila Conglomerate is the most widely distributed rock unit on site covering approximately 55% of the TSF footprint. The unit is comprised of sub-horizontal beds of variable composition, ranging from thin silty sand beds to thick massive beds comprised of a wide range of particle sizes from boulders to fines. The dominant grain size of the Tcg coarsens from south to north across the site. Rock quality designation (RQD) in the Tcg is typically high. Structural discontinuities in the Tcg are comprised of open or eroded sub-horizontal bedding planes and rarely observed sub-vertical joints.

Weathering is typically shallow and limited to the upper 30 ft based on drill hole results, although only a few feet of weathering was observed in test trenches.

Tertiary Basalt (Tb)

Tertiary Basalt outcrops at the southeast corner of site where it forms a tabular flow interbedded with Gila Conglomerate. It is a light to dark grey fine grained basalt with some zones of flow breccia. Weathering varies from fresh to moderate with no obvious correlation with depth. RQD ranges from 0% to 50% in the top 60 ft, increasing to 80% to 100% below 60 ft. The Tb is variably described as weak to strong rock (R2 – R4).

Rhyolite (Tp)

Exposed Rhyolite at the northeast corner of site forms prominent bluffs and escarpments. It is predominantly glassy, aphyric perlitic rhyolite with zones of flow brecciation, fracturing and vesicles, and zones of flow banding. It ranges from slightly to moderately weathered. RQD is highly variable, typically ranging from 15% to 80% in the top 100 ft. Below 100 ft it is typically 100% but can be as low as 30%. Intact rock classifies as very weak to medium-strong (R1 to R3).

Tuff (Tt and Tal)

Tertiary tuffs (Apache Leap – Tal and Poorly Welded Tuff – Tt) are widely distributed across the north and south sides of the site. The Tal is exposed in areas of high relief and forms prominent bluffs and escarpments, whereas the Tt is exposed in areas of low relief. The tuffs are dominantly strongly welded and crystalline and show only moderate weathering, however local examples of Tt completely weathered to hard clay were observed outside of the TSF footprint in drill core. RQD is typically greater than 50%, and in most cases it is 100%. Joints vary from open to closed. The tuffs classify as strong rock (R3 to R4) for samples tested within the TSF footprint.

Escabrosa Limestone (Me)

This unit is not exposed within the TSF footprint and was not encountered during the drilling programs. However, it may be present at depth based on the geologic sequence and is therefore included in this summary.

Martin Limestone (Dm)

Exposed along the west side of the site, within the TSF footprint, this unit is exposed in steep bluffs or ridges. It was not encountered during the drilling program, but observations of outcrops indicate that the rock is fresh, comprised of dipping beds and is closely jointed, parallel to bedding and sub-vertical and is medium strong to very strong (R3-R5).

Bolsa Quartzite (Cb)

Exposed along the west side of the site, within the TSF footprint, this unit is exposed in steep bluffs or ridges. It was not encountered during the drilling program, but observations of outcrops indicate that the rock is fresh and generally comprised of medium to coarse grained quartzite rich sandstone in massive or crudely graded beds interbedded with medium to fine grained, cross bedded and planar bedded sandstone with dark tan to brown laminations. The unit is very closely fractured, parallel to bedding and sub-vertical, and medium strong (R2-R3).

Diabase (Yd)

Exposed in the northwest, north, and northeast portions of the TSF footprint, this unit forms the majority of faulted blocks of Apache Group rocks. At surface the unit is weathered to a regolith and is highly weathered and closely fractured to a depth of up to 60 ft. RQD varies from 0% to 100% from surface to 140 ft. Below 140 ft RQD is typically greater than 50% and often 100%. Below the upper weathered zone, rock strength is weak to medium strong rock (R2-R3).

Mescal Limestone (Ym)

Exposed in the western edge of the TSF, and in fault blocks in the northern portion of the TSF footprint, this unit is composed of massive to laminated calcareous siltstone, with prominent zones of healed brecciation and silicification. RQD is generally greater than 60%, but less than 100%. It is typically fresh, with rare zones of highly weathered rock, especially at contacts with diabase, where zones of dissolution may occur. Core descriptions of strength found medium strong to strong rock (R3-R4).

Dripping Spring Quartzite (Yds)

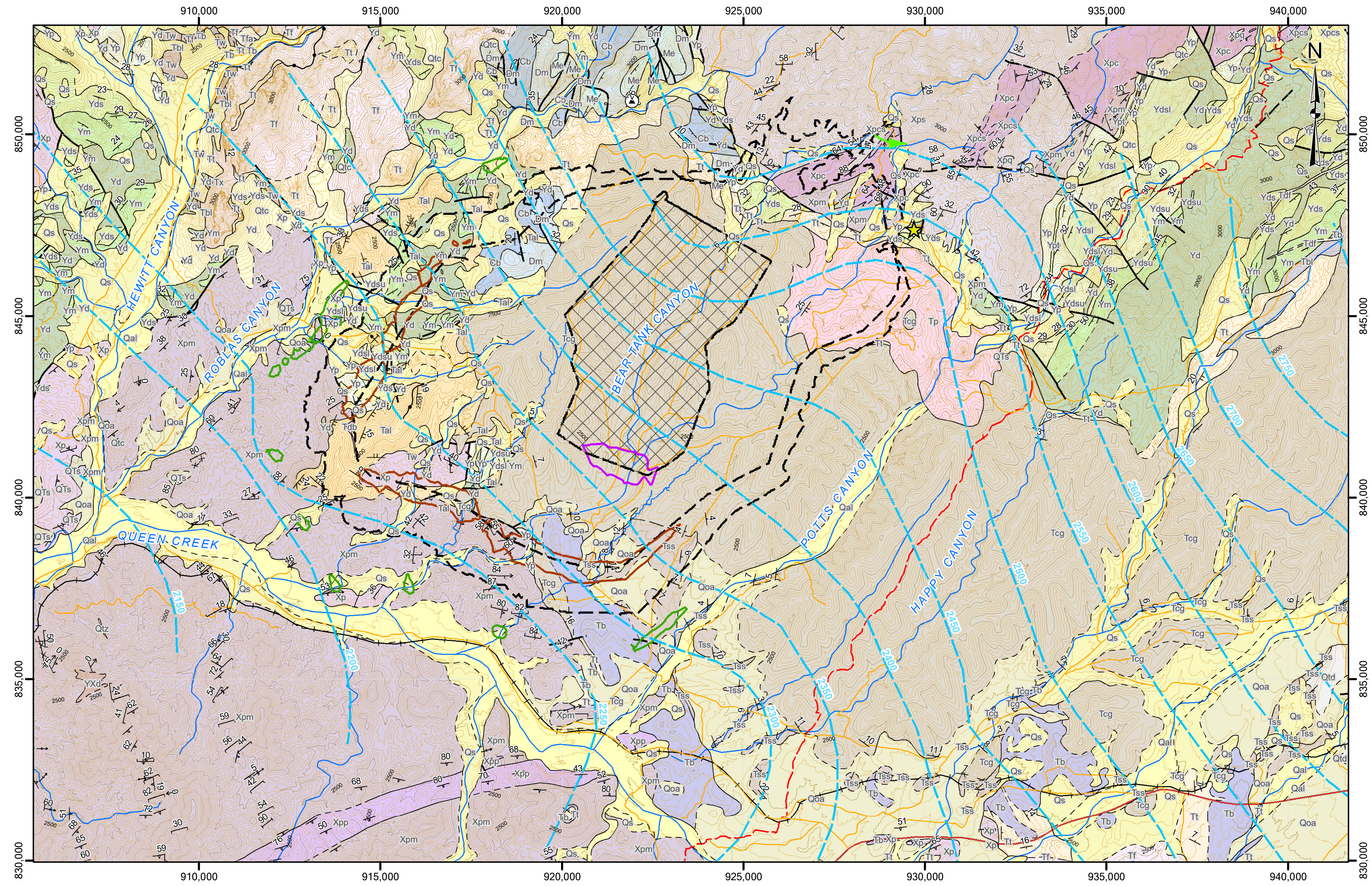
This unit is exposed within fault blocks on the western, southwestern, and northern edge of the TSF footprint. It is composed of laminated siltstone grading downwards into very fine grained sandstone and coarse grained quartzite. Prominent zones of brecciation are observed at the surface and in drill holes. RQD is variable between 40% and 90%, with occasional zones as low at 0%. Core descriptions classify intact Yds as weak to medium strong rock (R2-R3). Yds is typically moderately weathered.

Pioneer Shale (Yp)

This unit is exposed within fault blocks on the western, southwestern, and northern edge of the TSF and is typically recessive and forms relatively flat areas with little exposed rock or moderate talus slopes. Pioneer shale is composed of deep reddish brown siltstone and fine grained sandstone. RQD is low, and typically 0% to 100 ft depth; below that RQD is variable between 20% and 80%. Strength is very weak to weak rock (R1-R2).

Pinal Schist (Xp)

Pinal Schist is widespread at the surface along the southern and northern margins of the TSF footprint. Along the southern margin of the proposed TSF, areas underlain by Pinal Schist are low rolling ridges and broad drainages. To the north, schist underlies the foothills of the Superstition Mountains with steep canyons and ridges. Schist is medium to fine grained, low to moderate grade metamorphic rock. Generally, Pinal Schist is very closely fractured and broken with common zones of gouge and crushed rock in core samples. RQD is typically low (often zero) with alternating zones of very closely fractured rock, and zones of more widely fractured rock, with no clear trend with depth. Foliation-parallel defects are dominant, and persistence is variably low to high (1 m to 20 m). Joint surfaces are rough to smooth, with some slickensided, highly weathered surfaces with clay gouge. Intact zones of Pinal Schist are medium strong to strong rock (R3-R4); however, much of the core is very weak rock (R1) that was too weak to test.



GEOLOGICAL UNITS

Qs	Undivided Surficial Deposits (Quaternary)
Qtd	Disturbed Surficial Deposits (Holocene)
Qtc	Talus and Colluvium (Quaternary)
Qal	Unconsolidated Alluvium (Quaternary)
Qoa	Old Alluvium (Quaternary)
QTs	Older Alluvium (Early Quaternary to Late Tertiary)
Tcg	Conglomerate (Pliocene to Late Miocene)
Tss	Sandstone (Pliocene to late Miocene)
Tb	Basalt (Mid-Miocene to Early Miocene)
Tp	Perlitic Aphyric Rhyolite (Middle Tertiary)
Tal	Apache Leap Tuff (Early Miocene)
Tt	Tuff (poorly welded) (Miocene)
Tf	Felsic Volcanic Rocks, undivided (Middle Tertiary)
Tbl	Lower Basalt (Middle Tertiary)
Tx	Rock Avalanche or Talus Breccia (Middle Tertiary)
Tw	Whitetail Conglomerate
Tdb	Basaltic Dikes (Middle Tertiary)
Kd	Quartz Diorite (Latest Cretaceous)
Me	Escabrosa Limestone (Mississippian)
Dm	Martin Limestone (Devonian)
Cb	Bolsa Quartzite (Cambrian)
Yd	Diabase (Middle Proterozoic)
Ym	Mescal Limestone (Middle Proterozoic)
Yds	Dripping Spring Quartzite, undivided (Middle Proterozoic)
Ydsu	Dripping Spring Quartzite, Upper Unit (Middle Proterozoic)
Ydsl	Dripping Spring Quartzite, Lower Unit (Middle Proterozoic)
Yp	Pioneer Shale (Middle Proterozoic)
Ypt	Pioneer Shale, Tuff Unit (Middle Proterozoic)
YXd	Diorite (Early or Middle Proterozoic)
Xp	Pinal Schist, undivided (Early Proterozoic)
Xpc	Pinal Schist, Calc-silicate Facies (Early Proterozoic)
Xpcs	Pinal Schist, Calc-silicate and Schist Facies (Early Proterozoic)
Xpm	Pinal Schist, Psammite Facies (Early Proterozoic)
Xpp	Pinal Sctist, Phyllite Facies (Early Proterozoic)
Xpq	Pinal Schist, Quartzite Layers (Early Proterozoic)
Xps	Pinal Schist, Pelitic Schist (Early Proterozoic)

LEGEND

- ALTERNATIVE 3B: NEAR WEST TSF
- PYRITE CELL
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- SCAVENGER STARTER DAM
- PRIMARY SEEPAGE COLLECTION DAM
- PYRITE STARTER DAM
- CLOSURE SPILLWAY
- OLD BOMBOY MINE
- HAWKS CLAW CAVE

TRANSPORTATION
- ROAD
- HIGHWAY
- RAILROAD
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)

- FELSIC DYKE
- FAULT
- FAULT - APPROXIMATE
- FAULT - CONCEALED
- MARKER HORIZON (LOCAL)
- CONTACT (BETWEEN GEOLOGIC UNITS)
- CONTACT - APPROXIMATE
- CONTACT - INFERRED
- GROUNDWATER LEVEL CONTOURS
- CONTOUR (20ft)
- CONTOUR (100ft)

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. REFER TO REPORT FOR SOURCE OF GEOLOGY
3. GROUNDWATER CONTOURS ACQUIRED APRIL, 2017. PROVIDED BY MONTGOMERY & ASSOCIATES. DEPTH BASED ON STABALIZED GROUNDWATER LEVELS IN THE AREA

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

0 — 1 Mile

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PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3B - NEAR WEST MODIFIED PROPOSED ACTION (HIGH-DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE: SITE GEOLOGY

PROJECT No. M09441A20 | FIG No. 2.3

Z:\MV\CR\M09441A20 - RES-Near West PFS-PES\400 Drawings\GIS\Mxd\Reports\all3b_NearWest\NearWest_Site_Geology.mxd 2018-04-05 10:42:06 AM

2.6 Site Hydrogeology

M&A completed a conceptual hydrogeologic model for the Superior Basin with a focus on the Near West site (M&A 2017b). The following elements of the conceptual model have been taken directly from the hydrogeological conceptual model report (M&A 2017b):

- The Superior Basin is drained by Upper Queen Creek from its headwaters to an earthen dam known as Whitlow Ranch Dam. Land surface in the basin ranges from 5,560 ft above mean sea level (amsl) in the mountainous terrain north of Superior to 2,056 ft amsl at the inlet of Whitlow Ranch Dam. The proposed TSF is in the lowlands of the basin adjacent to an ephemeral reach of Queen Creek. Groundwater leaving the basin is forced to land surface at Whitlow Ranch Dam by a truncation of shallow unconsolidated deposits and narrowing of the bedrock geometry.
- Tests conducted in Gila Conglomerate and Pinal Schist indicate a negative correlation between hydraulic conductivity and test interval depth. Below a depth of 100 ft, the geomean of hydraulic conductivity for all tests in Gila Conglomerate decreases from 7.3×10^{-6} cm/s to 7.9×10^{-7} cm/s; the geomean for all tests in Pinal Schist decreases from 2.6×10^{-5} cm/s to 2.7×10^{-6} cm/s. In both cases, the geomean of tests conducted above 100 ft versus below 100 ft differs by approximately an order of magnitude.
- Preliminary results of aquifer testing in the Quaternary alluvial deposits indicate that the hydraulic conductivity of the alluvium is on the order of 1.0×10^{-1} cm/s, several orders of magnitude greater than the hydraulic conductivity of the bedrock units. Consequently, the alluvial deposits represent relatively more conductive pathways for groundwater movement through the Superior Basin.
- Measured groundwater levels within the basin approximately mimic the shape of the topography, decreasing in elevation from the highlands around the northern, eastern, and southern boundaries of the basin toward Whitlow Ranch Dam in the west.
- Horizontal hydraulic gradients vary across the site. The gradient is notably reduced along the Queen Creek alluvium and within the perlite near the northeastern corner of the proposed TSF. The flattening of gradients in these two areas is caused by higher hydraulic conductivities in these two hydrogeologic units.
- With few exceptions, existing vertical hydraulic gradients in the proposed TSF foundation are upward which is understood to be indicative of recharge, occurring in the uplands, flowing along deeper groundwater flow paths until reaching the higher conductivity alluvial sediments in drainages.
- Groundwater evapotranspiration occurs in stream channels where deep-rooted riparian vegetation draws water from shallow groundwater within the stream channel alluvial deposits.
- A broad range of water chemistries exist in the Superior Basin. This is attributed to the complex and varied hydrogeology in the basin.

- Waters sampled from the alluvial units are of calcium-bicarbonate composition.
- Water sampled from the upper 100 ft of the Gila Conglomerate, Apache Group, Pinal Schist and alluvials have similar chemistry. Isotopic analyses indicate that water sampled from a shallower depth are younger than water sampled from depths greater than 100 ft. The test data support that shallower waters are more active which is consistent with the vertical distribution of hydraulic conductivities.
- Based on a groundwater balance for the basin, prepared by M&A (2017b), precipitation-derived recharge makes up 95% of the inflow to the basin, the remaining 5% is treated effluent from the Superior Waste Water Treatment Plant. Treated water is sourced from outside the basin. Groundwater evapotranspiration (42%) and discharge through Whitlow Ranch Dam (43%) are the primary groundwater outflows from the basin. Groundwater pumping accounts for the remaining 15%.

2.7 Climate and Hydrology

The Near West site is within a semi-arid climate zone with low average annual precipitation (18 inches) and high estimated average annual potential evapotranspiration, or PET (72 inches). The annual average temperature is 69°F and daily temperatures typically range from 40°F to 100°F.

The region experiences three seasonal types of precipitation event (Applied Weather Associates 2013), comprising the following:

- Winter storms that occur during October through March. These are typically long duration, low intensity events.
- Summer monsoonal storms that occur during June through September. These are typically short duration, high intensity thunderstorms, and are common throughout the monsoon season.
- Tropical storms that occur during August through October. These are rare events but produce the most extreme rainfalls in southern Arizona. They are the dying remnants of oceanic tropical storms and typhoons and are typically moderate duration (~24 hrs), high intensity events.

Refer to the design basis memorandum (DBM) in Appendix I for details on design storm events.

In its current state, drainage at the site occurs through a series of roughly north-south oriented valleys (or canyons) that report to Queen Creek in the south. These drainage valleys are ephemeral streams that are typically dry, but are locally fed by springs.

There are numerous springs and seeps that have been identified within Superior Basin (M&A 2017b). The springs located within the Near West site (Bear Tank Canyon Spring and Benson Spring) have flows less than 2 gpm, and are often dry. There is no evidence to suggest the Perlite Spring located in the perlitic rhyolite in the northeast is a natural spring. It is formed by an impoundment located at the base of a former perlite quarry.

3 TAILINGS CHARACTERIZATION

3.1 Tailings Types

The Resolution project will generate two physically, mineralogically and geochemically discrete tailings streams known as scavenger tailings and pyrite tailings; scavenger tailings will account for approximately 84% of tailings produced by weight and pyrite tailings the remaining 16%.

KCB (2018) has summarized the existing geotechnical laboratory testing data for the tailings and geotechnical characterization for the DEIS design.

Duke HydroChem (2016 and 2017b) summarized the tailings geochemical laboratory data and characterization for the DEIS design (Duke Hydrochem 2016 and 2017b).

3.2 Geochemical

The scavenger tailings contain a very low percentage of pyrite (with a mean sulfide content of less than 0.1% by weight) and low neutralization potential. Additionally, the release of acidity, sulfate and metal/metalloids from the scavenger tailings is limited by the very low sulfide and residual metal contents (Duke HydroChem 2016).

The pyrite tailings contain a much higher percentage of pyrite (>20% by weight) and are classified as PAG (Duke HydroChem 2016). The pyrite tailings' specific gravity ranges from 3.23 to 4.33, with an average of 3.87, which reflects the variability in high-density pyrite content of the samples.

3.3 Geotechnical

Geotechnical properties of the tailings for the DEIS were characterized based on laboratory testing, literature review and comparison with similar projects, refer to Table 3.1 and Table 3.2. Key comments regarding the tailings geotechnical characterization are as follows:

- Properties (particle size distributions, plasticity, specific gravity, consolidation behavior, and hydraulic conductivity) of the pyrite tailings and scavenger "total" tailings were measured in the laboratory. The same suite of testing was performed on the scavenger "beach" and scavenger "fines" tailings, except for consolidation.
- Properties of the cycloned sand and cyclone overflow were estimated from numerical cyclone simulations, pilot-scale cyclone tests, and comparison of scavenger and pyrite tailings index properties with those at other sites.
- The scavenger beach "composite" is not a discrete tailings type, rather an interlayered deposit of scavenger tailings and cyclone overflow that will form the tailings beach. Properties of the composite beach were guided by the characterization of the other tailings types, with consideration for the method of deposition and experience on other projects.
- Shear strength values were estimated based on similar materials at other mines including Bingham Canyon Mine (Kennecott), Pinto Valley Operations and a literature review.

- Average consolidated tailings densities for slurry tailings were selected based on large-strain consolidation testing and KCB experience on similar projects.
- The compacted density of cycloned sand was estimated using the specific gravity of the tailings and a typical void ratio for compacted sand with a similar gradation.

Further details on tailings characterization and engineering design property selection are reported in KCB (2018a).

Ranges or “base case” values are provided for engineering design properties based on laboratory testing and case histories.

Engineering design properties based on the tailings characterization are summarized in Table 3.1. Ranges of values are specified for hydrogeological properties (Table 3.2). Engineering properties have been selected from available characterization data with specific consideration to the objectives of the analysis.

Table 3.1 Summary of Tailings Engineering Properties used in Design Assessments

<table>
<tr><th rowspan="2">Material</th><th rowspan="2">Specific Gravity[1]</th><th rowspan="2">Atterberg Limits[1,4]</th><th rowspan="2">USCS Class</th><th colspan="2">Particle Size Distribution[2]</th><th rowspan="2">Deposition Method</th><th rowspan="2">Dry Unit Weight for Tailings Staging (pcf)[3]</th><th rowspan="2">Effective Friction Angle (ϕ’)</th><th rowspan="2">Peak Undrained Shear Strength Ratio (Su-p/σ’v)</th><th rowspan="2">Liquefied Undrained Shear Strength Ratio (Su-LIQ/σ’v)</th></tr>
<tr><th>% fines <74 micron</th><th>% clay <2 micron</th></tr>
<tr><td>Pyrite Tailings</td><td>3.87</td><td>LL: 18%
PI: 3%</td><td>ML</td><td>80</td><td><20</td><td>Subaqueous deposition at 50% solids content</td><td>106</td><td>27°</td><td>0.2</td><td>0.05</td></tr>
<tr><td>Scavenger “Total” Tailings</td><td rowspan="6">2.78</td><td rowspan="6">LL: 20%
PI: 1%</td><td>ML</td><td>50</td><td><10</td><td rowspan="3">Subaerial or subaqueous deposition at 65% solids content</td><td rowspan="2">87</td><td rowspan="5">32°</td><td rowspan="5">0.25</td><td rowspan="5">0.1 (base case); 0.05 (sensitivity)</td></tr>
<tr><td>Scavenger “Beach” Tailings</td><td>SM</td><td>25</td><td>2</td></tr>
<tr><td>Scavenger “Fines” Tailings</td><td>ML</td><td>94</td><td>7</td><td rowspan="3">81</td></tr>
<tr><td>Cyclone Overflow</td><td>ML</td><td>90</td><td>15</td><td>Subaerial or subaqueous deposition at 50% to 60% solids content</td></tr>
<tr><td>Scavenger Beach “Composite”</td><td>-</td><td>-</td><td>-</td><td>Mixture of spigotted scavenger tailings and cyclone overflow</td></tr>
<tr><td>Cycloned Sand</td><td>SP-SM</td><td><20</td><td>0</td><td>Discharged to hydraulic cells at 60% solids content and compacted</td><td>113</td><td>34°</td><td>N/A</td><td>N/A</td></tr>
</table>

Notes:

1. Represent averages from the tailings tested or cyclone numerical simulations.
2. “Beach” and “Fines” values directly measured from laboratory testing. For rationale behind values selected for other materials refer to the DBM (Appendix I)
3. For long-term, consolidated dry density estimates to be used in other analyses, refer to Appendix II.
4. LL = Liquid Limit; PI = Plasticity Index.
5. Su-p = peak undrained strength; Su-LIQ = liquefied undrained strength; and σ’v = vertical effective stress.

Table 3.2 Summary of Engineering Hydraulic Parameters

Material	Horizontal Saturated Hydraulic Conductivity k_h (cm/s)	Anisotropy Ratio k_h/k_v	Total Porosity n_{total}	Effective Porosity $n_{effective}$	Specific Yield S_y
Pyrite Tailings	1×10^{-6} to 1×10^{-7}	1 to 10	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Scavenger “Total” Tailings	5×10^{-5} to 5×10^{-6}	1 to 10	0.30 to 0.40	0.25 to 0.40	0.20 to 0.30
Scavenger “Beach” Tailings	5×10^{-4} to 5×10^{-5}	1 to 10	0.30 to 0.40	0.25 to 0.40	0.25 to 0.35
Scavenger “Fines” Tailings	1×10^{-6} to 1×10^{-7}	1 to 10	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Scavenger Beach “Composite”	5×10^{-5} to 5×10^{-6}	10 to 100	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Cyclone Overflow	1×10^{-6} to 1×10^{-7}	1 to 10	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Cycloned Sand	5×10^{-2} to 1×10^{-3}	1 to 10	0.30	0.30	0.30

3.4 Tailings Deposition Slopes

Tailings deposition slopes are a function of particle size distribution, percent solids of discharged slurry, specific gravity, spigot design/arrangement, distance from deposition point and whether tailings will be deposited subaerially or sub aqueously. Slopes should be monitored regularly during operations and the tailings deposition plan adjusted as required. Deposition slopes for discharged slurry tailings adopted for deposition modeling are summarized in Table 3.3. They were chosen based on review of case history data from operating cycloned sand tailings impoundments and subaqueous pyrite tailings facilities.

Table 3.3 Tailings Slopes

Tailings Type	Tailings Slopes	Justification
Scavenger Beach "Composite"	Above Water: 1% for the first 1,500 ft, 0.5% after 1,500 ft Below Water: not applicable for Alternative 3B	Based on topography and bathymetry surveys from two large, cycloned sand impoundment beaches and slopes below water. These facilities have long exposed beaches, up to five miles.
Pyrite Tailings	Below Water: 10.0% for the first 100 ft, 0.5% after 100 ft	Based on topography and bathymetry surveys of subaqueous disposal of high-pyrite tailings from floating barges.

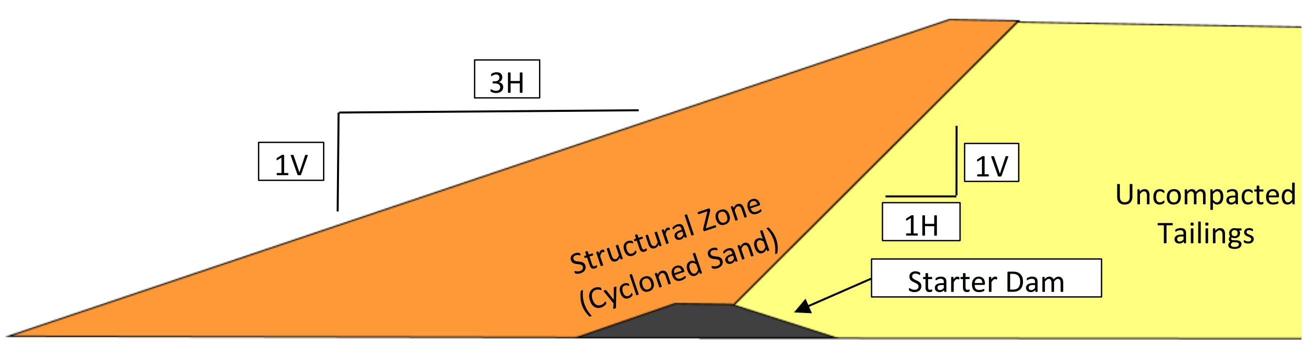
4 DESIGN BASIS

4.1 General

The DBM, refer to Appendix I, was developed with input and agreement from RC. A summary of key design basis and objectives are outlined below; however, the DBM (Appendix I) should be referenced for further details.

- The pyrite tailings are to be deposited subaqueously from a floating barge and remain saturated throughout operations. This is done to reduce potential for acid rock drainage (ARD) and metal leaching (ML) that can be triggered by pyrite tailings exposure to water and oxygen (Duke 2017b).
- The scavenger tailings not sent to the cyclones and cyclone overflow are to be additionally thickened as much as practical at the TSF and deposited in thin lifts to increase evaporation of slurry water and prevent formation of a water pond. The goal of this approach is to reduce seepage into the foundation to manage downstream water quality.
- For stability analysis, all potentially liquefiable contractive tailings are assumed to liquefy regardless of the triggering mechanism.
- The design cross section for the perimeter embankment includes an outer compacted cycloned sand structural zone that is raised using a modified-centerline approach (Figure 4.1).
    - The modified-centerline approach was found to be preferred based on a trade-off study of several cross sections and raise methods (KCB 2017a) because of the design resiliency, and benefits for progressive reclamation.
- The downstream slope of the cycloned sand embankment was set to 3H:1V based on the results of stability analyses (KCB 2017a). Localized flattening or excavation of weak foundation layers, may be required to meet stability criteria in all areas.
- Available "best practice" management methods to reduce seepage as much as practical are included in the DEIS design at this preliminary stage.

Figure 4.1 Modified Centerline Schematic



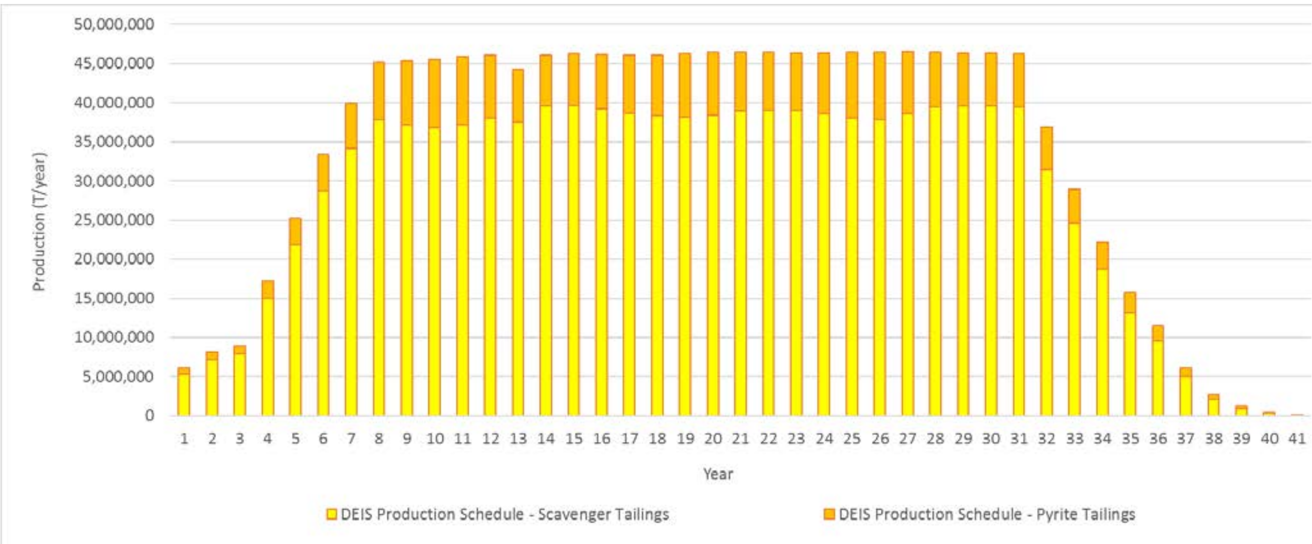
4.2 Tailings Production Rate

The tailings production schedule is summarized in Table 4.1 and illustrated on Figure 4.2.

Table 4.1 Production Schedule Summary

Item	Production Schedule
Scavenger Tailings	1,151 Mtons
Pyrite Tailings	220 Mtons
Total Tailings (Scavenger and Pyrite)	1,371 Mtons
Percentage of Pyrite Tailings by Mass	16%
Number of Production Years	41

Figure 4.2 Annual Tailings Production Schedule Comparison



4.3 BADCT Approach

The TSF would apply for an Aquifer Protection Permit (APP) with an "individual" Best Available Demonstrated Control Technology (BADCT) approach, which is performance based, and allows the applicant to select from all available Demonstrated Control Technologies (DCTs) that constitute BADCT. This process considers site specific characteristics, operational controls, and other DCTs.

Under the individual BADCT approach, the TSF is considered a "tailings impoundment" and will be designed in accordance with Section 3.5 of the BADCT manual (ADEQ 2005). The seepage dams are considered to be "surface ponds" and will be designed in accordance with Section 3.6 of the BADCT manual (ADEQ 2005) and the regulations pertaining to water dams (A.A.C. R12-15).

5 TAILINGS MANAGEMENT PLAN

5.1 TSF Features

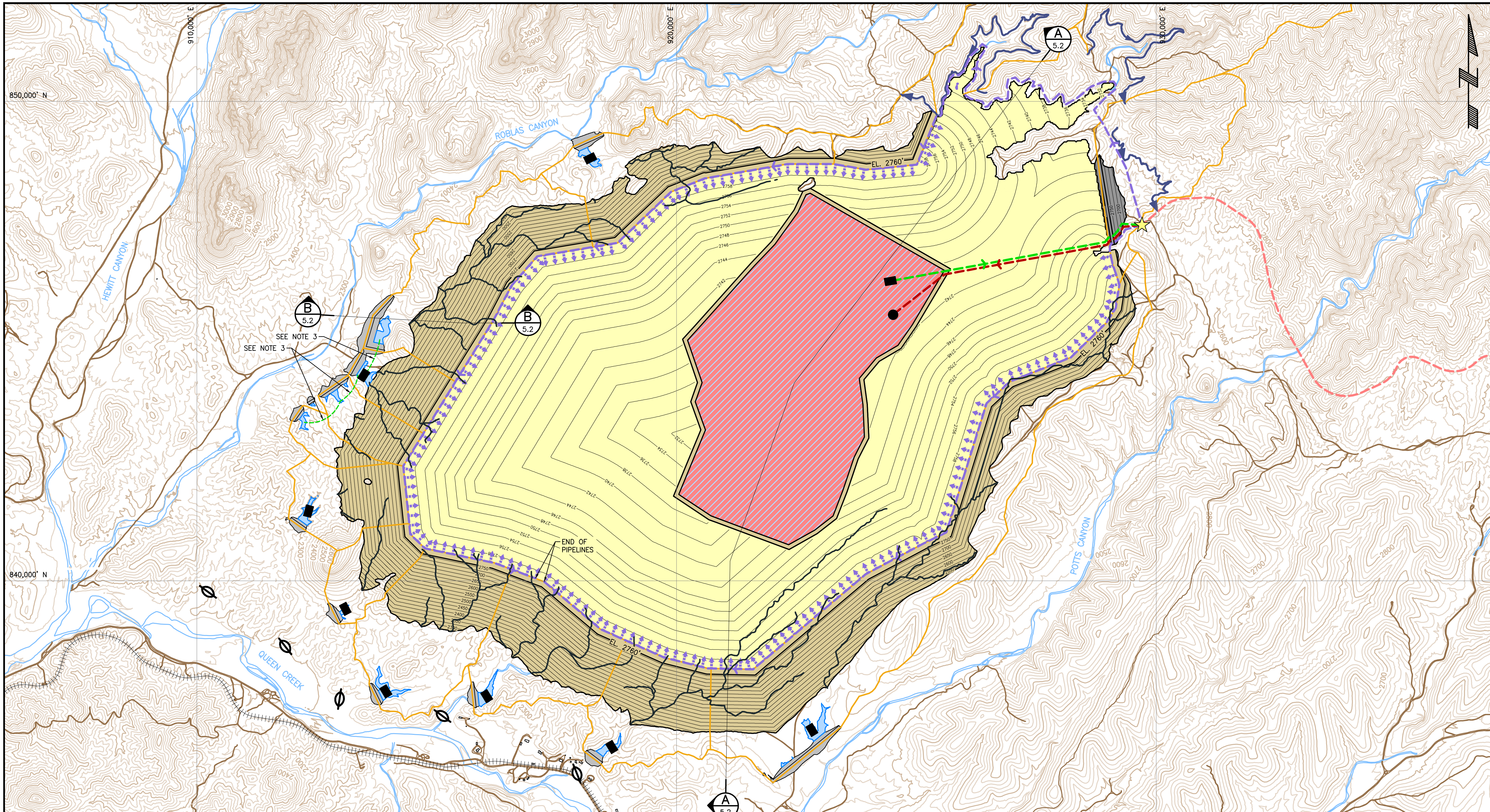
Key features of the TSF during start-up and operations include the following:

- A general fill borrow area and rhyolite quarry developed within the TSF footprint to provide a construction fill source for starter dams, drains and erosion protection.
- A compacted, cycloned sand embankment that forms the perimeter of the impoundment.
- Earthfill starter dams to facilitate tailings placement before the cycloned sand embankment is established.
- An earthfill North Dam constructed at the north end of facility to retain the tailings.
- A segregated, low permeability pyrite cell (contained by a splitter berm) within the TSF footprint which retains the pyrite tailings and the reclaim pond.
- An underdrain system comprised of a sand and gravel blanket drain and rockfill finger drains that underlies the cycloned sand embankment and a portion of the tailings beach.
- Diversion channels upslope of the impoundment to divert non-contact water around the facility.
- A tailings delivery system that delivers scavenger total tailings and pyrite tailings to the TSF for deposition.
- A reclaim pond maintained within the pyrite cell to provide water for the cyclone system, pyrite tailings saturation and reclaim to the West Plant.
- A pond reclaim system that comprises a floating pump barge and the mechanical and electrical infrastructure to reclaim water to the West Plant.
- A pyrite tailings deposition barge and associated pipelines and support systems located within the pyrite cell to facilitate subaqueous deposition of pyrite tailings.
- A cyclone system that receives a portion of scavenger total tailings at a cyclone house and processes it to produce cyclone underflow (cycloned sand) for embankment construction. A by-product of this operation is cyclone overflow which is thickened before being deposited into the TSF impoundment.
- Tailings thickeners located at the TSF for the scavenger tailings (total that is not cycloned and cyclone overflow) prior to deposition in the TSF.
- All components of the seepage management system comprise the items listed below, refer to discussion on seepage management in Section 8:
  - Eleven primary seepage collection dams (SCDs) and five auxiliary seepage collection dams (ASCDs) constructed in natural valleys downstream of the cycloned sand embankment and their associated seepage collection ponds (SCPs).

- Foundation treatment and, potentially, an engineered low-permeability layer[5] placed over more permeable portions of the foundation.
- A grout curtain installed around the perimeter of the TSF, between the SCDs.
- Associated mechanical and electrical infrastructure required to return collected seepage water to the reclaim pond.

The majority of these features are shown on Figure 5.1 and Figure 5.2. The potential areas of the foundation that could be treated (that may include engineered low-permeability layers) are shown on Figure 8.1.

[5] The engineered low-permeability layer could be comprised of one or more of the following: compacted fine tailings, geomembrane liner, asphalt, slurry bentonite and/or cemented paste tailings.



LEGEND

- DIVERSION CHANNEL
- RAILWAY
- EXISTING ROAD
- MAJOR NATURAL DRAINAGE
- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
- SCAVENGER TAILINGS DISCHARGE
- CATCHMENT BOUNDARY
- FINGER DRAINS
- CYCLONE HOUSE AND ACCESS ROUTE TIE–IN POINT
- RECLAIM BARGE
- FLOATING PYRITE TAILINGS DEPOSITION BARGE
- SCAVENGER PIPELINE
- PYRITE PIPELINE
- WATER PIPELINE
- ACCESS ROUTE TO WEST PLANT
- SCAVENGER CYCLONED SAND EMBANKMENT AND SPLITTER BERM
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER MIXTURE)
- PYRITE TAILINGS
- TSF RECLAIM POND
- SCD POND

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. POTENTIAL EXCAVATION (TO FILL) OR PUMP AND PIPELINE.

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

1000 0 1000 FT

CLIENT: RESOLUTION COPPER

Klohn Crippen Berger

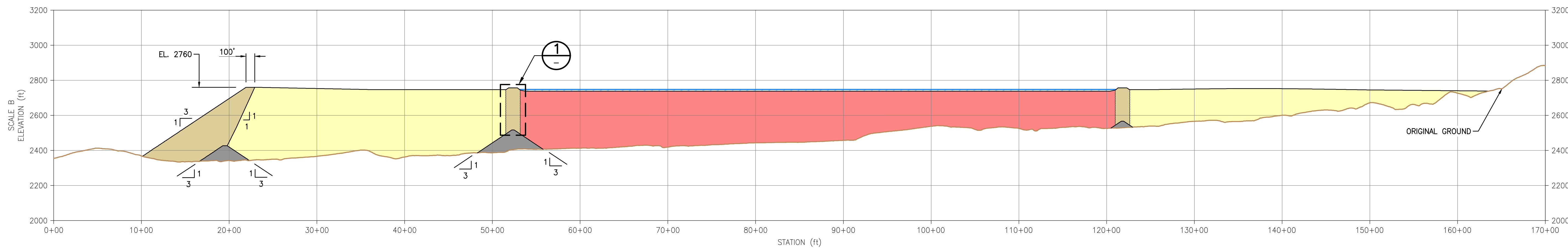
PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3B – NEAR WEST MODIFIED PROPOSED ACTION (HIGH–DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE: GENERAL LAYOUT ULTIMATE CONFIGURATION AND WATER MANAGEMENT

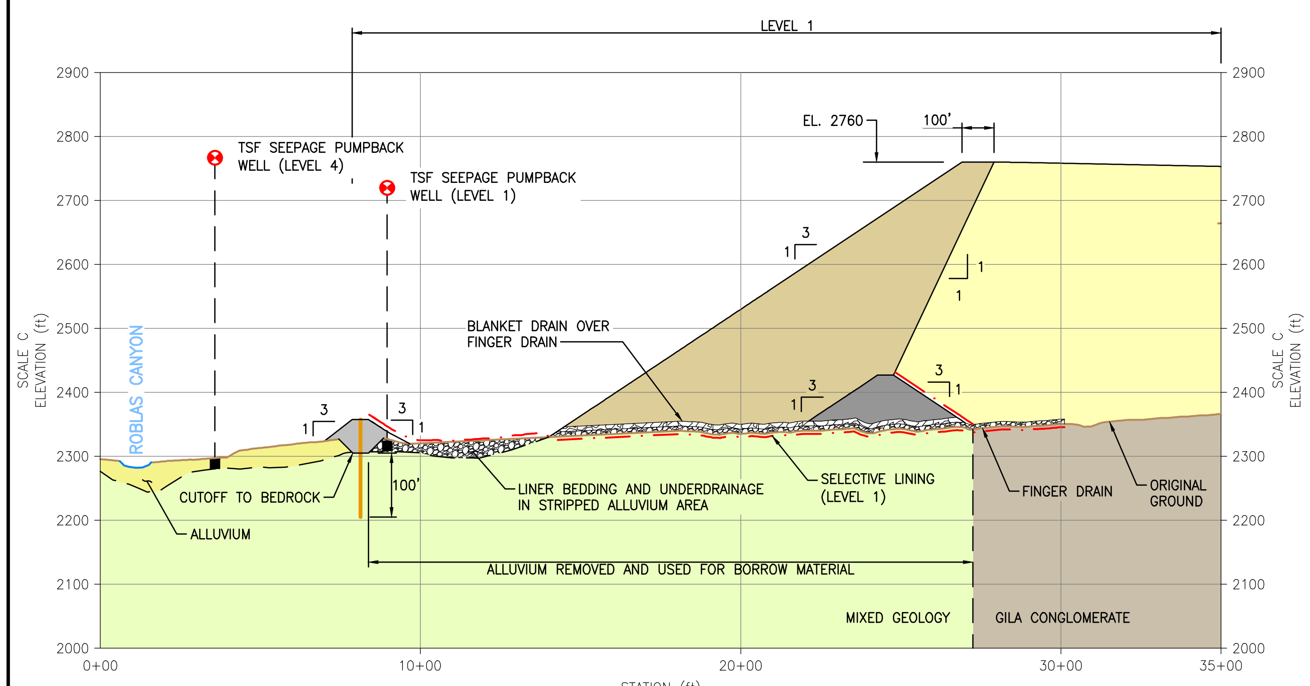
SCALE	PROJECT No.	FIG. No.
AS SHOWN	M09441A20	5.1

KCB–FIG–D–L

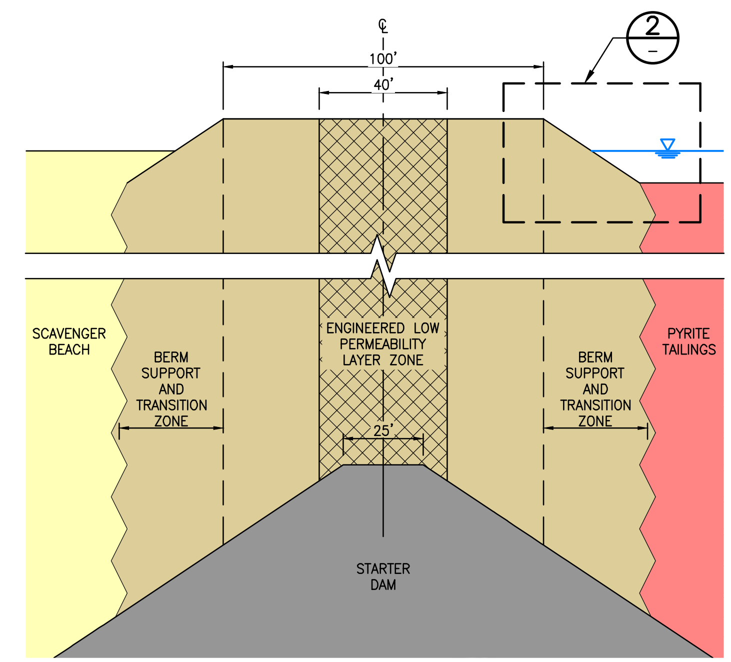
Date: 2018–05–30 Time: 11:42 AM
Drawing File: Z:\M\VCR\M09441A20 – RES–Near West PFS–PES\400 Drawings\CAD\Alt 3B Near West Dry TSF\DEIS\FIG_5.1.dwg – FIG (jbokic)



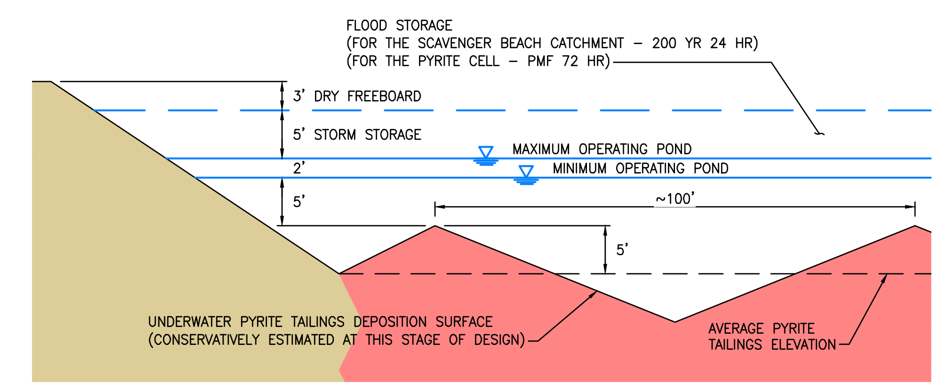
SECTION A
SCALE A 5.1



SECTION B
SCALE B 5.1



DETAIL 1
N.T.S.



DETAIL 2
N.T.S.

LEGEND

- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- CYCLONED SAND EMBANKMENT
- STARTER DAMS
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- TSF RECLAIM POND
- ENGINEERED LOW-PERMEABILITY LAYER (NOTE 4)
- GROUT CURTAIN

GEOLOGY UNITS

- QUATERNARY ALLUVIUM
- GILA CONGLOMERATE
- MIXED GEOLOGY

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. SELECTIVELY LINED AREAS WOULD INCLUDE FOUNDATION TREATMENT AND/OR APPLICATION OF AN ENGINEERED LOW-PERMEABILITY LAYER. DETAILS ON THE TREATMENT OF THESE AREAS ARE TO BE DETERMINED IN FUTURE DESIGN STAGES BUT AN ENGINEERED LOW-PERMEABILITY LAYER COULD COMPRISE OF ONE OR MORE OF THE FOLLOWING: GEOMEMBRANE LINER, COMPACTED FINE TAILINGS, ASPHALT, SLURRY BENTONITE, CEMENTED PASTE TAILINGS, ETC.

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TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

SCALE A: 600 0 600 FT
SCALE B: 300 0 300 FT
SCALE C: 125 0 125 FT

CLIENT	RESOLUTION COPPER
	Klohn Crippen Berger
PROJECT	RESOLUTION COPPER PROJECT DEIS DESIGN FOR ALTERNATIVE 3B – NEAR WEST MODIFIED PROPOSED ACTION (HIGH-DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)
TITLE	TYPICAL CROSS-SECTIONS AND DETAILS
SCALE	AS SHOWN
PROJECT No.	M09441A20
FIG. No.	5.2

Date: 2018-05-30 Time: 11:43 AM
Drawing File: Z:\M\VCR\M09441A20 - RES-Near West PFS-PES\400 Drawings\CAD\Alt 3B Near West Dry TSF\DEIS\FIG_5.2.dwg - PRE (jbokic)

KCB-FIG-D-L

5.2 Embankment Design

5.2.1 Overview

The TSF embankment would be constructed of borrow material and then raised using compacted cycloned sand by using a modified centerline approach. Key components of the design include the following:

- Cycloned sand shell to provide structural support which is compacted to a specified density required to achieve a dilative behavior.
- Underdrain system comprising a sand and gravel blanket drain with gravel primary drains along main drainages and some are extended into the TSF footprint to maintain a low phreatic surface in the tailings embankment, and intercept and direct seepage from the impoundment and hydraulic placement to the downstream SCDs.

The ultimate embankment layout is shown on Figure 5.1. Typical cross sections through the embankment are shown on Figure 5.2.

5.2.2 Downstream Embankment Slope and Stability

The cycloned sand embankment for Alternative 3B is assumed to have a downstream slope of 3H:1V and an upstream slope of 1H:1V. The embankment section (see Figure 5.2) is assumed to meet DEIS design stability criteria with typical foundation conditions and the preliminary stability analysis presented in KCB (2017a). Localized flattening or excavation of weak foundation layers may be required to meet stability criteria in select areas.

5.3 Tailings Management Strategy

Figure 5.1 presents the proposed layout of the Alternative 3B TSF at ultimate configuration (end of mine life). The overall tailings management strategy for Alternative 3B is as follows:

- Scavenger tailings and pyrite tailings earthfill starter dams would be constructed to store tailings at start-up before the cycloned sand embankment is established. The pyrite starter cell would include a low permeability layer and be flooded for subaqueous deposition of pyrite tailings.
- During operations, a portion of scavenger tailings would be cycloned and the coarser underflow by-product (cycloned sand) would be used as embankment fill which would be placed in hydraulic placement cells.
- Scavenger tailings that are not cycloned and the finer cyclone overflow by-product would be thickened to minimize slurry bleed water and discharged from the cycloned sand embankment crest in “thin lifts” to maximize evaporation and prevent formation of a pond.
- A segregated, low-permeability pyrite cell would be established within the TSF footprint, retained by a cycloned sand splitter berm. The reclaim pond would be maintained in the pyrite cell to keep the pyrite tailings saturated to prevent acid-generation, refer to Section 5.4.

- A floating barge would be used to recycle excess water from the pyrite cell pond to the mill for ore processing.
- The perimeter cycloned sand embankment would be raised progressively to maintain adequate capacity for tailings and flood storage.
- A transition to a "dry-cover" facility would be made for closure to minimize the amount of water that is ponded on the TSF surface and reduce infiltration over the long-term.

The overall strategy is discussed further herein, including information regarding the supplementary structures necessary to meet project requirements.

5.4 Tailings Delivery and Process Facilities

Scavenger and pyrite tailings slurry would be thickened at the West Plant to 65% and 50% solids, respectively, and delivered to a "tie-in" point at the northeast corner of the TSF (see Figure 5.1). Downstream of the tie-in point, the scavenger tailings would be to a cyclone house for cycloning (during periods of embankment construction) or thickening. Pyrite tailings would be sent directly to a deposition barge located within the impoundment.

The key facilities located at the tie-in point are summarized below:

- a cyclone separation plant ("cyclone house") which houses slurry dilution tanks, storage tanks, pumps and cyclones;
- scavenger tailings thickeners;
- substation;
- vehicle maintenance and fueling shop;
- warehouse for spares along with outside storage areas;
- administration and locker room facilities; and
- parking facilities

Downstream of the tie-in point would be the following:

- cycloned sand distribution pipelines to hydraulic cells for embankment construction;
- scavenger tailings ("total" tailings and cyclone overflow) distribution pipelines to the embankment crest;
- pyrite distribution pipeline to the deposition barge and/or floating pipelines; and
- return water line from the reclaim pond.

Further details on the tailings delivery and process facilities is provided in the Tailings Corridor study report (RC 2016b).

5.5 Pyrite Tailings Management

Pyrite tailings would be deposited subaqueously from a floating barge throughout operations. No design has been prepared for the barge but the concept is for the barge to be moved frequently around the pyrite cell (to minimize pond volumes) to develop a roughly horizontal subaqueous tailings surface.

The primary advantages of this management approach relate to mitigating potential water quality impacts:

- Pyrite tailings would be maintained in a saturated state throughout operations to prevent or reduce oxidation and potential acid generation until they can be covered and encapsulated with scavenger tailings at closure.
- Low-permeability layers may be included within the splitter berm to further limit horizontal seepage from the pyrite cell, refer to Figure 5.2.
- Placing pyrite tailings within the center of the facility increases the horizontal flow pathway length resulting in the longer lag time for seepage to reach the receptors, thus increasing potential for attenuation.
- Pyrite tailings to be stored primarily on the Gila Conglomerate foundation, which has a lower bulk permeability compared to some other bedrock units on site.
- Pyrite tailings would be capped for closure to reduce infiltration and oxygen ingress over the long-term.

5.6 Tailings Staging Plan

Tailings deposition would be divided into four major stages, as described below.

- Stage I – Years 0 to 2 (1% of total tailings volume)
  - Scavenger and pyrite tailings are deposited behind their respective starter dams within Bear Tank Canyon.
  - Pyrite tailings deposition into the pyrite reclaim pond from a floating barge.
  - Any slurry bleed water or surface water runoff that collects on the scavenger tailings surface would be collected in low points and pumped to the pyrite reclaim pond. Water in the pyrite pond is reclaimed to the cyclone house.
  - Cycloning of scavenger tailings to produce fill for embankment and splitter berm construction.
- Stage II – Years 3 to 4 (2% of total tailings volume)
  - As Stage I, except another scavenger starter dam (Scavenger Starter Stage II) is commissioned in the valley west of Bear Tank Canyon and scavenger deposition commences there. Commissioned starter dams are raised with cycloned sand.
  - Pyrite tailings deposition into the pyrite reclaim pond from a floating barge.

- Stage III – Years 5 to 9 (14% of total tailings volume)
  - As Stage II, except another scavenger starter dam (Scavenger Starter Stage III) is commissioned in the westernmost valleys and scavenger deposition commences there. Commissioned starter dams are raised with cycloned sand.
  - Pyrite tailings deposition into the pyrite reclaim pond from a floating barge.
- Stage IV – Years 10 to 41 (83% of total tailings volume)
  - Scavenger deposition from the perimeter of the cycloned sand embankment as the embankment is raised.
  - The pyrite cell is expanded and raised as required.
  - Ponded water on the scavenger tailings surfaces is collected and pumped to the pyrite cell.
  - Pyrite tailings deposition into the pyrite cell from a floating barge.
  - The Northern Containment Dam is commissioned to retain encroaching tailings.
  - Cycloning of scavenger tailings to produce fill for embankment and splitter berm construction.
  - Towards the end of Stage IV, scavenger tailings are deposited within the TSF to cover the pyrite tailings and promote drainage towards the north (where a closure spillway would be constructed) and within the southern portion of the pyrite cell, reducing the area of pyrite tailings that would need to be covered at the end of operations.

The tailings staging plan described above was modeled using the software program MUCK3D (MineBridge Software Inc., version 1.0.5). A detailed discussion on the modeling approach, key assumptions and results are summarized in Appendix II.

Key observations from the tailings deposition models include the following:

- Pyrite tailings can be deposited subaqueously at all stages to maintain saturation.
- The pyrite cell would have the capacity, above the operating pond level, to store the Probable Maximum Flood (PMF) for the pyrite cell catchment and the Environmental Design Flood (EDF) from the scavenger beach catchment. The PMF could be stored within the impoundment although the flood would inundate the scavenger beaches. Long beaches (>400 ft) are maintained even when storing PMF for all years.
- The ultimate TSF height (510 ft) is within precedent for the industry in this area.
- The forecasted rate of rise for the perimeter embankment and the pyrite cell, above the initial starter dam crests, is shown on Figure 5.3. Rates of rise as high as 18 ft/yr are expected in the first 15 years before leveling out to less than 10 ft/yr for the remainder of operations, which is within the range for facilities of this type.
- The total cycloned sand volume required to build the embankment and the pyrite cell splitter berm is approximately 50 Myd^3 less than the total cycloned sand available (243 Myd^3), based

on the assumed density and cycloned sand availability assumptions provided in the DBM (Appendix I). The surplus in cycloned sand could potentially be used for other construction activities to reduce the borrow requirements (e.g. road construction, liner bedding, starter and north dam construction).

Figure 5.3 Alternative 3B Rate of Rise

6 FOUNDATION CHARACTERIZATION AND DESIGN SECTOR DEFINITION

6.1 General

The foundation of the TSF has been divided into "design sectors", each of which encompasses a region of broadly similar foundation geology and embankment geometry, and therefore, requires similar foundation treatment and seepage control measures, refer to Figure 6.1. These design sectors are referenced throughout this report in connection to seepage management, particularly in Section 8, where the seepage management plan is described per sector.

Key details on the design sectors are summarized in Table 6.1 and further discussion on the environmental, safety and mitigation measures is provided in the following subsections.

Table 6.1 Design Sectors

Sector Name	Primary Foundation Geology	Key Design Considerations
Northeast	Rhyolite (Tp) and Tuff (Tt)	Relatively high hydraulic conductivity of the foundation rock units providing a pathway for seepage. Potential for low-strength layers in the foundation.
East	Gila Conglomerate (Tcg)	Potential for reduced foundation strength resulting from Gila Conglomerate saturation, and potential seepage through the Gila Conglomerate into Potts Canyon
Southeast	Gila Sandstone (Tss)	Potential for low-strength layers (montmorillonite clay) in the foundation. The existing site investigation information indicate these layers are potentially present within 30 ft of the surface (KCB 2017b).
South	Pinal Schist (Xp) and Tertiary Basalt (Tb)	Control of seepage through the bedrock to prevent flow into Queen Creek, and the potential for low-strength layers within the Pinal Schist.
West	"Mixed" Bedrock Geology	Potential for low-strength or collapsible layers within the Apache Leap tuff, dissolution of the limestone units, and seepage into Roblas Canyon. Limited occurrence of these were observed during the site investigation (KCB 2017b). Existing workings from the abandoned Bomboy Mine may present a collapse risk and pathway for seepage.
Northwest	Gila Conglomerate (Tcg)	Similar considerations to the East Design Sector; however, in this region, the potential seepage and stability considerations are less pronounced because the embankment height is lower and seepage flow is against the regional gradient.
North	"Mixed" Bedrock Geology	Potential for seepage through the foundation towards Potts Canyon.

6.2 Northeast Design Sector

The Northeast design sector encompasses a region of Tertiary rhyolite (Tp), and a narrow strip of Tertiary tuff (Tt) at the southern boundary of the design sector. This design sector forms part of a ridge leading to Potts Canyon to the east of the TSF. The main design considerations for this design sector relate to the high hydraulic conductivity and potential for low strength layers in the foundation units.

The hydraulic conductivity of these units is typically in the range of 10^{-5} cm/s to 10^{-6} cm/s; however, zones up to 3 x 10^{-1} cm/s and 2 x 10^{-3} cm/s were recorded in tuff and rhyolite, respectively, during packer testing in the 2016/2017 SI (KCB 2017b). The water level in this region is also lower than the regional trend. These observations imply a potential for seepage to pass through these units into Potts Canyon; seepage management is discussed in Section 8.

There has been a suggestion that low strength layers may exist in these units based on observations of weathered tuff layers in boreholes outside the embankment footprint during the 2016/2017 SI as well as observations of montmorillonite clay-rich weathered layers within the rhyolite. It is currently assumed that rhyolite would form one of the main borrow sources for granular fill required for drains (see Section 10); therefore, blasting/excavation of this unit is already accounted for within the design. If these layers are found to be pervasive and/or persistent in the tuff, it is assumed they could be managed by excavation of a shear key or localized flattening of the embankment slope, without significantly impacting the overall TSF design.

6.3 East Design Sector

The East design sector extends along a ridge of Gila Conglomerate (Tcg), which separates the TSF from Potts Canyon. The main design considerations for this sector include the potential for reduced foundation strength resulting from Gila Conglomerate saturation, and potential seepage through the Gila Conglomerate into Potts Canyon.

The Gila Conglomerate at the Near West site has an average unconfined compressive strength (UCS) of roughly 1800 psi, classifying as a very weak to weak rock. This strength is significantly higher than that of the tailings and does not impact the stability of the TSF; however, an additional consideration for Gila Conglomerate is that this unit can lose strength during saturation. This potential was assessed in the geotechnical site characterization (KCB 2017b) and a reduced strength of $\phi' = 26°$ has been selected for the upper 10 ft of Gila Conglomerate in this DEIS design to account for this possible strength reduction.

It is currently assumed that weathered Gila Conglomerate will not be susceptible to strength loss during undrained loading or liquefaction because there is no reported evidence of this occurring in the region. Samples of crushed Gila Conglomerate tested in the 2017 site characterization (KCB 2017b) were also found to contain between 13 % and 19 % montmorillonite clay in the total mass of the sample, suggesting that the weathered soil will be clay-like and unlikely to liquefy.

The hydraulic conductivity of the Gila Conglomerate at the Near West site varies widely between 1 x 10^{-2} cm/s to 1 x 10^{-8} cm/s (based on packer testing) with the higher values being associated with localized discontinuities. These discontinuities will be treated, where identified, during foundation preparation. Other seepage control measures to limit the potential for flow through the Gila Conglomerate into Potts Canyon are discussed in Section 8.

6.4 Southeast Design Sector

The Southeast design sector encompasses a region of Gila sandstone (Tss), which was found to contain montmorillonite clay layers with a drained residual friction angle as low as $\phi' = 10°$ in the upper 30 ft of this unit. If these layers are persistent and continuous, they would impact the stability of the TSF in this region. Since these layers were observed in two boreholes during the 2016/2017 SI, a shear key trench may be required through this unit in this design sector to remove these layers from the upper 30 ft.

Limited data are available for the hydraulic conductivity of the Tss compared with the Tcg; however, the available data typically plot in the same range. Therefore, it is assumed that similar seepage control measures will be required for this design sector as for the East design sector (see Section 8).

6.5 South Design Sector

The South design sector covers an area dominated by Pinal Schist (Xp) located along the southern perimeter of the TSF, which separates the TSF from the Queen Creek aquifer. The Pinal Schist in this area is intersected by several alluvial drainage channels, and the eastern boundary of the design sector is underlain by Tertiary basalt (Tb). The main design considerations in this region relate to controlling seepage through the bedrock to prevent flow into Queen Creek, and the potential for weak layers within the Pinal Schist. Flow through the alluvial sediments is not a concern since the design incorporates excavation and removal of all alluvium within the footprint of the TSF and SCDs for use as drain material.

The hydraulic conductivity of the basalt ranges from 5×10^{-5} cm/s to 9×10^{-8} cm/s and the Pinal Schist varies between 2×10^{-3} cm/s and 6×10^{-8} cm/s.

Due to the importance of controlling seepage towards Queen Creek, a preliminary layout of several levels of seepage control has been included in this design, as discussed in Section 8. The need for, and extent of, each of these layers of seepage control will be evaluated during hydrogeological modeling and additional site characterization before construction.

Pinal Schist commonly has reduced strength along foliation planes. The orientation of foliation along the south design sector is typically favorable to stability.

Gouge filled foliations with a friction angle of $\phi' = 32°$ and $c' = 14,400$ psf have been identified in the Pinal Schist at Near West. Observations at other facilities have found lower strengths (in the order of $\phi' = 27°$) on a scale that is large enough to impact stability are possible in this unit. As a result, a strength of $\phi' = 27°$ and $c' = 1000$ psf has been selected for this unit.

6.6 West Design Sector

The West design sector encompasses a region of variable geology, referred to in previous design assessments at Near West as the 'mixed geology' area. This mixed geology area separates the TSF from Roblas Canyon to the west. Examples of the units in this area include Apache Leap Tuff (Tal), Mescal Limestone (Ym), Martin Limestone (Dm), Dripping Springs Quartzite (Ydsl/ Ydsu), Bolsa Quartzite (Cb) and diabase (Yd).

The main design considerations in this area relate to the potential for weak or collapsible layers in the Apache Leap tuff, dissolution of the limestone units, and seepage into Roblas Canyon. Packer testing in these units identified hydraulic conductivities ranging widely between 6 x 10^{-3} cm/s and 5 x 10^{-8} cm/s, and observations of fluid losses during drilling suggest there are discrete zones within these units where the hydraulic conductivity is significantly higher than other areas in the rock mass. To mitigate the potential for seepage through these layers reaching Roblas Canyon, and/or causing dissolution of the limestone layers, selective lining of this area has been included together with other seepage control measures in this design, as discussed in Section 8.

Based on the limited observations of weathered material in the 2017 SI, it is assumed that any weathered material will be located close to the surface (i.e. within the upper 10 ft to 20 ft) and would be excavated as part of site preparation; however, deeper zones of weathered tuff (up to roughly 60 ft) were observed in drill holes located outside of the facility footprint, implying that deeper zones of weathering could exist. If these layers are found to be pervasive and/or persistent in the tuff, it is assumed they could be managed by excavation of a shear key or localized flattening of the embankment slope, without significantly impacting the overall TSF design.

A 3 ft deep void was observed in the televiewer profile of a highly fractured area of Mescal Limestone in one of the drill holes, which implies that localized dissolution of the limestone units may have occurred in this region. Packer testing found low hydraulic conductivity (10^{-7} cm/s) across the zone where the potential voids were observed suggesting this void is limited in extent.

Due to limited observations and extent of these features, and the site and regional geology, the current design assumption is that any existing dissolution features are minor and localized and would not affect the integrity of the TSF. Because dissolution features could be a potential seepage pathway, the implementation of seepage mitigation measures discussed in Section 8 would treat areas to prevent seepage flows where dissolution features are discovered in the future.

An abandoned underground mine and shafts called Bomboy Mine is located in this design sector. These mine workings could potentially impact the TSF by providing a preferential flow path for seepage, or by collapsing under the embankment causing deformation of the embankment and/or seepage control measures. The extent of these mine workings and whether they have collapsed/partially collapsed will be investigated with geophysical methods. It is currently assumed that these workings are intact and the design will incorporate treatment by grouting or removing the hill that they are in.

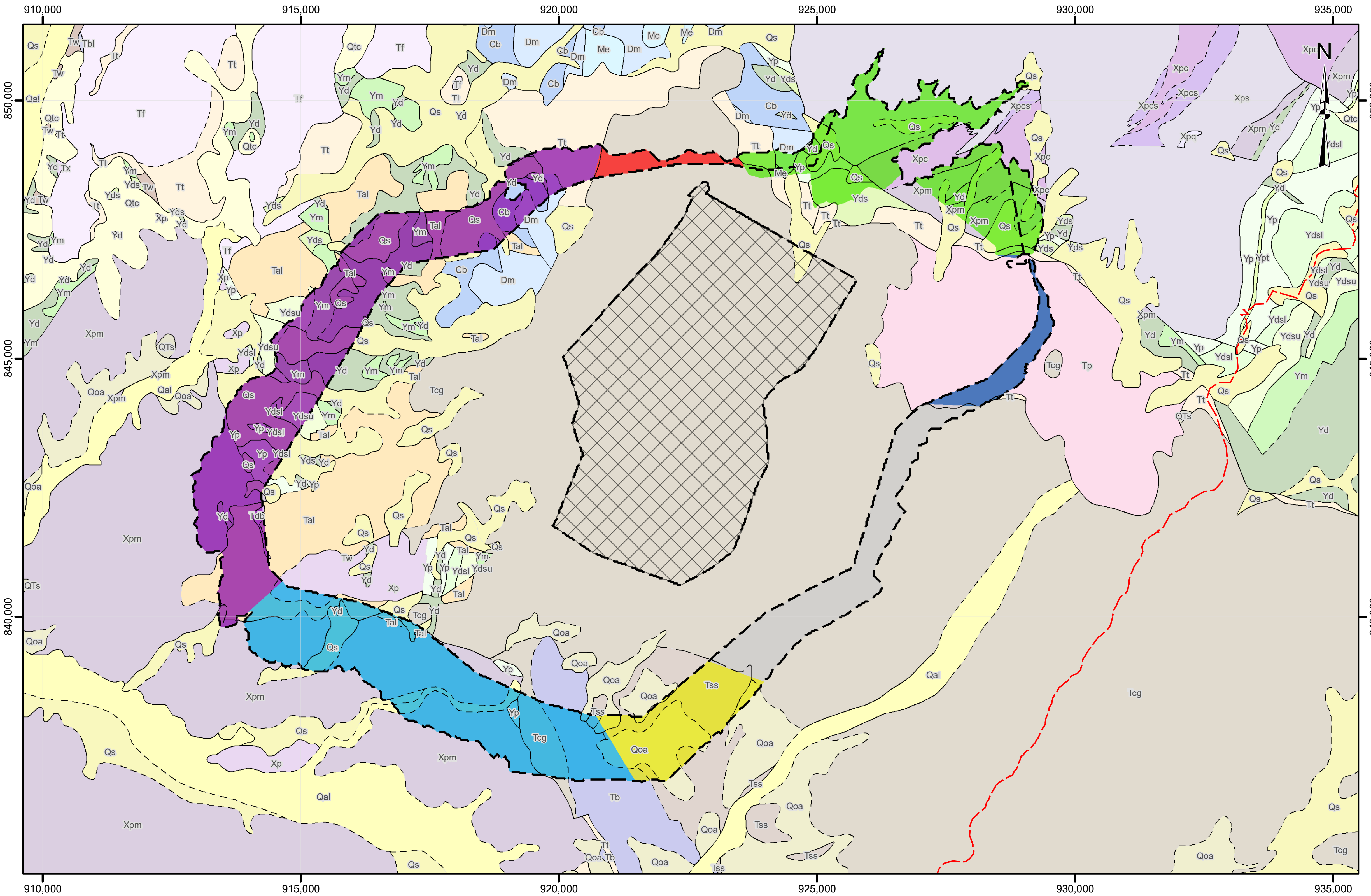
6.7 Northwest Design Sector

The Northwest design sector covers a region of Gila Conglomerate. The design considerations in this region are similar to those discussed for the East design sector; however, in this region, the potential seepage and stability considerations are less pronounced because the embankment height of this area (up to 200 ft) is lower than in the East design sector (up to 350 ft) and the seepage flow is against the regional gradient.

The current design assumption is that seepage could develop through this region towards Roblas Canyon, if it is not mitigated, due to potential changes to the groundwater flow regime because of groundwater mounding beneath the TSF. Therefore, an allowance for grouting surface bedrock fracture zones in this region has been included in the seepage control measures (see Section 8); however, the need for this grouting will be reviewed using hydrogeological modeling and additional site characterization in advance of construction.

6.8 North Design Sector

The North design sector includes a similar range of geological units as the West design sector; however, the embankment height in this sector (up to 150 ft) is less than all other sectors because the natural ground elevation is the highest. Therefore, the main design consideration in this area is the potential for seepage through the foundation towards Potts Canyon. As with the Northeast design sector, the embankments in this design sector will impound the pyrite tailings with a consistent water cover over the pyrite tailings.



GEOLOGICAL UNITS

Qs	Undivided Surficial Deposits (Quaternary)
Qtd	Disturbed Surficial Deposits (Holocene)
Qtc	Talus and Colluvium (Quaternary)
Qal	Unconsolidated Alluvium (Quaternary)
Qoa	Old Alluvium (Quaternary)
QTs	Older Alluvium (Early Quaternary to Late Tertiary)
Tcg	Conglomerate (Pliocene to Late Miocene)
Tss	Sandstone (Pliocene to late Miocene)
Tb	Basalt (Mid-Miocene to Early Miocene)
Tp	Perlitic Aphyric Rhyolite (Middle Tertiary)
Tal	Apache Leap Tuff (Early Miocene)
Tt	Tuff (poorly welded) (Miocene)
Tf	Felsic Volcanic Rocks, undivided (Middle Tertiary)
Tbl	Lower Basalt (Middle Tertiary)
Tx	Rock Avalanche or Talus Breccia (Middle Tertiary)
Tw	Whitetail Conglomerate
Tdb	Basaltic Dikes (Middle Tertiary)
Kd	Quartz Diorite (Latest Cretaceous)
Me	Escabrosa Limestone (Mississippian)
Dm	Martin Limestone (Devonian)
Cb	Bolsa Quartzite (Cambrian)
Yd	Diabase (Middle Proterozoic)
Ym	Mescal Limestone (Middle Proterozoic)
Yds	Dripping Spring Quartzite, undivided (Middle Proterozoic)
Ydsu	Dripping Spring Quartzite, Upper Unit (Middle Proterozoic)
Ydsl	Dripping Spring Quartzite, Lower Unit (Middle Proterozoic)
Yp	Pioneer Shale (Middle Proterozoic)
Ypt	Pioneer Shale, Tuff Unit (Middle Proterozoic)
YXd	Diorite (Early or Middle Proterozoic)
Xp	Pinal Schist, undivided (Early Proterozoic)
Xpc	Pinal Schist, Calc-silicate Facies (Early Proterozoic)
Xpcs	Pinal Schist, Calc-silicate and Schist Facies (Early Proterozoic)
Xpm	Pinal Schist, Psammite Facies (Early Proterozoic)
Xpp	Pinal Sctist, Phyllite Facies (Early Proterozoic)
Xpq	Pinal Schist, Quartzite Layers (Early Proterozoic)
Xps	Pinal Schist, Pelitic Schist (Early Proterozoic)

0 — 1 Mile

LEGEND

- ALTERNATIVE 3B: NEAR WEST TSF
- PYRITE CELL
- CONTACT (BETWEEN GEOLOGIC UNITS)
- CONTACT - APPROXIMATE
- CONTACT - INFERRED
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)

DESIGN SECTORS

- EAST
- NORTH
- NORTHEAST
- NORTHWEST
- SOUTH
- SOUTHEAST
- WEST

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. REFER TO GEOTECHNICAL SITE CHARACTERIZATION REPORT FOR SOURCE OF GEOLOGY

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

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PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3B - NEAR WEST MODIFIED PROPOSED ACTION (HIGH-DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE: DESIGN SECTORS

PROJECT No. M09441A20

FIG No. 6.1

7 WATER MANAGEMENT PLAN

7.1 Surface Water Management System

The objectives of the operational water management plan are to:

- divert non-contact water around the TSF to keep it separate from contact water;
- minimize water losses through tailings thickening and maximize contact water recycled back to the West Plant for ore processing;
- intercept embankment toe seepage and surface runoff from the TSF and recycle the water to the reclaim pond;
- maintain a reclaim pond to keep pyrite tailings saturated;
- store the inflow design flood within the impoundment with adequate freeboard; and
- protect the TSF and diversion structures from erosion from flood events.

The water management concept is schematically shown schematically on Figure 7.1, water management features are shown on Figure 5.1 and Figure 8.1. The surface water management system includes the following components:

Upstream Water Diversions

Alternative 3B would have the same upstream diversions as Alternative 2 (Near West GPO Proposed Action), as presented in KCB (2014).

The three diversion channels would be constructed north of the TSF to route the upstream catchment around the facility. The diversion channel general layouts are shown on Figure 5.1. They are sized to convey the peak PMF flow, which is the greater peak flow of the 6-hr to 72-hr.

Reclaim Pond

The TSF reclaim pond is sized based on the following:

- Pyrite starter reclaim pond (Year 1 to Year 9) – minimum water cover over pyrite tailings of 10 ft, which is a conservative depth for reclaim barge and pyrite deposition barge draft.
- Pyrite cell reclaim pond (Year 10 to Year 41) – minimum water cover over the pyrite tailings cone peaks of 5 ft, for reclaim barge and pyrite deposition barge draft. The reclaim barge will be strategically located to reclaim clarified water.

Downstream Embankment Runoff Collection Ditches

Lined collection ditches would be constructed along the embankment toe and at underdrain discharges to convey water to the SCDs.

Seepage Collection Dams (SCDs)

Eleven SCDs would be built to collect seepage water from the tailings embankment underdrain system and surface runoff from the embankment slope. The locations of the SCDs are shown on Figure 5.1 and a typical section is shown on Figure 5.2.

Water from the SCDs will be pumped to the cyclone house. The design criteria for the SCD sizing is included in the DBM (Appendix I). The storage capacity will have allowance for the minimum operating volume, maximum seasonal volume (for an average climatic year), volume required for operational upset, volume for critical duration storm events including sediment (Environmental Design Flood and Inflow Design Flood) and minimum freeboard above peak flood level.

The toe of the tailings embankment will be armored to convey seepage that daylights along ridges to the SCDs. The toe of the SCDs will be armored to protect the TSF from flooding in Queen Creek, Roblas Canyon and Potts Canyon.

Seepage collections dams may also be used to manage fines that are suspended in excess surface water from cycloned sand hydraulic placement cells.

Auxiliary Seepage Collection Dams (ASCD)

As part of the staged seepage management plan (see Section 8), Level 3 of the plan includes the construction of additional ‘auxiliary’ SCDs (ASCD) downstream of the SCDs.

The assumption at this design stage is that the ASCDs would include similar elements as the SCDs, but would be a maximum of approximately 15 ft high. This reduced height compared with the SCDs is because these ASCDs would not collect surface runoff from the TSF and would not be defined as a jurisdictional dam under the Arizona Department of Water Resources (ADWR).

Water Reclaim Systems

Pumping systems (e.g. floating barges, pump stations, siphons) would be utilized to move impounded contact water to central areas where it can be recycled back to the West Plant or used for some other beneficial purpose (e.g. for cyclone feed dilution, dust management on roads, etc.).

The water reclaim systems include the following:

- Pyrite Pond Reclaim System (PRS) – recovers water from pyrite cell reclaim pond and delivers it to the cyclone house at the northeast corner of the facility.
- Pond Transfer Reclaim System (PTRS) – mobile pumps located in low spots on the scavenger beach would be used to transfer any ponded water to the pyrite cell reclaim pond.
- Seepage Reclaim System (SRS) – returns seepage and embankment runoff to the cyclone house. Includes the SCDs and the additional seepage mitigation infrastructure discussed in Section 8.
- TSF Thickeners –overflow water from the TSF thickeners (for scavenger tails not cycloned and cyclone overflow) would be used to dilute cyclone feed stream and surplus would be reclaimed to the West Plant.

7.2 Water Balance

A start-up, operational and post-closure contact water balance was completed for monthly average inflows and outflows, the assumptions and results are summarized in Appendix III. The main objectives of the water balance were to:

- provide an understanding of monthly average inflows and outflows of the TSF system;
- estimate when the TSF system is in a state of "loss" (defined as having less water available than the West Plant requires, not including the other West Plant inflows) or "surplus" (i.e. defined as having more water than the West Plant requires, not including the other West Plant inflows);
- preliminary estimate of seasonal fluctuations of pond water for the sizing of water collection ponds; and
- provide a basis for further water quality and downstream solute transport assessments (completed by others).

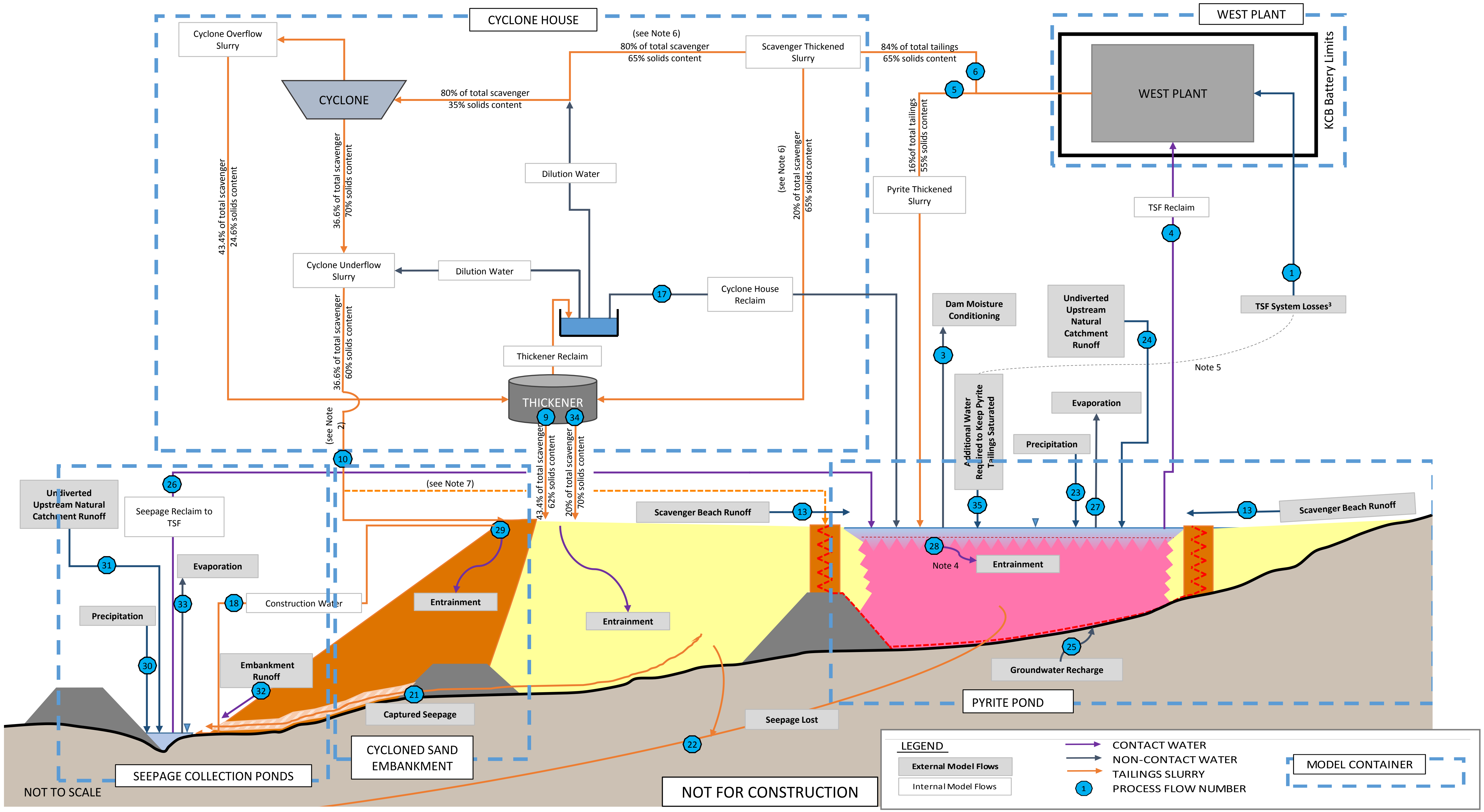
The operational TSF water balance is represented schematically on Figure 7.1 and is focused around the water ponds (i.e. seepage collection ponds, TSF reclaim pond). The West Plant water requirements and TSF reclaim rates are shown on Figure 7.2. A summary of the TSF system losses and surpluses are given in Table 7.1 and Table 7.2.

Table 7.1 Summary of TSF System Water Requirements from Other Sources

Flow Description	Operations (acre-ft)	Post-Closure Phase 1 (acre-ft)
Additional water required for Pyrite Pond (to maintain saturation)	1,000 (Years 2 to 8; 41)	0
TSF system loss (water required for the West Plant from other sources)	424,000	0

Table 7.2 Summary of TSF Active Water Management Requirements (System Surplus)

Flow Description	Operations (acre-ft)	Post-Closure Phase 1 (acre-ft)
Surplus from TSF Reclaim Pond	0	0
Surplus from Seepage Collection Ponds	0	0



Notes:
1. All percentages reported are by weight.
2. For staging/planning a 3% loss of the cyclone underflow mass in the embankment during hydraulic cell placement was assumed. This has not been taken into account in the water balance.
3. KCB does not account for water balance flows upstream of the tailings facility (i.e. ore processing facility, block cave dewatering etc.)
4. Bleed Water = Slurry Water - Entrainment
5. Total TSF system losses includes the TSF system losses (the difference between what the West Plant sends to the TSF and what is reclaimed from the TSF pond) and additional water required to keep pyrite tailings saturated.
6. Scavenger mass flow percentages shown are based on 80% of Scavenger tailings through the Cyclone. This value varies over the mine life.
7. Cycloned sand, and associated construction water, used on the Splitter Berm is not explicitly modelled in the water balance. This affects the reported Seepage Reclaim

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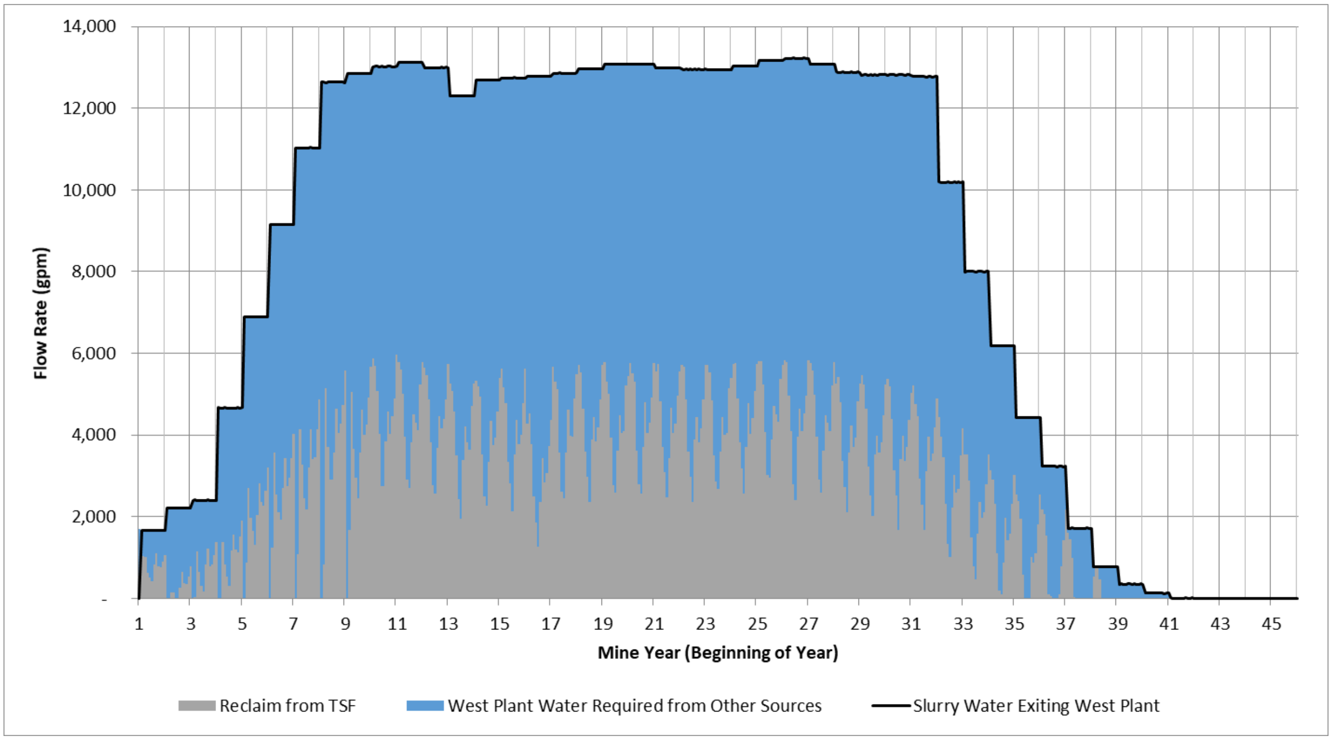
PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3B - NEAR WEST MODIFIED PROPOSED ACTION
(THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE: WATER BALANCE SCHEMATIC
OPERATION

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	7.1

Figure 7.2 West Plant Water Requirements from TSF and Other Sources



8 SEEPAGE MANAGEMENT PLAN

Available "best practice" management methods to reduce seepage as much as practical are included in the DEIS design at this stage. Seepage mitigation measures would be refined and optimized between the DEIS and final EIS if this was the selected alternative. In line with ADEQ requirements, the assumed groundwater points of compliance are shown on Figure 8.1.

Components of the seepage management plan described below are summarized in Table 8.1 and Level 4 (which includes the components of Levels 1 through 3) is shown on Figure 8.1. Seepage mitigations are roughly sequenced in an upstream (nearest to TSF) to downstream (nearest to downstream receptor) direction:

- Level 1– Foundation Treatment and Primary Seepage Collection Measures;
- Level 2 – Grout Curtain Extension;
- Level 3 – Auxiliary Seepage Collection Dams (ASCDs); and
- Level 4 – Downstream Pumping Wells.

Level 1 - Foundation Treatment and Primary Seepage Collection Measures

Level 1 includes foundation treatment (dental concrete, cut-offs, grouting) or selective engineered low permeability layers[6] to decrease infiltration in the foundation and a primary layer of seepage collection (underdrainage, SCDs, pumpback system). Specific treatments would be reviewed for each design sector.

Underdrainage would include the following:

- The scavenger starter dams would be constructed above the embankment blanket drain. The intention is that the blanket and finger drains would collect water from the tailings and convey it beneath the starter dams to a series of lined channels located within the drainage channels downstream of the TSF. The lined channels would then convey the collected seepage water to lined SCDs.
- Underdrains would be extended into the impoundment to intercept seepage from the scavenger beach area.

SCDs are included in Level 1 of the seepage control. These dams are located in the drainage valleys and would include the following elements:

- Excavation of all alluvial soil beneath the crest of the dam and replacement with compacted granular fill.
- An engineered low-permeability layer placed on the upstream face.

[6] The engineered low-permeability layer could be comprised of one or more of the following: compacted fine tailings, geomembrane liner, asphalt, slurry bentonite and/or cemented paste tailings.

- A cementitious grout curtain that extends to a depth of 100 ft into the foundation, and roughly 100 ft into each abutment.
- Pumpback wells installed in the granular fill beneath the SCD on the upstream side of the grouted core.

Level 2 – Grout Curtain Extension

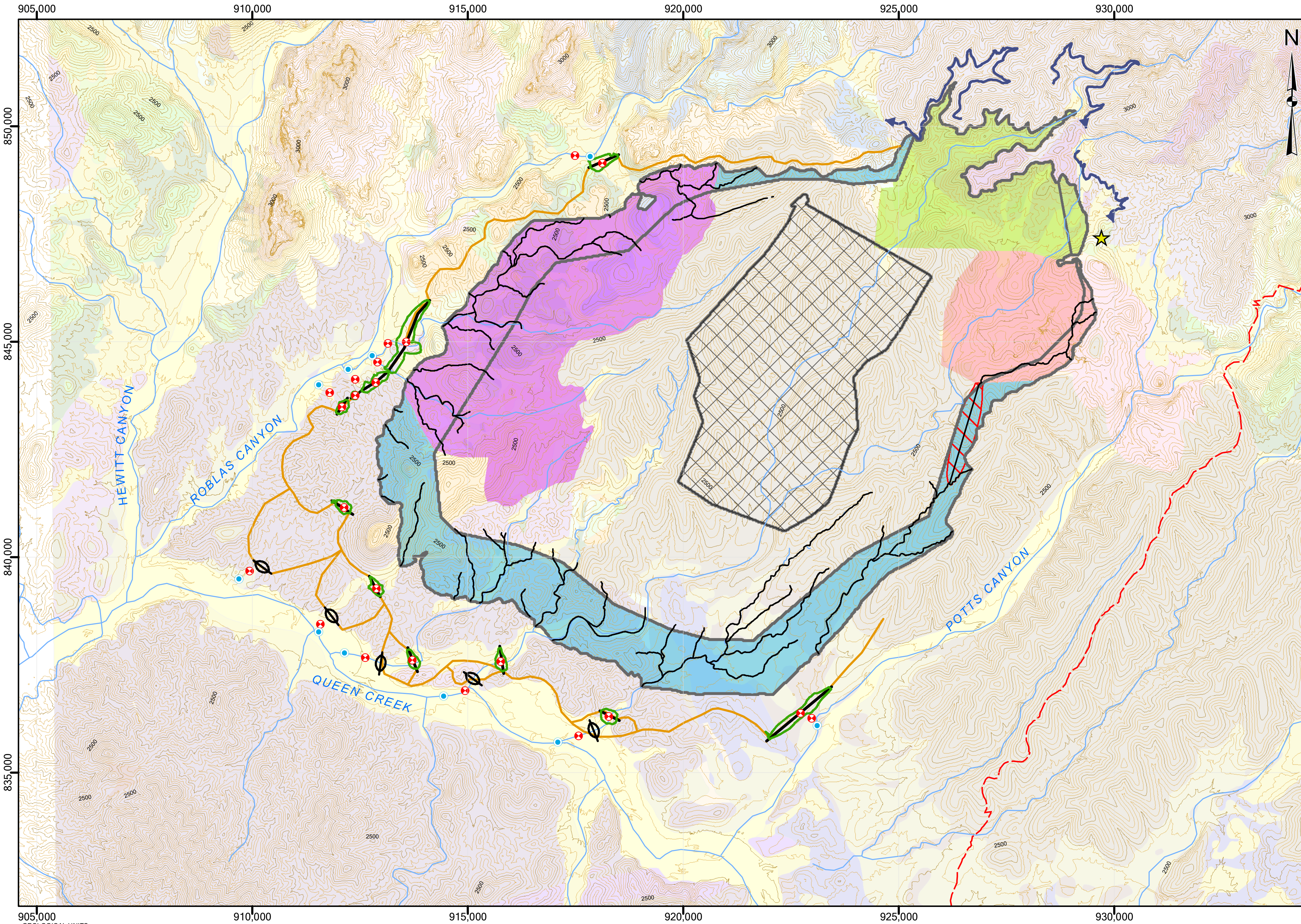
Level 2 measures include extending the grout curtain installed at the SCDs along the bedrock ridges between the SCDs. This grouting would be completed in a phased manner after additional SI's to identify potential high permeability zones, in which the extent of the first phase would be specified based on monitoring data and groundwater modeling results, which would be reviewed and updated as the grouting progressed and be used to guide any additional grouting.

Level 3 – Auxiliary Seepage Collection Dams

Level 3 measures include the construction of additional 'auxiliary' SCDs (ASCD) downstream of the SCDs. The intent from these ASCDs would be to capture any seepage that bypasses the Level 1 and/or Level 2 controls, either through the bedrock ridges or beneath the grout curtains. The assumption behind these Level 3 ASCDs is that the flow through the bedrock ridges or beneath the grout curtains will ultimately report to drainage channels. Therefore, the ASCDs would be located as far downstream along the drainage channels as feasible to maximize opportunity for seepage capture. The current assumption is that these ASCDs would be located up to a maximum of roughly 750 ft from Queen Creek.

Level 4 – Downstream Pumping Wells

Level 4 measures are intended to be deployed if there are indicators that seepage could or is currently bypassing Level 1 to 3 measures. Level 4 measures include installation and operation of a series of pumping wells in the identified seepage pathways.



LEGEND

- ALTERNATIVE 3B: NEAR WEST TSF (INCLUDING STARTER DAMS)
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- UPSTREAM DIVERSION
- POINT OF COMPLIANCE (POC) TO BE LOCATED A MAXIMUM OF 750 ft DOWNSTREAM OF POLLUTION MANAGEMENT AREA (PMA)
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- MAJOR NATURAL DRAINAGES
- CONTOUR (20ft)
- CONTOUR (100ft)

SEEPAGE MANAGEMENT

LEVEL 1

- TSF SEEPAGE PUMPBACK WELL
- FINGER DRAINS
- GROUT CURTAIN
- CUT-OFF WALL
- PRIMARY SEEPAGE COLLECTION DAM
- EXCAVATION (TO FILL) AND REGRADING (SEE NOTE 3)
- SELECTIVE LINED NORTH AREA (SEE NOTE 4)
- BLANKET DRAIN
- RHYOLITE QUARRY AREA AND SELECTIVE LINING (SEE NOTE 4)
- SELECTIVE LINED WESTERN MIXED GEOLOGY AREA (SEE NOTE 4)
- PYRITE CELL

LEVEL 2

- GROUT CURTAIN EXTENSION

LEVEL 3

- AUXILIARY SEEPAGE COLLECTION DAM
- GROUT CURTAIN EXTENSION

LEVEL 4

- TSF SEEPAGE PUMPBACK WELL

GEOLOGICAL UNITS

- Undivided Surficial Deposits (Quatenary)
- Disturbed Surficial Deposits (Holocene)
- Talus and Colluvium (Quaternary)
- Unconsolidated Alluvium (Quaternary)
- Old Alluvium (Quaternary)
- Older Alluvium (Early Quaternary to Late Tertiary)
- Conglomerate (Pliocene to Late Miocene)
- Sandstone (Pliocene to late Miocene)
- Basalt (Mid-Miocene to Early Miocene)
- Perlitic Aphyric Rhyolite (Middle Tertiary)
- Apache Leap Tuff (Early Miocene)
- Tuff (poorly welded) (Miocene)
- Felsic Volcanic Rocks, undivided (Middle Tertiary)
- Lower Basalt (Middle Tertiary)
- Rock Avalanche or Talus Brecchia (Middle Tertiary)
- Whitetail Conglomerate
- Basaltic Dikes (Middle Tertiary)
- Quartz Diorite (Latest Cretaceous)
- Escabrosa Limestone (Mississippian)
- Martin Limestone (Devonian)
- Bolsa Quartzite (Cambrian)
- Diabase (Middle Proterozoic)
- Mescal Limestone (Middle Proterozoic)
- Dripping Spring Quartzite, undivided (Middle Proterozoic)
- Dripping Spring Quartzite, Upper Unit (Middle Proterozoic)
- Dripping Spring Quartzite, Lower Unit (Middle Proterozoic)
- Pioneer Shale (Middle Proterozoic)
- Pioneer Shale, Tuff Unit (Middle Proterozoic)
- Diorite (Early or Middle Proterozoic)
- Pinal Schist, undivided (Early Proterozoic)
- Pinal Schist, Calc-silicate Facies (Early Proterozoic)
- Pinal Schist, Calc-silicate and Schist Facies (Early Proterozoic)
- Pinal Schist, Psammite Facies (Early Proterozoic)
- Pinal Sctist, Phyllite Facies (Early Proterozoic)
- Pinal Schist, Quartzite Layers (Early Proterozoic)
- Pinal Schist, Pelitic Schist (Early Proterozoic)

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. REFER TO REPORT FOR SOURCE OF GEOLOGY
3. EXCAVATION DONE TO PROMOTE DRAINAGE INTO UNDERDRAINS
4. SELECTIVELY LINED AREAS WOULD INCLUDE FOUNDATION TREATMENT AND/OR APPLICATION OF AN ENGINEERED LOW-PERMEABILITY LAYER. DETAILS ON THE TREATMENT OF THESE AREAS ARE TO BE DETERMINED IN FUTURE DESIGN STAGES BUT AN ENGINEERED LOW-PERMEABILITY LAYER COULD COMPRISE OF ONE OR MORE OF THE FOLLOWING: GEOMEMBRANE LINER, COMPACTED FINE TAILINGS, ASPHALT, SLURRY BENTONITE, CEMENTED PASTE TAILINGS, ETC.
5. LEVEL 4 PUMPBACK WELLS WOULD BE DECOMMISSIONED IF SEEPAGE MANAGEMENT LEVEL 5 WAS IMPLEMENTED

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

0 2,500 Feet 0 0.5 Mile

CLIENT

RESOLUTION COPPER

Klohn Crippen Berger

PROJECT
RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3B - NEAR WEST MODIFIED PROPOSED ACTION (HIGH-DENSITY THICKENED NPAG SCAVENGER AND SEGREGATED PAG PYRITE CELL)

TITLE

SEEPAGE MANAGEMENT
LEVEL 4

PROJECT No. M09441A20

FIG No. 8.1

Table 8.1 Alternative 3B Seepage Management Plan

Level	Applicable Design Sectors	Applicable Geology Units	Receiving Waterbody	Mitigation	Purpose
1	South and Southwest	Pinal Schist, Gila Conglomerate/ Sandstone, and Alluvium	Queen Creek and Roblas Canyon in the southwest corner	▪ Foundation preparation and treatment (e.g. grouting or dental concrete) beneath embankment ▪ Finger drains extending 200 ft upstream of the ultimate embankment crest ▪ SCD with engineered low-permeability layer and cutoff trench ▪ Drainage layer below SCD low-permeability layer and pumpback well to collect flow bypassing blanket drain ▪ Grout curtain below SCD and in SCD abutments ▪ Pyrite starter pond with engineered low-permeability layer	▪ Decrease foundation permeability ▪ Collect and direct seepage to SCDs ▪ Collect seepage and return to TSF ▪ Decrease foundation permeability and limit seepage bypassing collection systems
	East and Northwest	Gila Conglomerate	Potts Canyon and Roblas Canyon	▪ Excavation (for borrow) and re-shaping/smoothing ▪ Selective foundation treatment/placement of engineered low-permeability layer ▪ Blanket drain beneath main embankment	▪ Promote positive drainage of seepage ▪ Decrease foundation permeability ▪ Collect and direct seepage to SCDs
	West	Paleozoic units (e.g. Bolsa Quartzite, Apache Leap Tuff, Escabrosa Limestone), and Alluvium	Roblas Canyon	▪ Selective foundation treatment/placement of engineered low-permeability layer	▪ Decrease foundation permeability
	Northeast	Perlitic Rhyolite	Potts Canyon	▪ Foundation treatment/placement of engineered low-permeability layer	▪ Decrease foundation permeability
	North	Pinal Schist and Mixed Geology	Potts Canyon	▪ Selective foundation treatment/placement of engineered low-permeability layer	▪ Decrease foundation permeability
2	South, Southeast, East, Northwest, and West	All	Queen Creek, Potts Canyon, Roblas Canyon	▪ Grouting the perimeter of the TSF through the ridges between SCDs	▪ Decrease foundation permeability and limit seepage bypassing collection systems
3	South and Southwest	Pinal Schist and Alluvium	Queen Creek and Roblas Canyon in the southwest corner	▪ Construction of ASCD downstream of SCD	▪ Additional seepage collection
4	South, Southeast, and West	Alluvium, Pinal Schist and Paleozoic units (e.g. Bolsa Quartzite, Apache Leap Tuff, Escabrosa Limestone)	Queen Creek and Roblas Canyon	▪ Pumpback wells downstream of SCD and ASCD	▪ Additional seepage collection

9 DUST MANAGEMENT PLAN

The key considerations for dust management of the Alternative 3B TSF are:

- the surface area of the impoundment;
- susceptibility of beach tailings to wind erosion, when dry;
- inability to use water/sprinklers as a dust suppressant on the scavenger tailings beach surfaces due to the operational objective of maintaining the scavenger beach as dry as possible;
- susceptibility of cycloned sand to wind erosion, when dry; and
- embankment slopes that cannot be progressively reclaimed until the later stages of operations; and
- proximity of the Near West site to sensitive receptors (the town of Superior (4 miles northeast), community of Queen Valley (4 miles southwest), Boyce Thompson Arboretum State Park (1.5 miles east) and the Superstition Wilderness Area (4 miles north)).

The conceptual dust management plan for the Alternative 3B is based on the following approach to manage wind erosion of the TSF surface.

- Cycloned sand embankment slope:
  - The embankment would be constructed to establish the ultimate downstream slope as soon as practical to allow progressive reclamation of the slope with an erosion resistant cover. After Year 30 there is enough cumulative cycloned sand available to raise the embankment horizontally and the majority of the outer slope could be progressively reclaimed (see Appendix II).
  - Active hydraulic placement cells would be wetted through construction water and would not need additional dust suppression.
  - Areas that would be exposed for an extended period (inactive areas that have not been progressively reclaimed) would have temporary erosion controls, such as: polymers, wind fences, and/or temporary sand and gravel erosion protection layer.
- Tailings beach:
  - Tailings deposition spigot locations would be scheduled to encourage drying of the beach tailings surface to limit seepage into the foundation.
  - Tailings beaches undergoing active tailings deposition are considered wetted and resistant to dust erosion.
  - Inactive tailings beaches are considered to be dry, however, typically high-density thickened tailings (especially fine tailings, like cyclone overflow) crust at the surface, providing some resistance to wind erosion. If crusting is not sufficient, synthetic dust suppressants can be used. For example, Kennecott uses an acrylic polymer (EnvirotacII),

which has been approved by Rio Tinto's environmental group; and New Afton (in BC, Canada) uses a polymer emulsion, Soil-Sement®[7].

- Pyrite cell:
  - Splitter berm surfaces that have active hydraulic cells would be wetted through construction water.
  - Splitter berm surfaces that would be exposed for an extended period (inactive areas) would have temporary erosion controls such as: wind fences, and/or use synthetic dust suppressants.
  - Tailings submerged in the pyrite cell would not be exposed to wind erosion.

In addition, service roads would be regularly watered or sprayed with a dust suppressant, as required.

[7] http://midwestind.com/soil-sement/

10 BORROW PLAN

Earthfill construction materials are required for the following purposes:

- general fill for dam construction;
- sand and gravel for underdrains, blanket drains and dam zones; and
- riprap for erosion protection.

Based on the Near West foundation characterization (refer to Section 2.5), the most likely general fill borrow source of sufficient quantity is the Gila Conglomerate (Tcg), which outcrops over approximately 55% of the TSF footprint. Experience at the West Plant site indicates a surface layer of the material can be ripped with a dozer but below approximately 5 ft to 10 ft drilling and blasting may be required. All of the material must be processed to varying degrees to produce a well graded 12 in. minus fill material.

The preferred source of sand and gravel for the blanket drains and underdrains is the alluvial sediments located within the active channels supplemented with processed rock. Based on the volume estimates prepared for the GPO design (KCB 2014), it is expected that roughly 180,000 yd^3 of 0.8 inch minus sand and gravel is available in the alluvial channels.

Riprap for erosion protection will be sourced from the rhyolite quarry in the Northeast design sector, subject to the volume of rhyolite required to supplement the alluvium for drainage rock. If an additional source of riprap is required, this could be sourced from the Apache Leap Tuff unit located in the southern part of the West design sector.

11 PRELIMINARY CLOSURE PLAN

The long-term closure goals for Alternative 3B are to have a well-drained, stable embankment and to limit the duration of post closure water management. Management during operations of the PAG pyrite tailings and their location within the facility post-closure is important to reducing the risk of Acid Rock Drainage / Metal Leaching (ARD/ML) in tailings seepage.

The closure and cover strategy for the facility begins during operations and tailings deposition planning, and continues through to the onset of closure. The primary performance objectives for closure and reclamation of the TSF are to:

- develop a stable landform;
- develop a stable vegetated cover system that limits net infiltration and protects surface water runoff quality;
- minimize ponded water on the closed tailings surface;
- promote high levels of saturation of the pyrite tailings to reduce their exposure to atmospheric oxygen during operations (and post-closure by limiting oxygen ingress);
- protect the reclaimed surface against wind and water erosion;
- provide a growth medium for vegetation establishment and long-term sustainability; and
- minimize the duration of post closure water management.

Management during operations of the PAG pyrite tailings and their location within the facility post-closure is important to reducing the risk of Acid Rock Drainage / Metal Leaching (ARD/ML) in tailings seepage. The tailings deposition strategy is to confine the pyrite tailings within a segregated, low-permeability cell within the TSF footprint to minimize contact with water and oxygen.

During operations, the cycloned sand embankment slopes would be progressively reclaimed as soon as practical. Towards the end of operations, scavenger tailings would be strategically deposited within the TSF to cover the pyrite tailings and promote drainage towards the north (where a closure spillway would be constructed), and within the southern portion of the pyrite cell, reducing the area of pyrite tailings that would need to be covered at the end of operations.

At the end of operations, the remainder of the pyrite tailings cell would be covered with a layer of scavenger tailings while the reclaim pond size is decreased through pumping to the West Plant and active water management. A cover system would be placed over the top of the impoundment surface and be revegetated. The ultimate tailings surface would also be shaped to shed water to a closure spillway, so that no permanent ponds would be impounded on the surface.

The downstream slopes of the embankment would be armored and runoff collection channels would be constructed on the slopes to convey surface runoff.

Post closure is separated into two phases for the water balance: active closure and passive closure.

The active closure phase starts immediately after the end of operations and ends when the pyrite TSF pond is reclaimed. During this phase, the pyrite TSF pond area is slowly reclaimed and would assist with evaporation of impoundment draindown water, which collects at the SCDs and is pumped back to the TSF.

Phase 1 – Active TSF Closure

Mine Years 42 to 51 (first nine years after end of operations):

- The embankment slopes are reclaimed (covered and vegetated).
- The tailings beaches are reclaimed (covered and vegetated).
- The pyrite cell is covered with hydraulically deposited scavenger tailings. The pond is expected to evaporate within five years[8]. However, if evaporation alone is insufficient, the pond would be pushed to one end of the pyrite cell and managed via active water management[9].
- Excess impoundment draindown water that collects at the SCDs is pumped back to the TSF reclaim pond. Between the TSF reclaim pond and Seepage Collection Pond areas, all impoundment draindown water can be managed by evaporation. If evaporation alone is insufficient, the pond would be pushed to one end of the pyrite cell and managed via active water management.
- A closure spillway and diversions are constructed to convey runoff from the natural catchment and reclaimed TSF surfaces around the Seepage Collection Ponds as soon as practical (assumed to be completed by year five post-closure).
- The SCDs are upgraded to provide additional pond storage and surface area to evaporate captured seepage. Little or no active management of seepage water will be required once the SCDs are raised to their final closure heights. However, the pumping systems would be left in placed during Active Closure to manage seepage via active water management, if required.
- The pyrite TSF reclaim pond is filled in with scavenger tailings, dewatered, and reclaimed.

Phase 2 – Passive Closure

- Assumed in perpetuity.
- SCDs are able to passively evaporate all inflows without the need for active water management after the end of operations. If water reporting to the Seepage Collection Ponds is of suitable quality to discharge, the collection dams/ponds would be decommissioned when possible.

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[8] The pyrite cell has an area of 508 acres. The estimated annual precipitation and potential evaporation are 18 inch/year and 72 inch/year, respectively. Therefore, the evaporative capacity of the pyrite cell is approximately 2,300 acre-ft/year.
[9] Active water management is defined as any required management of water at the seepage collection dams so that the pond does not discharge to the environment below a 200-year 24-hour storm runoff. This can include pumping to another location (e.g. a pond on the tailings surface), treating and releasing to the environment, releasing to the environment directly if the water quality is suitable or using spray evaporators to manage by evaporation.

12 CLOSING

This report is an instrument of service of Klohn Crippen Berger Ltd. The report has been prepared for the exclusive use of Resolution Copper Mining LLC (Client) for the specific application to the Resolution Copper Project, DEIS design for Alternative 3B, Near West Modified Proposed Action (High-density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell). The report's contents may not be relied upon by any other party without the express written permission of Klohn Crippen Berger. In this report, Klohn Crippen Berger has endeavored to comply with generally-accepted professional practice common to the local area. Klohn Crippen Berger makes no warranty, express or implied.

KLOHN CRIPPEN BERGER LTD.

Joseph Quinn, P.Geo. (AB), Ph.D.
Associate, Senior Engineering Geologist

Jim Casey, P.E.
Geotechnical Engineer

Expires 3/31/2021

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

Rick Friedel, P.E.
Principal, Senior Geotechnical Engineer

Expires 3/31/2021

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APPENDIX I

Design Basis Memorandum

Resolution Copper Project

DEIS Design for Alternative 3B – Near West Modified Proposed Action (High Density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell)

Technical Memorandum

Appendix I – Design Basis Memorandum

DISCLAIMER

1 INTRODUCTION

1.1 General

This is the design basis memorandum (DBM) for the design of Alternative 3B – Near West Modified Proposed Action (High-density thickened NPAG Scavenger and Segregated PAG Pyrite Cell) which is one of the tailings storage facility (TSF) design alternatives that Resolution Copper Mining LLC (RC) intends to include in the draft environmental impact statement (DEIS) for the proposed Resolution Copper Project. This TSF is located at the Near West location in Pinal County, Arizona. The DBM outlines the design objective as well as the design criteria and assumptions. This DBM is considered a "live" document that will be reviewed and updated throughout the design process.

1.2 Design Objective

The objective of the TSF is to store the tailings produced by the proposed Resolution Copper Project. The design incorporates findings from alternatives studies and site-specific data collected from site investigations, where applicable.

The design regulations and guidelines are outlined in Section 1.3, and the design criteria and assumptions are tabulated in Section 2.

The scope of the DEIS design is to provide a basis for comparing impacts from TSF alternatives.

1.3 Design Regulations and Guidelines

The TSF design is governed and guided by the regulations and guidelines listed below. The general approach adopted in this design is to set the design criteria based on the governing regulations, and then to supplement these regulations with guidelines from international practice where the governing regulations are not specific. Where international guidelines are more stringent than the governing regulations, consideration is also given to the additional measures needed to meet the more stringent guidelines.

Governing

Tailings Storage Facility and Seepage Collection Dams

- Arizona State Legislature. 2016. Arizona Administrative Code (A.A.C.).
  - Title 18. Environmental Quality. Chapter 9: Department of Environmental Quality – Water Pollution Control. Chapter 11: Department of Environmental Quality, Article 1: Water Quality Standards.
  - Arizona State Legislature. 2016. Arizona Revised Statutes (A.R.S.).
    - Title 49 – The Environment.
- Regulatory agency: Arizona Department of Environmental Quality (ADEQ).
- Environmental Protection Agency (EPA). Clean Water Act (CWA) - 33 U.S.C. §1251 et seq. (1972).
- Rio Tinto. 2017. D5 – Management of Tailings and Water Storage Facilities.

Seepage Collection Dams (only)

In addition to the above governing regulations, the seepage collection dams are regulated by the Arizona Department of Water Resources (ADWR). The additional application Arizona Administrative Code (A.A.C.) is Title 12. Natural Resources. Chapter 15. Department of Water Resources (A.A.C. R12-15).

Guidance

- Arizona Department of Environmental Quality (ADEQ). 2005. Arizona Mining Guidance Manual BADCT (Best Available Demonstrated Control Technology).
- British Columbia Ministry of Energy and Mines (MEM). 2016. *Health, Safety and Reclamation Code for Mines in British Columbia*.
- Canadian Dam Association (CDA). 2007a. *Dam Safety Guidelines (with 2013 revision).*
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- Federal Emergency Management Agency (FEMA). 2013. *Selecting and Accommodating Inflow Design Floods for Dams. FEMA-P-94.*
- United States Army Corps of Engineers (USACE). 2002. Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes).
- United States Army Corp of Engineers (USACE). 2004. *General Design and Construction Considerations for Earth and Rock-Fill Dams. EM 1110-2-2300.*
- United States Army Corp of Engineers (USACE). 2003. *Slope Stability. EM 1110-2-1902.*

1.4 BADCT Approach

The TSF will apply for an Aquifer Protection Permit (APP) with an “individual” Best Available Demonstrated Control Technology (BADCT) approach, which is performance based, and allows the applicant to select from all available Demonstrated Control Technologies (DCTs) that constitute BADCT. This process considers site specific characteristics, operational controls, and other DCTs.

Under the individual BADCT approach, the TSF is considered a “tailings impoundment” and will be designed in accordance with Section 3.5 of the BADCT manual (ADEQ 2005). The seepage dams are considered to be “surface ponds” and will be designed in accordance with Section 3.6 of the BADCT manual (ADEQ 2005) and the regulations pertaining to water dams (A.A.C. R12-15).

2 DESIGN CRITERIA

Table 2.1 Design Criteria

	Item	Design Criteria	Reference
1.0	**Tailings Storage Facility (TSF) Embankment Design**		
1.01a	CDA Consequence Classification	To be confirmed following inundation study	▪ CDA (2007a)
1.01b	Rio Tinto Risk Category	Class IV (considered Class IV until all necessary mitigations have been included in design)	▪ D5 Standard (Rio Tinto 2017)
1.02	Storage capacity	Capacity to store all NPAG scavenger (scavenger) and PAG pyrite (pyrite) tailings production	▪ RC requirement
1.03	Downstream slope	▪ No steeper than 2H:1V	▪ MEM (2016)
1.04	Minimum Factor of Safety	▪ Static (upstream or downstream) – 1.5 (during operation and long term) ▪ Liquefied/post-cyclic – 1.2 ▪ Rapid drawdown – N/A	▪ BADCT (ADEQ 2005) supplemented with MEM (2016) ▪ D5 Rio Tinto (2017) ▪ CDA (2007a) ▪ N/A
1.05	Deformations (seismic or static, e.g. settlement)	▪ For cases with no liquefiable materials, horizontal seismic coefficient for pseudo-static analysis = 0.6 x Peak ground acceleration (PGA). This seismic coefficient is selected to maintain consistency with the requirements of the seepage collection dams, as per A.A.C R12-15-1216. ▪ For elements of the TSF sensitive to deformation, a simplified deformation analysis is required. ▪ Predicted deformations shall not jeopardize containment integrity (e.g. does not reduce freeboard sufficiently to lead to an uncontrolled release of fluid tailings, does not impact the functionality of the drains, etc.).	▪ BADCT (ADEQ 2005) ▪ D5 Rio Tinto (2017)
1.06	Seismicity	▪ Maximum Credible Earthquake (MCE). Earthquake design ground motions will be selected in future design stages for appropriate return period events.	BADCT (ADEQ 2005) supplemented with MEM (2016), CDA (2014), D5 Rio Tinto (2017) and industry practice
1.07	Pond Storage Capacity (within the Pyrite Cell)	See Figure 2.1 Storage capacity = minimum operating volume + maximum average seasonal volume + volume required for operational upset + volume for critical duration storm event including sediment (Environmental Design Flood and Inflow Design Flood) + volume required for “dry” freeboard (Table 2.1, Item 1.11)	BADCT (ADEQ 2005)

Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
1.08	Storage Volume for Operational Upset Conditions	RC to confirm after RC internal risk audit and to be updated in next stage of design.	
1.09	Environmental Design Flood (EDF)	Minimum requirement for BADCT is 100-year 24 hr. Design will assume 200-year 24 hr; EDF will be confirmed through water balance and water quality modeling.	BADCT (ADEQ 2005)
1.10	Inflow Design Flood (IDF) For Dam Safety	Return Period: Probable Maximum Flood (PMF) Duration: For individual BADCT, the facility-specific critical design storm duration is established by considering several durations and determining which results in the maximum required storage capacity to contain the design flood volume. Therefore, the duration will be confirmed during the flood routing and water balance calculations: ▪ with a spillway: spillway sized for the critical duration of 6 hr to 72 hr; and ▪ without a spillway: minimum of 72 hr (to be confirmed based inflows and discharge rates).	BADCT (ADEQ 2005) FEMA (2013) MEM (2016) D5 Rio Tinto (2017)
1.11	"Dry" Freeboard for Perimeter Embankment	▪ Wind and wave run-up + 2 ft ▪ Wind event annual exceedance probability = 2-year ▪ Wave height and run-up to be calculated using industry standard methods ▪ Earthquake-induced settlements of the embankment crest to be assessed and included in minimum freeboard determination	▪ BADCT (ADEQ 2005) ▪ CDA (2007b) ▪ USACE (2002)
1.12	Beach length	Will become part of the Quantitative Performance Objectives (QPO) ▪ Sufficient to achieve seepage and hydraulic gradient criteria during normal operations and periods of flood storage. ▪ Sufficient to provide a secondary defense against loss of fluid tailings in the event of downstream slope displacement.	
1.13	Seepage	Water quality requirements at the point of compliance are to be assessed.	BADCT (ADEQ 2005), Clean Water Act (EPA) and Arizona State Legislature (A.A.C. R18-11)
1.14	Drains	▪ Provide drains/filters satisfying USACE (2004) guidelines to mitigate potential for internal erosion. ▪ Drains designed to maintain phreatic surface to acceptable levels within the embankment with adequate safety factor to account from clogging and uncertainty.	USACE (2004)

Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
1.15	Construction and Operations	▪ Quantifiable performance objectives to be defined prior to construction. ▪ All construction and borrow materials with contingency to be defined prior to construction.	MEM (2016)
1.16	Closure	Planned closure landscape is to be a physically stable landform without a permanent water pond that meets point of compliance criteria.	D5 Rio Tinto (2017)
1.17	Closure Surface Diversions	The design criteria will be selected based on consequence of failure, e.g. impact on other structures or environment.	BADCT (ADEQ 2005) D5 Rio Tinto (2017)
1.18	External Erosion Protection	The design criteria will be selected based on consequence of failure, e.g. impact to structural zones, containment, other structures or the environment. BADCT requires, at a minimum, that if the TSF is within the 100-year flood plain, drainage controls must be designed to protect the TSF from damage or flooding for 100-year peak streamflows.	BADCT (ADEQ 2005)
2.0	**Seepage Collection Dams**		
2.01	Assumed downstream hazard classification	High (will be reviewed for each individual seepage dam in future design stages).	A.A.C R12-15-1216
2.02	Downstream slope	As per Table 2.1, item 1.03	
2.03	Stability Factor of Safety (FOS)	▪ End of construction – Static (upstream or downstream) – 1.3 (≤ 50 ft high), 1.4 (> 50 ft high) ▪ Steady state seepage – Static – 1.5 ▪ Rapid drawdown – 1.2	A.A.C R12-15-1216 D5 Rio Tinto (2017)
2.04	Deformations (seismic or static, e.g. settlement)	▪ Pseudo-static – FOS = 1.0 with horizontal seismic coefficient = 0.6 x Peak ground acceleration (PGA). ▪ As per Table 2.1, item 1.05, where elements are sensitive to deformations, a simplified deformation analysis will be conducted to identify the potential displacements for comparison with allowable deformations for that element. ▪ Predicted deformations shall not jeopardize containment integrity (e.g. does not impact the integrity of the dam core or the spillway, etc.)	A.A.C R12-15-1216 and BADCT (ADEQ 2005) D5 Rio Tinto (2017)
2.05	Seismicity	▪ MCE, assumed to be mean 1:10,000 year return period: ♦ Sensitivity to 95th percentile to be considered	A.A.C R12-15-1216 supplemented with MEM (2016) and CDA (2007a)
2.06	Pond Storage Capacity	See Table 2.1, item 1.07	
2.07	Storage Volume for Operational Upset Conditions	One week of average seepage and precipitation to account for a period of pump shut-down	

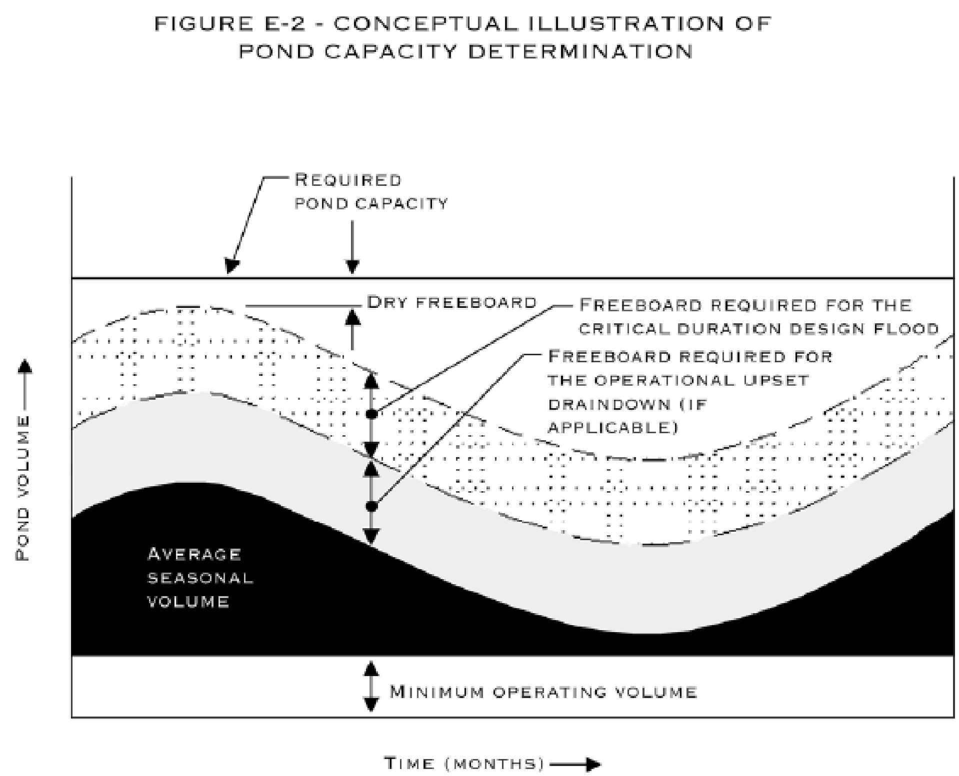
Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
2.08	Environmental Design Flood (EDF)	Minimum requirement for BADCT is 100-year 24 hr. TSF design will assume 200-year 24 hr; EDF will be confirmed through water balance and water quality modeling.	BADCT (ADEQ 2005)
2.09	Inflow Design Flood (IDF) For Dam Safety	Storm to be routed through spillway - Probable Maximum Flood (PMF) BADCT: Return Period: if failure of dam would pose an imminent risk to human life and/or high downstream incremental consequences the PMF should be used. Duration: For individual BADCT, the facility-specific critical design storm duration is established by considering several durations and determining which results in the maximum required storage capacity to route the design flood volume. The range of storm duration to be considered are 6 hr to 72 hr. A.A.C R12-15-1216: For a high hazard potential dam, the applicant shall design the dam to withstand an inflow design flood that varies from .5 PMF to the full PMF, with size increasing based on persons at risk and potential for downstream damage. The applicant shall consider foreseeable future conditions. FEMA (2013): PMF for a dam classified as high hazard.	BADCT (ADEQ 2005) A.A.C R12-15-1216 D5 Rio Tinto (2017) FEMA (2013)
2.10	Freeboard	Largest of: ▪ IDF + wave run up with a critical wind annual exceedance probability of the 1 in 2 year event ▪ IDF + 3 ft ▪ 5 ft	A.A.C R12-15-1216 with consideration from CDA (2007b)
2.11	Low level outlet (or discharge - pump)	Can discharge 90% of storage volume within 30 days (minimum capacity).	A.A.C R12-15-1216
2.12	Seepage	See Table 2.1, item 1.13	
2.13	Drains	▪ Provide core and drains/filters satisfying USACE (2004) guidelines to limit potential for internal erosion. ▪ Drains designed to maintain phreatic surface to acceptable levels within the embankment with adequate safety factor to account from clogging and uncertainty.	BADCT (ADEQ 2005), USACE (2004) and A.A.C R12-15-1216
2.14	Crest width	Minimum of dam height (centerline) divided by 5, plus 5 ft. Minimum crest width = 12 ft, maximum crest width = 25 ft.	A.A.C R12-15-1216

Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
2.15	Erosion protection	Well graded, durable riprap, sized to withstand wave action, placed on a well graded pervious sand and gravel bedding or geotextile with filtering capacity suitable for the site.	A.A.C R12-15-1216
2.16	External Erosion Protection	The design criteria will be selected based on consequence of failure, e.g. impact on other structures or environment. (BADCT requires, at a minimum, that if the TSF is within the 100-year flood plain, drainage controls must be designed to protect the TSF from damage or flooding for 100-year peak streamflows.)	BADCT (ADEQ 2005)

Figure 2.1 Pond Capacity Determination (ADEQ 2005)



3 DESIGN BASIS

Table 3.1 Design Assumptions, Constraints & Data Sources

	Item	Design Basis	Comments
1.0	**General Design Basis**		
1.01	TSF location	▪ Near West site, Pinal County, Arizona (USFS land) ▪ Coordinates (Arizona State Plane Central NAD83): 920,000' E, 880,000' N	
1.02	Mine Flow Sheet	Selective	
1.03	Mine life	41 years	Received from RC
1.04	TSF operating life	41 years	Received from RC
1.05	Tailings types	Two types of tailings are produced: ▪ scavenger tailings (84% of total weight); and ▪ pyrite tailings (16% of total weight).	Received from RC
1.06	Tailings technology	High-density thickened slurry (scavenger tailings); thickened slurry pyrite tailings).	
1.07	Tailings delivery	See process schematic (Figure 3.1). Scavenger "total" tailings and cyclone overflow discharged into the impoundment using a "thin lift" deposition method to maximize drying.	
1.08	Total tailings production	1.37 billion short tons	Received from RC
1.09	Ore and tailings production schedule	Table 3.2	
1.10	Units	U.S. Customary	
1.11	Embankment raise methodology	Hydraulically placed cycloned sand modified centerline (see Figure 3.2)	KCB (2017a)
1.12	Cycloned sand availability	Cycloned Sand Recovery: 45% Cyclone uptime: 50% (Year 1-2); 70% (Year 3-5); 80% (Year 6-41) Cycloned sand retention in hydraulic cells: 90%	Lower bound recovery from Krebs simulations (KCB 2018). To account for reduced efficiency at the start of operations; communicated by RC.
2.0	**Topography**		
2.01	Projection	Arizona State Plane Central	
2.02	Datum	NAD83	

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

<table>
<tr><th></th><th>Item</th><th>Design Basis</th><th>Comments</th></tr>
<tr><td>2.03</td><td>Unit of measurement</td><td>U.S. Customary</td><td></td></tr>
<tr><td>2.04</td><td>Survey</td><td>2013 LiDAR survey received from RC on June 5/6, 2013.</td><td></td></tr>
<tr><td>3.0</td><td colspan="2">Seismicity</td><td></td></tr>
<tr><td>3.01</td><td>Ground Motions</td><td>Not analyzed at this stage of design (refer to Table 3.1, Item 8.02).</td><td></td></tr>
<tr><td>3.0</td><td colspan="2">Climate and Hydrology</td><td></td></tr>
<tr><td>4.01</td><td>Average precipitation (in inches)</td><td><table><tr><th>J</th><th>F</th><th>M</th><th>A</th><th>M</th><th>J</th><th>J</th><th>A</th><th>S</th><th>O</th><th>N</th><th>D</th><th>Total</th></tr><tr><td>2.0</td><td>2.0</td><td>2.0</td><td>0.8</td><td>0.3</td><td>0.3</td><td>1.9</td><td>2.8</td><td>1.5</td><td>1.2</td><td>1.4</td><td>2.1</td><td>18.2</td></tr></table></td><td>Data collected at the Superior climate station (ID: 028348) with gaps filled using data from the regional climate stations.</td></tr>
<tr><td>4.02</td><td>Wet and dry year precipitations</td><td>Consideration to wet and dry years for the water balance will not be made at this stage of design.</td><td></td></tr>
<tr><td>4.03</td><td>Average annual pan evaporation</td><td>96.5 in</td><td>Pan evaporation data collected at the Roosevelt 1 WNW climate station (ID: 027281).
Free water surface evaporation determined using the Evaporation Atlas for the Contiguous 48 United States (NOAA 1982).</td></tr>
<tr><td>4.04</td><td>Evapotranspiration for reference surface/crop (in inches)</td><td><table><tr><th>J</th><th>F</th><th>M</th><th>A</th><th>M</th><th>J</th><th>J</th><th>A</th><th>S</th><th>O</th><th>N</th><th>D</th><th>Total</th></tr><tr><td>2.9</td><td>3.4</td><td>5.0</td><td>6.6</td><td>8.5</td><td>9.2</td><td>9.0</td><td>8.0</td><td>7.0</td><td>5.8</td><td>3.8</td><td>3.1</td><td>72.3</td></tr></table></td><td>Calculated using the Penman-Monteith combined equation in Hydrus1D based on the generated Superior climate data set and reference vegetation parameters.</td></tr>
<tr><td>4.05</td><td>Natural catchment runoff coefficient</td><td>0.15</td><td>Calculated by dividing the average annual runoff from the nearby USGS hydromet station by the average annual precipitation at site (KCB 2014).</td></tr>
<tr><td>4.06</td><td>Probable Maximum Precipitation (PMP)</td><td><table><tr><th rowspan="2">Storm Type</th><th colspan="3">PMP Depth (inches)</th></tr><tr><th>6 hour Duration</th><th>24 hour Duration</th><th>72 hour Duration</th></tr><tr><td>General Winter</td><td>4.9</td><td>9.0</td><td>13.3</td></tr><tr><td>Tropical</td><td>12.4</td><td>16.3</td><td>20.4</td></tr><tr><td>Local</td><td>12.1</td><td>-</td><td>-</td></tr></table></td><td>Applied Weather Associates PMP Evaluation Tool. Determined as the critical storm for design. For the Near West site catchment.</td></tr>
<tr><td>4.07</td><td>Runoff coefficient during storm events</td><td>1.0</td><td>To account for high antecedent moisture conditions and the predominantly exposed rock in the catchment</td></tr>
<tr><td>4.08</td><td>Extreme point precipitation depths</td><td>See Table 3.3</td><td>From NOAA Atlas 14 (NOAA 2018).</td></tr>
</table>

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis		Comments
5.0	**Tailings Characteristics and Deposition**			
		Scavenger Tailings	**Pyrite Tailings**	
5.01	Target gradation produced at mill	*"Total" Tailings:* Target P80 = 160 microns 50% fines (<74 microns) <10% clay (<2 microns)	Target P80 = 75 to 80 microns 80% fines (<74 microns) <20% clay (<2 microns)	Scavenger "Total" Tailings: Provided by RC. Pyrite Tailings: Provided by RC. Clay content assumed from previous test work on cleaner tailings. See Figure 3.3
5.02	Target gradation produced by cyclones	*Cycloned Sand (Underflow)*: Target P80 = 200 microns <20 % fines (<74 microns) 0% clay (<2 microns) *Cyclone Overflow:* Target P80 = 60 microns 90% fines (<74 microns) 15% clay (<2 microns)	N/A	Provided by RC. See Figure 3.3. Target fines content for cycloned sand to be less than 20%, based on seepage performance and constructability from other cycloned sand embankment case histories.
5.03	Specific gravity	2.78	3.87	Average values from KCB laboratory testing programs on scavenger "total" tailings and cleaner tailings.
5.04	Solids content pumped from the mill	65%	50%	Provided by RC
5.05	Cyclone solids content	*Cyclone Feed:* 35% *Cyclone Overflow:* 25% *Cycloned Sand:* 70%	N/A	From most recent Krebs simulations (KCB 2018).
5.06	Solids content discharged into TSF	*"Total" Tailings:* 70% *Cyclone Overflow:* 62% *Cycloned Sand:* 60%	50%	"Total" scavenger tailings and cyclone overflow solids content preliminarily estimated to minimize slurry bleed water, while still allowing for the use of a high-rate thickener type and allowing the tailings to be transported and deposited as a slurry. Cycloned sand solids content based on case history data and construction performance at other large cycloned sand embankments that use hydraulic cell construction. To be confirmed from ongoing rheology testing and future design and constructability trade-offs.
5.07	Liquefaction assumption	All potentially liquefiable tailings will liquefy at the TSF, regardless of triggering mechanism.		

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis		Comments
5.08	Pyrite tailings management	N/A	Subaqueous deposition	
5.09	Tailings beach slopes (above water)	1% within 1,500 ft of discharge point, 0.5% thereafter	N/A	Scavenger Tailings - Based on topography and bathymetry surveys from two large, cycloned sand impoundment beaches and slopes below water. These facilities have long exposed beaches, up to five miles. High-density thickened tailings may have steeper slopes than unthickened slurry tailings for the first few hundred feet along the beach, however, the preliminary beach slopes were kept consistent with Alternative 3A at this conceptual stage.
5.10	Tailings beach slopes (below water)	N/A	10% within 100 ft of discharge point; 0.5% thereafter	Pyrite Tailings - Based on topography and bathymetry surveys of subaqueous disposal of high-pyrite tailings from floating barges.
5.11	Dry beach runoff coefficient	0.15	N/A	Estimate based on Hydrus1D infiltration modeling.
5.12	Dry density for annual staging assessments	*Interlayered "Total" Tailings and Cyclone Overflow (Composite Beach):* 75 pcf (first 5 years of operations); 81 pcf (remaining years of operations) *Cycloned Sand (compacted):* 113 pcf	106 pcf	KCB (2018)
6.0	**Cyclone Plant Design**			
6.01	No. of Clusters	2		
6.02	Feed Tonnage	5,040 dry stph		
6.03	Feed Flow	45,267 USGPM		
6.04	Solids Content of Feed, Overflow, Underflow	see Table 3.1, Item 5.05		
6.05	Pressure Drop	15 psi		
6.06	Target No. of Spare Cyclones per Cluster	2		

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis	Comments
6.07	Target No. of Spare Ports per Cluster	1	
6.08	Selected Cyclone Model	gMAX15U	
6.09	Selected Cyclone Vortex	6.75 inches	
6.10	Selected Cyclone Apex	3 inches	
6.11	Selected Cyclone Diameter	15 inches	
6.12	Selected Operating Cyclones per Cluster	24	
6.13	Selected No. of Spare Cyclones per Cluster	2	
6.14	Selected No. of Cyclones Installed per Cluster	26	
6.15	Selected No. of Spare Ports per Cluster	2	
7.0	**Thickener Design**		
7.01	Thickener Type	High-Density	
7.02	No. of Thickeners	2	
7.03	Design Tonnage	144,000 tpd ore	
7.04	Diluted Feed %solids	20%	
7.05	Underflow %solids (Cyclone Overflow Feed)	62%	
7.06	Underflow %solids (Scavenger Total Tailings Feed)	70%	
7.07	Unit Settling Rate	0.98 ft^2/tpd	
7.08	Sizing Design Allowance	15%	
7.09	Thickener Diameter	250 ft	

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis	Comments
8.0	**Tailings Storage Facility (TSF) Impoundment Design**		
8.01	Design criteria	As per Table 2.1.	
8.02	Stability and Deformations	Embankment section (Figure 3.2) assumed to meet design stability and deformation criteria for DEIS	Based on preliminary stability analyses reported in KCB (2017a) and assumed typical foundation conditions at the Near West site (KCB 2017b)
8.03	Perimeter Embankment Crest width	100 ft	Sufficient to accommodate 2-way vehicle traffic, pipelines and any other equipment required to be on the crest (e.g. cyclones).
8.04	Perimeter Embankment Downstream Slope	3H:1V (see Figure 3.2)	Assumed based on preliminary stability analysis reported in KCB (2017a)
8.05	Perimeter Embankment Upstream Slope	1H:1V (see Figure 3.2)	Assumed based on preliminary stability analysis reported in KCB (2017a)
8.06	Pyrite Cell Splitter Berm Crest Width	100 ft	Sufficient to accommodate hydraulic cell construction
8.07	Pyrite Cell Splitter Berm Downstream Slope	Vertical	Assumed based on support provided on both sides of the berm by tailings. To be analyzed in future design stages.
8.08	Pyrite Cell Splitter Berm Upstream Slope	Vertical	
8.09	Liner	Pyrite cell: Engineered low-permeability liner[2] beneath the cell, and extended vertically to separate from scavenger tailings Scavenger area: selective engineered low-permeability liner[2] placement over the foundation	
8.10	Drainage	Sand and gravel drainage blanket in the embankment footprint; gravel/rockfill finger drains in existing drainage channels in the embankment footprint	
8.11	Closure	TSF Surfaces: slope, cover and revegetate to shed water, limit infiltration, limit erosion and return the landscape to a similar condition prior to mining. Pyrite management: limit oxygen ingress through subaqueous deposition, cover and encourage saturation of the pyrite tailings in the long term (i.e. after removal of the pond).	Approach agreed by RC

[2] The engineered low-permeability liner could be comprised of one or more of the following: compacted fine tailings, geomembrane liner, asphalt, slurry bentonite, and/or cemented paste tailings

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis	Comments
9.0	**Pond Management**		
9.01	Pond management	▪ No permanent water pond in the scavenger tailings area; permanent pond maintained in the pyrite cell. Ponded water on the scavenger tailings surfaces will be collected and transferred to the pyrite cell.	D5 Rio Tinto (2017)
9.02	Minimum operating pond volume	▪ Minimum amount to keep pyrite tailings saturated and provide operating pond depth.	
9.03	Minimum operating pond depth	▪ Seepage Collection Dams: 10 ft for reclaim pump (could be accounted for by a sump). ▪ Minimum Water Cover above Maximum Tailings El. in pyrite cell: 10 ft	

Table 3.2 Mine and Tailings Production Schedule

Description	Year	Mine Year	Modeling Year	Tailings Tonnage (tons/year)		
				Scavenger	Pyrite	Total
Care and Maintenance	2017	-	1	-	-	-
Care and Maintenance	2018	-	2	-	-	-
Care and Maintenance	2019	-	3	-	-	-
Care and Maintenance	2020	-	4	-	-	-
Construction	2021	-	5	-	-	-
Construction	2022	-	6	-	-	-
Construction	2023	-	7	-	-	-
Construction	2024	-	8	-	-	-
Construction	2025	-	9	-	-	-
Construction	2026	-	10	-	-	-
Construction	2027	-	11	-	-	-
First Ore	2028	1	12	5,346,486	766,631	6,113,118
Ramp up	2029	2	13	7,187,504	991,640	8,179,144
Ramp up	2030	3	14	7,897,945	1,014,556	8,912,501
Ramp up	2031	4	15	15,085,826	2,110,526	17,196,352
Ramp up	2032	5	16	21,902,288	3,328,288	25,230,577
Ramp up	2033	6	17	28,780,765	4,569,518	33,350,283
Ramp up	2034	7	18	34,178,734	5,793,075	39,971,810
Full Production	2035	8	19	37,849,588	7,340,459	45,190,047
Full Production	2036	9	20	37,128,274	8,184,034	45,312,308
Full Production	2037	10	21	36,749,978	8,772,867	45,522,845
Full Production	2038	11	22	37,121,210	8,792,910	45,914,120
Full Production	2039	12	23	38,040,923	8,019,027	46,059,950
Full Production	2040	13	24	37,486,298	6,800,935	44,287,232
Full Production	2041	14	25	39,582,789	6,518,836	46,101,626
Full Production	2042	15	26	39,666,729	6,589,905	46,256,634
Full Production	2043	16	27	39,211,923	6,919,174	46,131,097
Full Production	2044	17	28	38,679,739	7,360,739	46,040,478
Full Production	2045	18	29	38,273,841	7,838,027	46,111,868

Table 3.2 Mine and Tailings Production Schedule (cont'd)

Description	Year	Mine Year	Modeling Year	Tailings Tonnage (tons/year)		
				Scavenger	Pyrite	Total
Full Production	2046	19	30	38,130,733	8,150,877	46,281,610
Full Production	2047	20	31	38,448,597	7,968,471	46,417,068
Full Production	2048	21	32	38,926,908	7,537,946	46,464,854
Full Production	2049	22	33	39,028,952	7,382,565	46,411,517
Full Production	2050	23	34	39,006,219	7,367,901	46,374,120
Full Production	2051	24	35	38,564,309	7,824,341	46,388,650
Full Production	2052	25	36	38,008,651	8,406,901	46,415,552
Full Production	2053	26	37	37,822,090	8,629,862	46,451,952
Full Production	2054	27	38	38,599,981	7,902,469	46,502,450
Full Production	2055	28	39	39,472,443	6,988,070	46,460,513
Full Production	2056	29	40	39,579,974	6,796,869	46,376,843
Full Production	2057	30	41	39,595,841	6,786,681	46,382,522
Full Production	2058	31	42	39,503,382	6,740,343	46,243,725
Ramp Down	2059	32	43	31,481,866	5,391,484	36,873,350
Ramp Down	2060	33	44	24,576,943	4,320,111	28,897,054
Ramp Down	2061	34	45	18,707,166	3,478,519	22,185,685
Ramp Down	2062	35	46	13,146,108	2,643,079	15,789,186
Ramp Down	2063	36	47	9,566,562	1,952,428	11,518,989
Ramp Down	2064	37	48	4,993,554	1,079,281	6,072,835
Ramp Down	2065	38	49	2,121,484	545,241	2,666,725
Ramp Down	2066	39	50	928,110	274,819	1,202,929
Ramp Down	2067	40	51	326,877	99,724	426,602
Ramp Down	2068	41	52	19,505	4,936	24,440
Closure	2069	-	53	-	-	-
			TOTAL TAILINGS	**1,150,727,095**	**219,984,066**	**1,370,711,161**

Notes: Tailings production schedule supplied by Resolution Copper.
Mine plan descriptions, mine years and modeling years supplied by Resolution Copper.

Table 3.3 Precipitation Depth-Duration-Frequency Estimates for the TSF

Average Recurrence Interval (years)	5 min	10 min	15 min	30 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr	2 day	3 day	4 day	7 day	10 day	20 day	30 day	45 day	60 day
Precipitation in inches																			
1	0.2	0.4	0.4	0.6	0.7	0.9	0.9	1.1	1.3	1.6	1.8	2.0	2.1	2.4	2.7	3.3	4.0	4.7	5.5
2	0.3	0.5	0.6	0.8	1.0	1.1	1.2	1.4	1.7	2.0	2.3	2.5	2.7	3.0	3.4	4.2	5.1	6.0	6.9
5	0.4	0.6	0.8	1.1	1.3	1.5	1.5	1.8	2.1	2.6	2.9	3.2	3.5	3.9	4.3	5.4	6.5	7.7	8.7
10	0.5	0.8	0.9	1.3	1.6	1.7	1.8	2.1	2.4	3.0	3.5	3.8	4.1	4.7	5.1	6.4	7.6	8.9	10.1
25	0.6	0.9	1.1	1.5	1.9	2.1	2.2	2.5	2.8	3.6	4.2	4.6	5.0	5.8	6.2	7.7	9.1	10.6	11.9
50	0.7	1.0	1.3	1.7	2.2	2.4	2.5	2.8	3.2	4.1	4.7	5.2	5.7	6.7	7.2	8.7	10.3	12.0	13.3
100	0.8	1.2	1.5	2.0	2.4	2.7	2.8	3.1	3.5	4.6	5.3	5.9	6.5	7.6	8.2	9.8	11.6	13.3	14.7
200	0.9	1.3	1.6	2.2	2.7	3.0	3.1	3.4	3.9	5.1	5.9	6.6	7.4	8.7	9.2	10.9	12.9	14.6	16.1
500	1.0	1.5	1.8	2.4	3.0	3.4	3.6	3.9	4.4	5.8	6.8	7.7	8.5	10.2	10.7	12.4	14.7	16.5	17.9
1000	1.1	1.6	2.0	2.7	3.3	3.7	3.9	4.2	4.7	6.4	7.4	8.5	9.5	11.4	12.0	13.6	16.1	17.9	19.3

Note: From NOAA Atlas 14 (NOAA 2018) for the Near West site.

Figure 3.1 Process Schematic

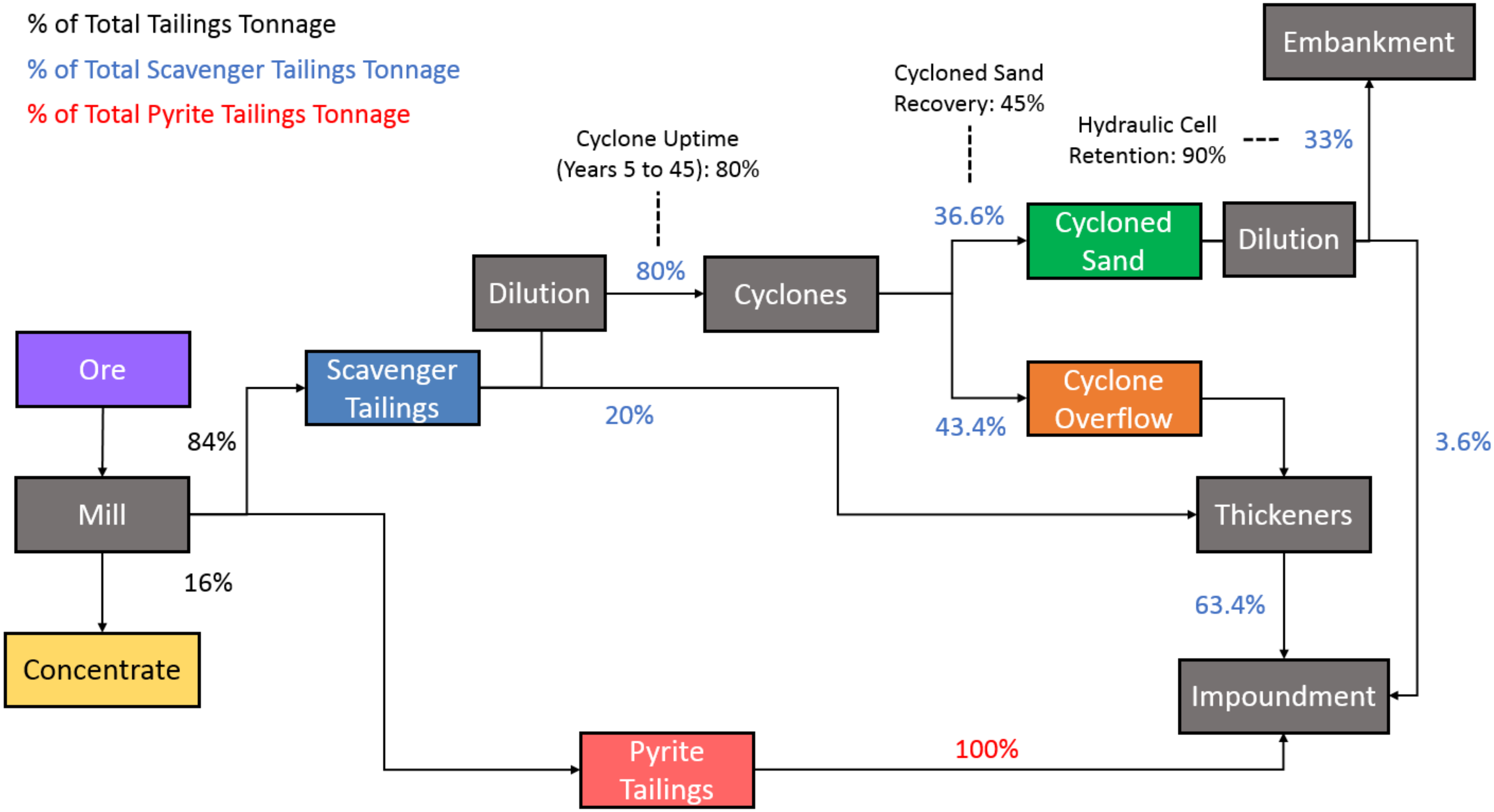


Figure 3.2 Modified Centerline Raise

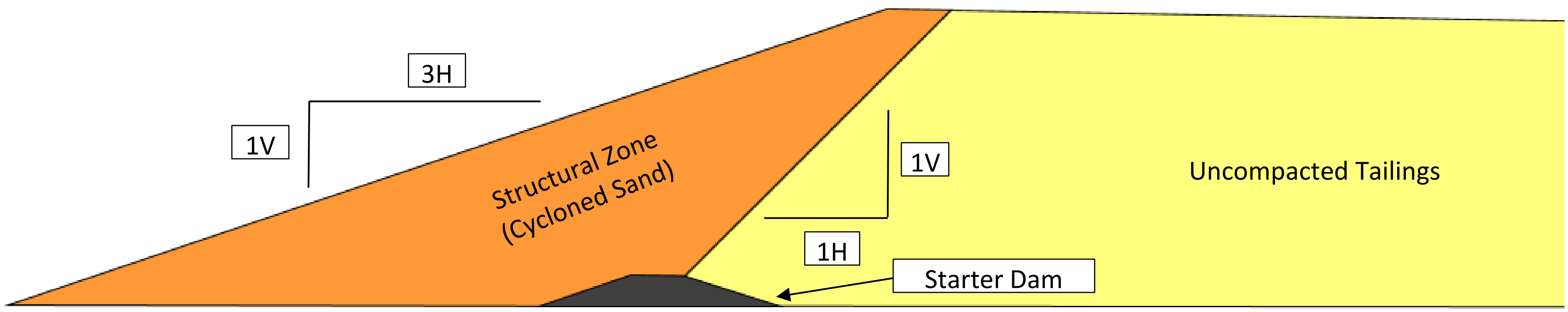
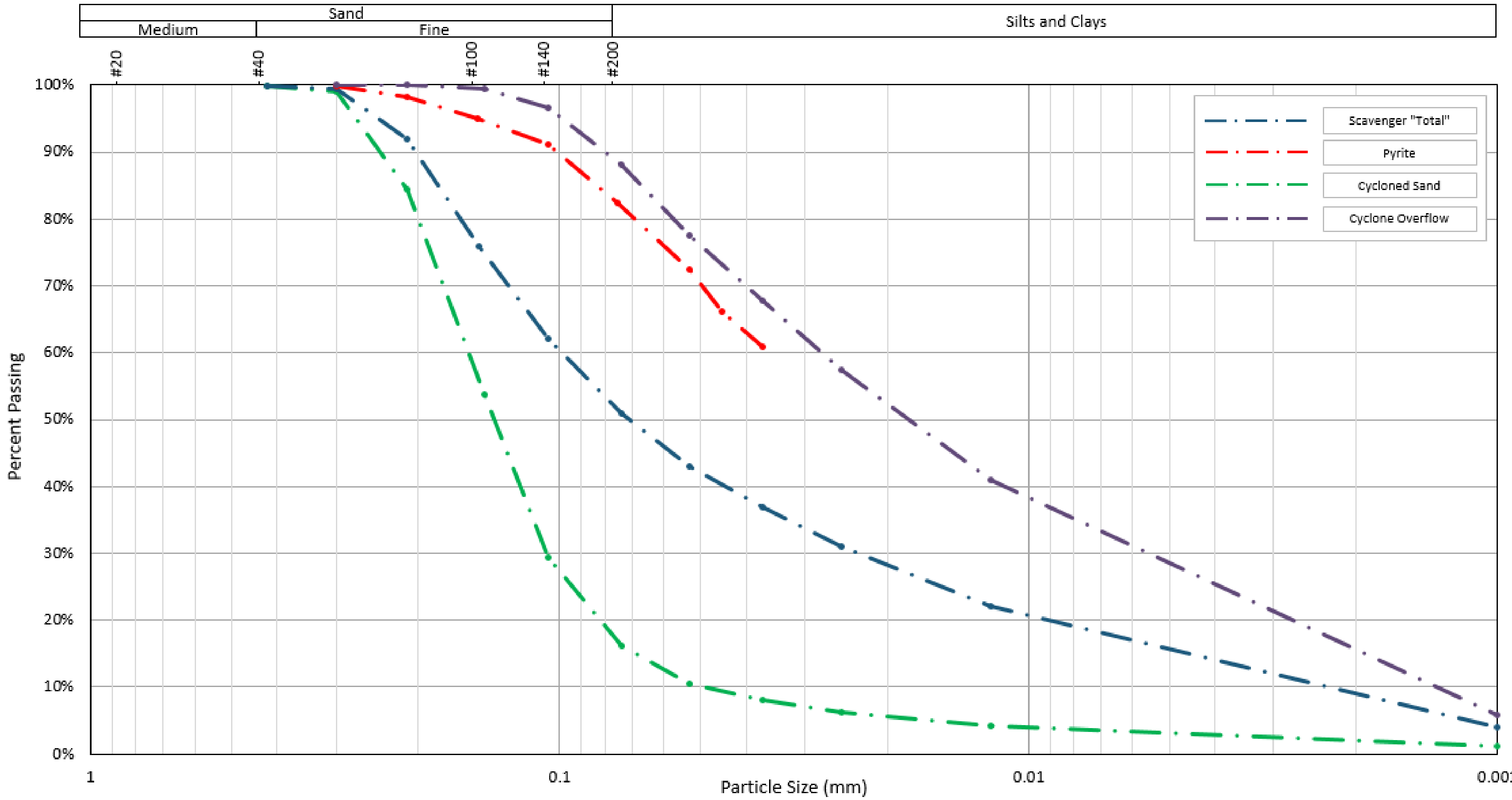


Figure 3.3 Target Tailings Gradations for Design



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APPENDIX II

Tailings Staging Plan

Resolution Copper Project

DEIS Design for Alternative 3B – Near West Modified Proposed Action (High-Density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell)

Technical Memorandum

Appendix II – Impoundment Layout and Tailings Staging Plan

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II-1 INTRODUCTION

This appendix presents the tailings staging plan for the Draft Environmental Impact Statement (DEIS) design for the Alternative 3B - Near West Modified Proposed Action (High-density thickened NPAG Scavenger and Segregated PAG Pyrite Cell) (Alternative 3B) tailings storage facility (TSF). The ultimate configuration presented herein was completed using the tailings deposition software Muck3D (MineBridge Software Inc., version 1.0.5). Ultimate TSF horizontal stage-storage curves were calculated using Muck3D. Then, the TSF raising schedule was estimated in excel using the ultimate configuration horizontal stage-storage curves, the tailings production schedule and the predicted tailings densities.

Key objectives of the tailings staging scope were as follows:

- confirm ultimate configuration required to meet storage requirements;
- develop a tailings deposition strategy that:
  - deposits the PAG pyrite (pyrite) tailings subaqueously in a segregated cell within the TSF;
  - provides required tailings and flood storage volumes;
  - manages the scavenger tailings beaches as dry where practical; and
  - establishes the ultimate exterior embankment slope as soon as practical to allow progressive reclamation.
- estimate annual and cumulative cycloned sand requirements[1] to support embankment and splitter berm construction;
- estimate the crest elevation and rate of rise for the perimeter embankment and splitter berms over the life of the mine; and
- identify potential periods when maintaining consistent elevations for the embankment, scavenger beach, splitter berm and pyrite tailings surface may be challenging.

II-2 ULTIMATE LAYOUT

The Alternative 3B ultimate layout is similar to Alternative 3A (KCB 2018) except:

- the downstream cycloned NPAG scavenger (scavenger) tailings embankment slope is 3H:1V; and
- the pyrite tailings are stored in a segregated cell within the TSF (still subaqueously).

[1] At this conceptual level, the embankment and splitter berm are assumed to be constructed of cycloned sand. A potential optimization is to use total scavenger tailings, which will be considered in future design stages.

The ultimate Alternative 3B layout is shown in the attachment, Figure II-A.1. The key features of Alternative 3B TSF layout include the following:

- Upstream non-contact water diversions. These would similar to Alternative 3A, and at this stage of design, the Alternative 3A diversions were assumed for the Alternative 3B layout.
- A borrow excavation area within the TSF footprint similar to Alternative 3A; at this stage of design, the Alternative 3A borrow area was assumed for the Alternative 3B layout.
- Starter dams constructed of borrow material to store tailings in early years of operations before the cycloned sand embankment is established. The starter facilities from Alternative 3A were assumed for the Alternative 3B layout.
- An embankment constructed of cycloned sand in a modified centerline configuration with a 100 ft crest, 3H:1V downstream slope, and 1H:1V[3] interface between the cycloned sand embankment and the hydraulically deposited beach tailings.
- Segregated pyrite tailings cell (contained by a splitter berm) within the TSF footprint. Potential use of engineered low-permeability liners[4] for vertical and lateral containment to manage downstream water quality, as required. A reclaim pond would be maintained within the cell to maintain a water cover over the pyrite tailings. The pyrite cell is sized for the expected volume of pyrite tailings, an operating pond, flood storage for the scavenger beach and pyrite cell catchment and 'dry' freeboard (see DBM, Appendix I). Contingency storage is included (approximately 15%) to account for variations in production and uncertainties with tailings density estimates.
- Embankment and scavenger beach seepage control and mitigation measures (engineered low-permeability liners[4], blanket drains, finger drains, seepage collection dams, grout curtains, etc.) would be similar to Alternative 3A; therefore, the Alternative 3A seepage mitigation measures were assumed for the Alternative 3B layout.

The tailings and pond management strategy would comprise the following:

- Scavenger tailings would be cycloned for embankment construction. Scavenger total tailings that bypass the cyclones and cyclone overflow would be thickened and deposited in thin lifts upstream of the embankment crest (to maximize drying through evaporation and reduce entrained pore water that could be lost as seepage).
- Scavenger beach would be maintained dry (i.e. no pond) where possible to promote evaporation losses. Precipitation runoff from scavenger beach would be temporarily collected

---

[3] Interface slope required for stability based on Alternative 3A configuration (KCB 2017), optimizations to be assessed in future design stages.
[4] Low-permeability containment details to be determined in future design stages but could comprise of one or more of the following: geomembrane liner, compacted fine tailings, asphalt core, slurry bentonite, cemented paste tailings, polymers, etc.[5] The Environmental Design Flood (EDF) for the scavenger tailings surface would be the 200-yr 24-hr storm event. The Inflow Design Flood (IDF) required for dam safety would be the Probable Maximum Flood (PMF).

in designated low spots or routed directly to downstream containment or the reclaim pond in the pyrite cell[5].

- Pyrite tailings would be deposited from a floating barge or pipelines into the pyrite cell.
- Water in the reclaim pond would be reclaimed back to the West Plant from a floating barge where it would be reintroduced back into the processing circuit.

II-3 TAILINGS DEPOSITION MODELING APPROACH

For this preliminary deposition modeling, the ultimate TSF configuration (developed in MUCK3D) was divided into three regions: cycloned sand embankment and; scavenger beach; and pyrite tailings cell (refer to Figure II-1). Stage-storage curves for each region developed from the ultimate MUCK3D TSF configuration are shown on Figure II-2. The forecasted annual tailings production in each region was used to estimate the annual crest/impoundment level in Excel, based on the following “rules”:

- Cycloned sand embankment crest must be 15 ft higher than the scavenger beach, to account for scavenger beach tailings deposition slopes which is not considered in the stage storage curves.
- Crest elevation of the pyrite cell splitter berm must be the same as the cycloned sand embankment crest.
- Scavenger tailings that are not cycloned for embankment construction report to the scavenger beach.
- The tailings elevations in the pyrite cell is kept approximately 15 ft to 20 ft below the crest of the pyrite cell splitter berm, to account for the pyrite cell storage requirements outlined in Section II-4.9 and Section II-4.10. During periods where the pyrite cell has excess capacity to store pyrite tailings, cyclone overflow tailings are assumed to be deposited into the pyrite cell to maintain elevation raising requirements.
- A minimum water cover of 10 ft over the pyrite tailings must be maintained which is a conservative depth for reclaim barge and pyrite deposition barge draft as well as accounts for uncertainty in the seepage losses and therefore the ability to form/maintain a pond during start-up.

[5] The Environmental Design Flood (EDF) for the scavenger tailings surface would be the 200-yr 24-hr storm event. The Inflow Design Flood (IDF) required for dam safety would be the Probable Maximum Flood (PMF).

Figure II-1 TSF Regions for Staging Assessment

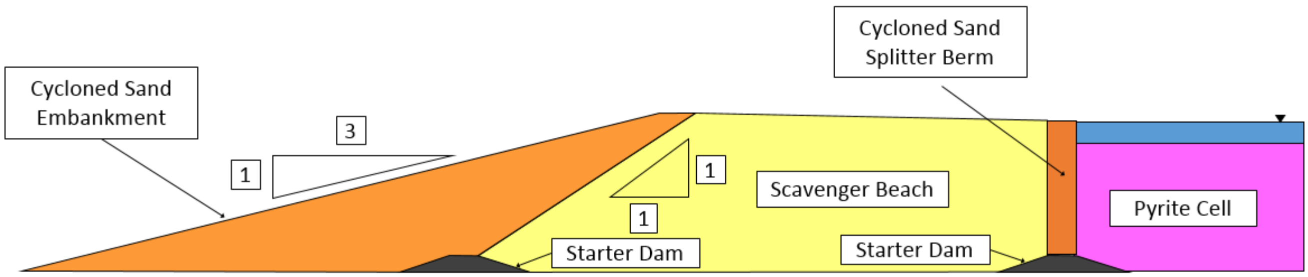
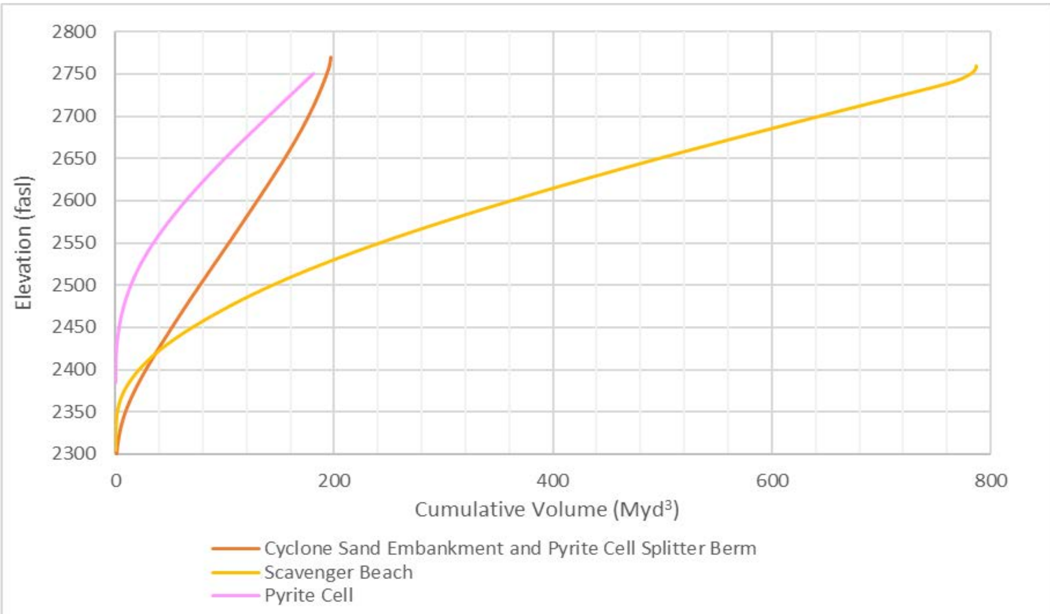


Figure II-2 TSF Region Horizontal Stage-Storage Curves



Note: The cyclone sand embankment and pyrite cell splitter berm volumes have been combined, because after the pyrite cell starter dam, these would need to be raised at approximately the same rise rate.

II-4 MODELING INPUT PARAMETERS AND ASSUMPTIONS

II-4.1 Ultimate TSF Configuration

The required model input parameters for the ultimate TSF Muck3D modeling are:

- baseline topography;
- discharge locations (i.e. spigots);
- tailings subaerial beach and below water slopes (see Section II-4.5);
- tailings dry density (see Section II-4.5); and
- tailings production (tons) (see Section II-4.3).

II-4.2 Borrow Area

The Alternative 3A borrow area within the Gila Conglomerate in Bear Tank Canyon, upstream of the Pyrite Starter Dam (KCB 2018), was assumed for the Alternative 3B layout. The borrow excavation would provide 27 Myd^3 of fill to support construction of the starter dams, seepage collection dams and north dams. The volume of removed borrow was incorporated into the pyrite cell stage-storage curve (see Figure II-2). The borrow area would be excavated as needed as much as practical, starting at the south end and progressing to the north. Structures in the TSF requiring general fill would be constructed prior to the borrow area being inundated with tailings to avoid double handling. The calculated excavation volume does not account for volume increase (bulking) during excavation or volume decreases that may occur during construction fill processing.

The borrow area layout is preliminary for the purposes of tailings staging and further details will be developed in future design stages. Further investigation will be conducted to identify other borrow areas for different stages of construction/operations.

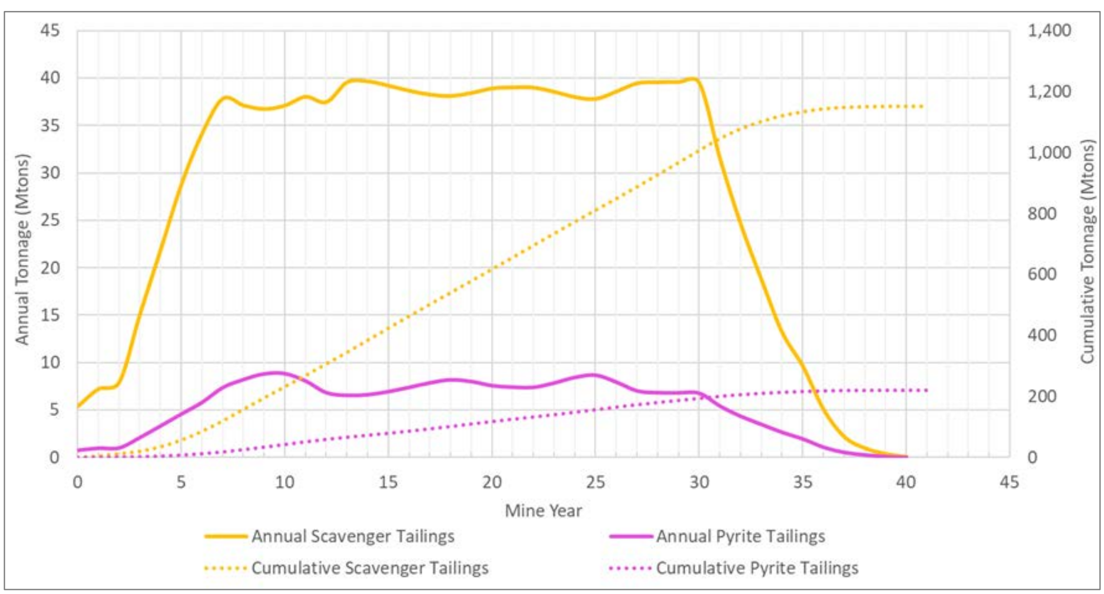
II-4.3 Tailings Production Schedule

The tailings production schedule is shown on Figure II-3 and summarized in Table II-1.

Table II-1 Total Tailings Production Comparison

Item	DEIS Production Schedule
Scavenger Tailings	1,151 Mtons
Pyrite Tailings	220 Mtons
Total Tailings (scavenger and pyrite)	1,371 Mtons
Amount of Pyrite Tailings as Percentage of Total Tailings	16%
Number of Production Years	41

Figure II-3 Tailings Production Schedule

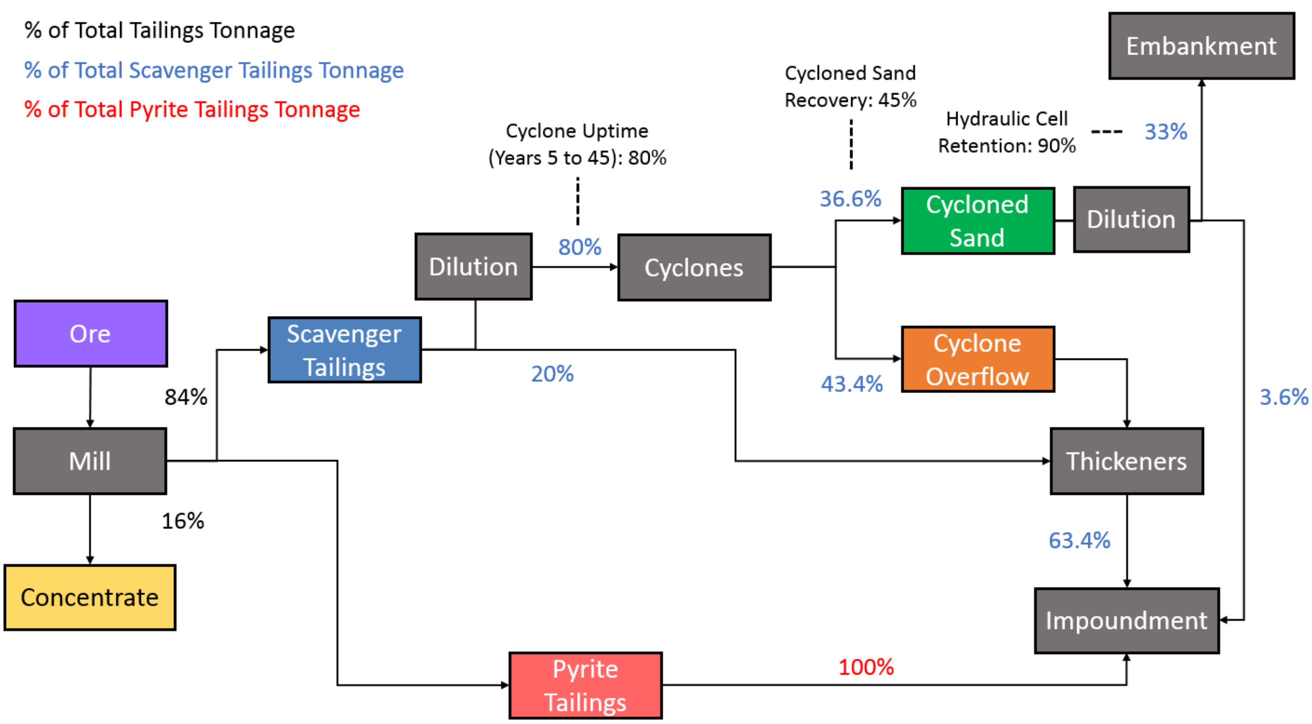


II-4.4 Tailings Process Flow Diagram

The tailings process flow diagram for Alternative 3B is shown schematically on Figure II-4. The maximum amount of cycloned sand that could be produced and placed in the cycloned sand embankment, as a percentage of the total scavenger tailings tonnage, is approximately 32% to 33% (from Year 5 onwards). This assumption is based on the following:

- 45% cycloned sand recovery from the cyclone system, based on cyclone simulations performed by Krebs (Jan 2018);
- 90% cycloned sand retention in the hydraulic cells used for perimeter embankment and splitter berm construction; and
- 50% cyclone uptime in Years 1 to 2, 70% in Years 3 to 4 and 80% in Years 5 to 41 (to account for reduced cyclone efficiency and adjustments to the milling process at the start of operations).

Figure II-4 Tailings Process Flow Diagram



Notes:

1. The water balance appendix (Appendix III) includes an expanded process flow chart.
2. Cycloned sand not retained from the embankment cells (3.6% of scavenger tailings tonnage) was deposited within the impoundment using the total scavenger/overflow in-situ dry density.

II-4.5 Tailings Properties

Tailings deposition properties are summarized in Table II-2 (see the design basis memorandum (DBM) in Appendix I for further details). A lower density for the total scavenger tailings and cyclone overflow was chosen in Years 1 through 5 for staging to provide additional storage contingency for early year planning.

For this preliminary stage of assessment, the same deposition slopes as Alternative 3A were assumed for the ultimate TSF configuration; however, the higher percent solids achieved from scavenger tailings thickening in Alternative 3B would result in slightly steeper slopes on the scavenger beach, particularly close to the deposition location. The beach slopes would be monitored throughout operations and the staging plan adjusted as necessary.

Table II-2 Tailings Deposition Properties

Tailings Stream	Tailings Type	Dry Density (pcf)	Deposition Solids Content (%)	Tailings Slopes[1]	Total Tonnage (Mtons)	Total Volume (Myd^3)[2]
Scavenger	Total	Years (0-5): 75 Years (6-41): 81	70%	Above Water: 1% for the first 1,500 ft, 0.5% after 1,500 ft	1150	958
	Cyclone Overflow		62%		544	499
	Cycloned Sand	113	60%		370	243
Pyrite	Total	106	50%	Below Water: 10.0% for the first 100 ft, 0.5% after 100 ft. These slopes are understood to be conservative at this stage of design and will be reviewed in future design stages.	220	154

Notes: 1. Scavenger tailings slopes are based on topography and bathymetry surveys from two large, cycloned sand impoundment beaches and slopes below water. These facilities have long exposed beaches, up to five miles. Pyrite tailings slopes are based on topography and bathymetry surveys of subaqueous disposal of high-pyrite tailings from floating barges.
2. Volumes given assume all available scavenger tailings is cycloned. Therefore, these are not consistent with the final staging results presented in Section II-5.

II-4.6 Impoundment Layout

The ultimate impoundment layout was based on the following:

- Cycloned sand embankment toe offset 30 ft (minimum) elevation below the ridges which bound the impoundment to the east and west.
- Cycloned sand embankment toe offset 1,650 ft (minimum) horizontally from Queen Creek normal high-water mark. This requirement was established through discussions with RC.
- Cycloned sand embankment toe offset 1,000 ft (minimum) horizontally from Roblas Creek. This requirement was established through discussions with RC.

II-4.7 Cycloned Sand Embankment Raise Methodology

Two approaches to modeling the construction of the cycloned sand embankment were considered:

- “sloped methodology”: the downstream slope of the embankment is maintained at all times, refer to Figure II-5. This represents the minimum amount of cycloned sand that must be placed annually to meet the crest elevation requirement, but does not allow for progressive reclamation to begin;
- “horizontal slice methodology”: the embankment is constructed in horizontal slices that extend to the ultimate downstream face, refer to Figure II-6. This represents the minimum amount of cycloned sand that must be placed annually to meet the crest elevation requirement and establish the downstream slope so that progressive reclamation can begin. The stage-storage curve shown in Figure II-2 is based on this construction methodology.

Due to construction constraints and cycloned sand availability, the actual embankment raising methodology would use a combination of these strategies, for example refer to Figure II-7.

During the mine life, adequate cycloned sand is forecast to be available for embankment construction using the sloped embankment construction methodology (Figure II-5). For this preliminary assessment, when there is not enough cycloned sand available to construct the embankment using the horizontal slice methodology (Figure II-6), it was assumed that the embankment would be constructed using the combination approach (Figure II-7).

Figure II-5 Downstream Sloped Embankment Raises

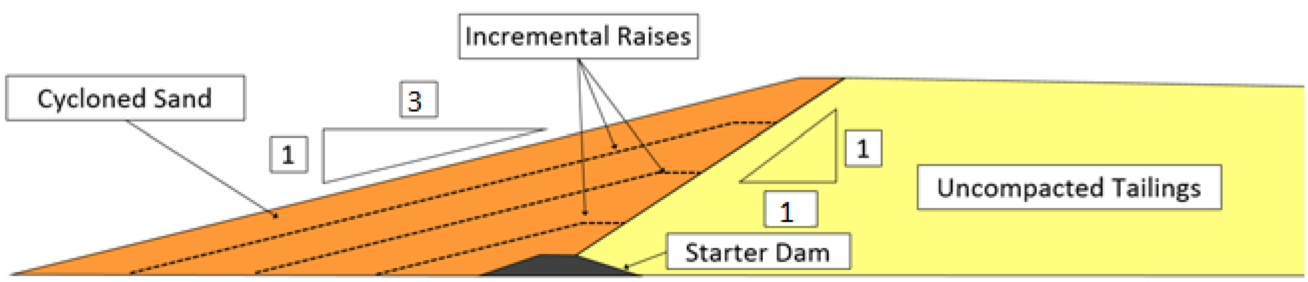


Figure II-6 Horizontal Slice Embankment Raises

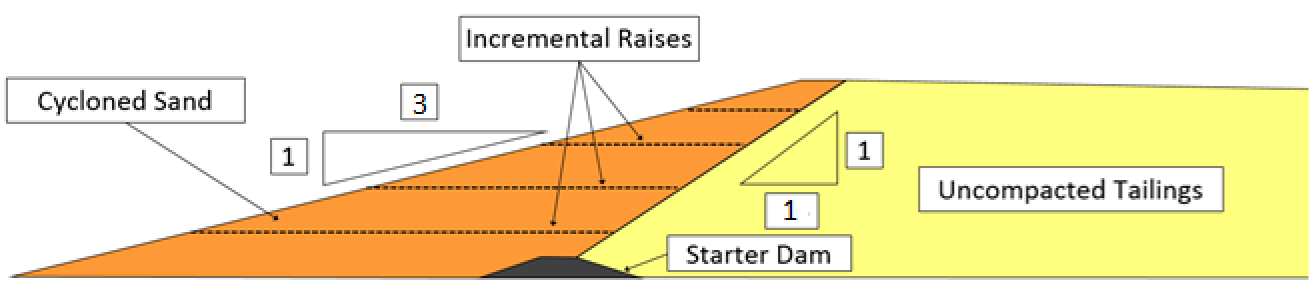
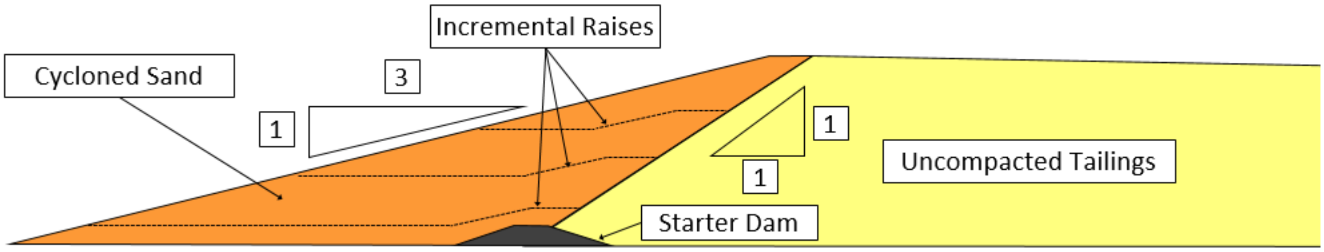


Figure II-7 Combination of Raising Methodologies



II-4.8 Splitter Berm Raise Methodology

For this conceptual level design, the splitter berm would be constructed based on the following assumptions:

- The splitter berm would be constructed by hydraulic placement and compaction of cycloned sand[6].
- Cycloned sand or thickened tailings would be deposited from the sides of the berm to develop short beaches/slopes to prevent encroachment of the pyrite cell pond and scavenger beach runoff into the hydraulic cells prior to filling with cycloned sand.
- The berm would be raised at a similar rate to the pyrite tailings cell and scavenger beach (and therefore, embankment) which allows the berm to be raised relatively vertically without large side slopes. For this preliminary assessment, the crest of the splitter berm is assumed to be the same height as the perimeter embankment throughout operations.
- The berm was modeled with a 100 ft wide crest, to provide space for hydraulic cell construction. An additional 50 ft width was assumed for the preliminary sizing to account for material spigotted from each side of the crest.
- Sequencing of construction would be done to achieve the required elevation for pyrite tailings storage and water management requirements (refer to Section II-4.9 and Section II-4.10).

II-4.9 Flood Management

Surface runoff (bleed water or precipitation) from the scavenger beach would be pumped or routed through ditches or internal spillway to the pyrite cell up to the Environmental Design Flood (EDF), which is the 200-yr 24-hr storm event. Water above the EDF would be released to the environment.

The pyrite cell would have the capacity, above the operating pond level, to store the Probable Maximum Flood (PMF) for the pyrite cell catchment and the EDF from the scavenger beach catchment. Runoff volumes greater than this would extend onto the scavenger beach.

---

[6] For the purposes of this staging assessment, the pyrite cell splitter berm is assumed to be composed of cycloned sand. Future laboratory testing and analysis will be completed to assess whether total scavenger tailings could be used.

To meet dam safety design criteria, the impoundment (scavenger beach and pyrite cell) would have capacity, above operating pond level, to store the 72-hour PMF on the surface with a minimum 400 ft wide beach and adequate freeboard. The PMF pond extents are shown on Figure II-A.1.

II-4.10 Pyrite Cell Sizing

The pyrite cell was sized for pyrite tailings, the operating pond, flood storage, 'dry' freeboard, and contingency for variations in tailings production and properties as per the DBM and summarized in Table II-3.

Table II-3 Pyrite Cell Sizing Assumptions

Item	Design Assumptions	Comments	
Pyrite Tailings	220 Mt (154 Myd^3)	DBM (Appendix I)	
Depth Allowance for Underwater Deposition Slopes	5 ft	Based on: Subaqueous deposition slope = 10% "Point of Deposition" Spacing[1] = 100 ft Depth between the lowest and highest portions of the pyrite tailings surface = 10 ft	
Minimum Depth of Operating Pond	5 ft	Allowance for water cover over the pyrite tailings and floating barge tailings pipeline discharge	
Depth Allowance for Storm Storage (within pyrite cell)	5 ft	scavenger beach catchment area = 3,050 acres 200yr 24hr depth = 5.1 inches flood volume = 1,300 ac-ft	Pyrite cell catchment area =510 acres Probably Maximum Precipitation (PMP) 72-hour depth = 20.4 inches flood volume = 860 ac-ft
Freeboard	3 ft	'dry' freeboard	
Contingency Storage in the Pyrite Tailings	23 Myd^3	15% above the predicted required pyrite tailings volume for operational variability	

Notes: 1. Pyrite tailings would be deposited by a floating barge or from pipelines extended into the pyrite cell. Details will be confirmed in future design stages.

II-5 TAILINGS DEPOSITION RESULTS

II-5.1 General

Figure II-8 shows the elevations of the TSF regions over the mine life and Figure II-9 shows the cumulative tailings volumes deposited. Based on the simplified staging approach, the pyrite cell splitter berm is not raised to the required elevation between Year 7 and Year 20 (i.e. the predicted pyrite tailings elevation is above the predicted perimeter embankment and splitter berm elevation). This is because the simplified staging approach is based on horizontal filling curves over the impoundment area (i.e. the low places over the entire site are filled in first). This observation indicates that embankment construction and scavenger tailings deposition would have to be sequenced to begin in Bear Tank Canyon before moving towards the west, similar to the alternative deposition plan described for Alternative 3A (KCB 2018). This sequencing would be refined during detailed staging assessments. If future detailed staging assessments conclude that the pyrite tailings are still predicted to be higher than the splitter berm, potential solutions could be:

- construct the embankment and deposit scavenger tailings solely in Bear Tank Canyon during early operations; this would allow the embankment and scavenger beach to reach the pyrite cell starter dam elevation earlier and allow the splitter berm to be raised as described in Section II-4.8;
- construct larger starter dams for the pyrite tailings cell; and/or
- re-configure borrow area to be within the pyrite cell footprint which would increase the starter pyrite tailings cell capacity, postpone the need for splitter berm construction, and slow the pyrite tailings rate of rise.

In later years of operations (~ Year 30), the amount of cycloned sand available is significantly greater than demand, which increases the quantity of scavenger total tailings deposited on to the beach. A portion of the cyclone overflow is also deposited into the pyrite cell to meet the raise requirements outlined in Section II-3. The percentages of available scavenger tailings for cycloned sand that does not need to be cycloned and the cyclone overflow deposited in the pyrite cell are shown on Figure II-10.

Figure II-8 Alternative 3B Elevation vs Mine Year

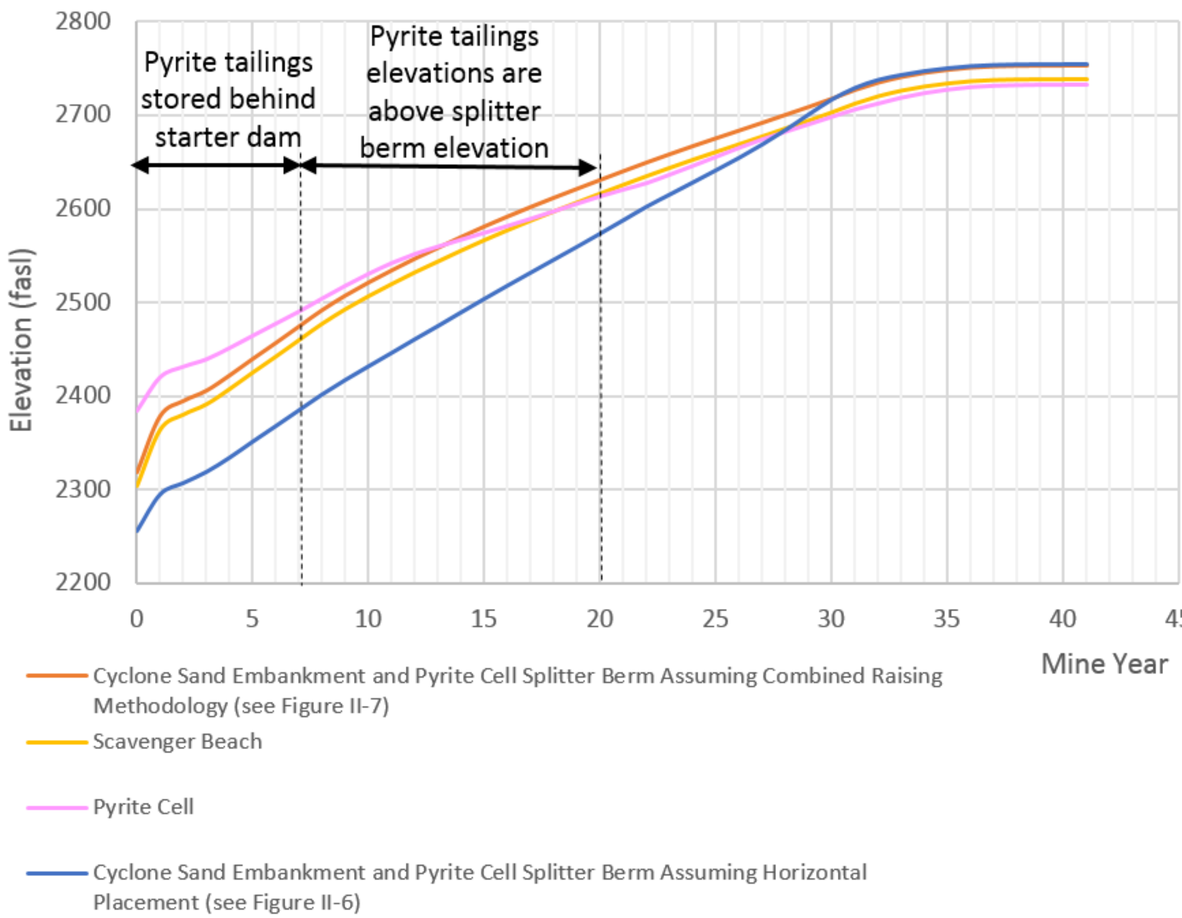
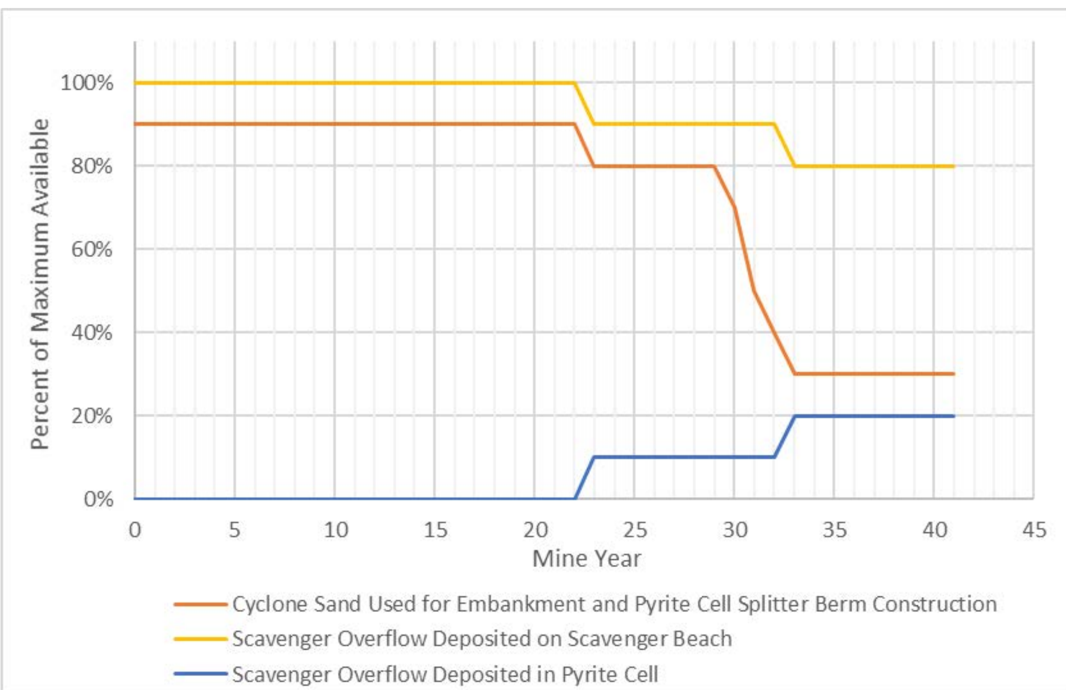


Figure II-9 Alternative 3B Cumulative Volume vs Mine Year

Figure II-10 Cycloned Sand and Scavenger Overflow Placement Percentage



II-5.2 Rate of Rise

The rate of rise of the cycloned sand, scavenger beach and pyrite cell are shown on Figure II-11. The high rate of rise during early operations is due to narrow valley bottoms being filled. Staging would be revised to achieve a more balanced rate of rise after the first five years of operation during future modeling or may require changes to the pyrite starter dam sizing. The rate of rise reduces in later years of operation to less than 10 ft/year, which is consistent with some similar scale operations.

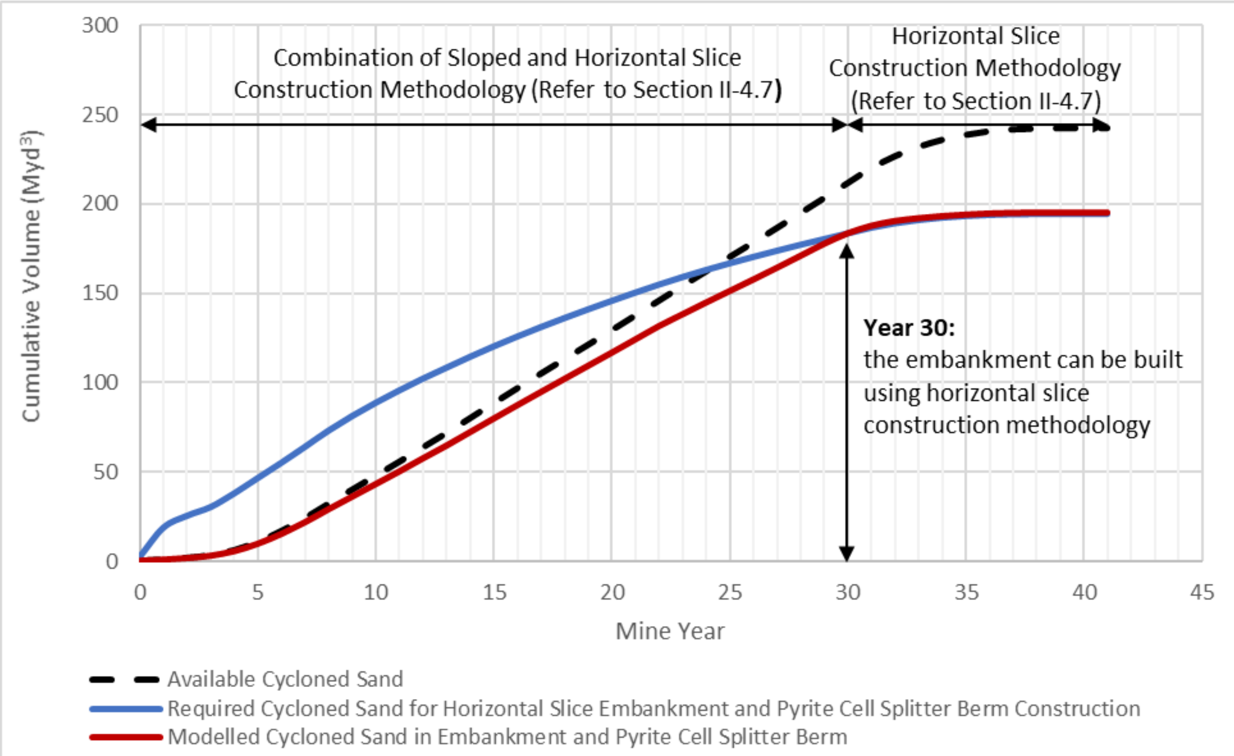
Figure II-11 Alternative 3B Rate of Rise

II-5.3 Cycloned Sand Usage and Time to Progressive Reclamation

Required and available cumulative cyclone sand volumes are plotted against mine year in Figure II-12. During the mine life, there is always adequate cycloned sand available for embankment construction using the sloped embankment construction methodology (see Figure II-5) and would be constructed using the combination approach (see Figure II-7). In Year 30 there is enough cumulative cycloned sand to construct the embankment using only the horizontal slice methodology (see Figure II-6).

Assuming the available cycloned sand is only used for embankment construction and splitter berm, the majority of the outer slope can be progressively reclaimed after Year 30. At this point, cycloned sand production can be ramped down. If cycloned sand is utilized for other construction activities (e.g. road construction, liner bedding, and north dam construction), the year at which the slope can be reclaimed is delayed.

Figure II-12 Available and Required Cycloned Sand vs. Mine Year



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APPENDIX II-A

Staging Figure

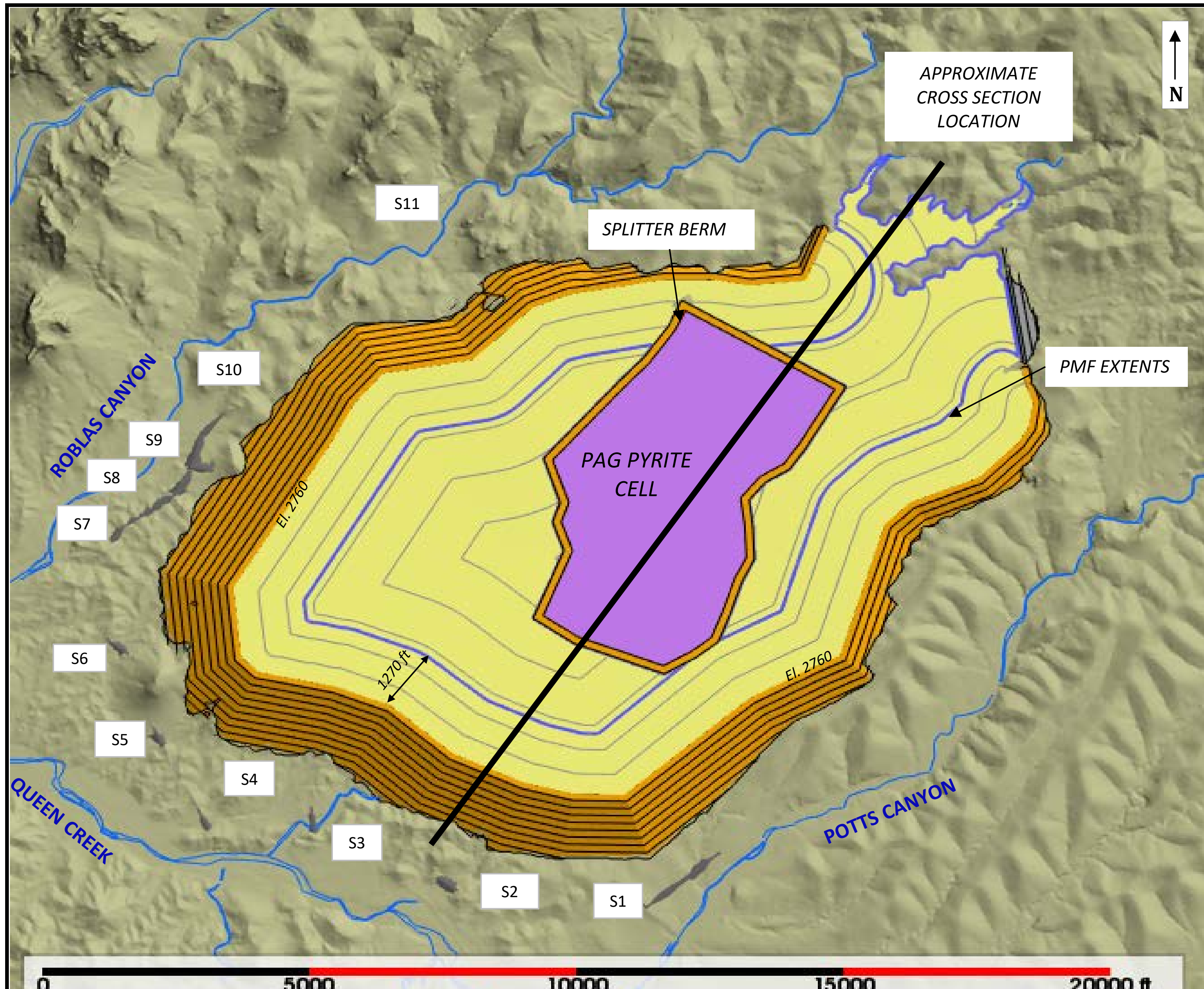
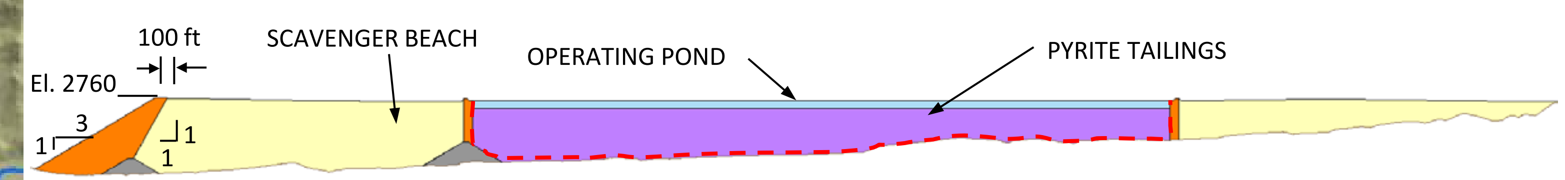


FIGURE 1 CROSS-SECTION SCHEMATIC



NOT TO SCALE

LEGEND

- NPAG SCAVENGER UNDERFLOW TAILINGS
- NPAG SCAVENGER BEACH
- PAG PYRITE TAILINGS
- OPERATING POND
- EARTHFILL DAM
- STREAM
- PMF EXTENTS
- 50 ft CONTOUR
- 5 ft CONTOUR
- ENGINEERED LOW-PERMEABILITY LINER
- S1 SEEPAGE DAM

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TITLE: ULTIMATE LAYOUT

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	II-A.1

APPENDIX III

Water Balance

Resolution Copper Project

DEIS Design for Alternative 3B – Near West Modified Proposed Action (High-Density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell)

Technical Memorandum

Appendix III – Water Balance

DISCLAIMER

Appendix III
Alternative 3B - Water Balance

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III-1 INTRODUCTION

This appendix summarizes the preliminary water balance results for DEIS Alternative 3B – Near West Modified Proposed Action (High-density thickened NPAG Scavenger Tailings and Segregated PAG Pyrite Cell) Tailings Storage Facility (TSF).

The purpose of the water balance assessment is to provide inputs into the following assessments completed by others for comparative analysis between TSF alternatives:

- site-wide water balance to estimate make-up water requirements; and
- downstream solute transport.

The scope of this work is separated into two parts:

- estimate infiltration through a typical scavenger tailings column (to be included in a three-dimensional seepage analysis completed by others); and
- estimate the water flows associated with the TSF for three periods of the mine life. These periods are: production ramp-up, full-production and production ramp-down.

III-2 TAILINGS INFILTRATION

Infiltration through the tailings was estimated by simplified one-dimensional (1D) seepage modeling using VADOSE/W to simulate of the variably saturated and unsaturated system and the climatic interactions. Figure III-1 illustrates the conceptual model, model parameters and assumptions, and results.

Assumptions to this simplified modeling approach are outlined in Table III-1.

Table III-1 Modeling Assumptions

Consideration	Explanation
Climate	Climate variability and precipitation distribution can have a significant impact on infiltration. The modeling applied a single-year climate pattern considered to be reflective of an "typical" year, both in terms of precipitation amount and frequency distribution. Results may be considered "indicative" of natural variations in the site's climate.
Tailings lift thickness and frequency	The model assumes monthly lift thickness calculated from the mine-life average annual rates of rise.
Tailings properties variability	Simplification of the tailings column does not account for horizontal and vertical variability in material types/properties. A single "tailings type" (with one vertical hydraulic conductivity and one soil-water-characteristic curve, SWCC) was used for the modeling.
Consolidation	The modeling does not account for long-term consolidation processes.
Foundation properties	Foundation properties have been assumed to be weathered Gila conglomerate and modeled as equivalent porous medium. For the intent of this modeling the adoption of weathered Gila properties (which has higher vertical hydraulic conductivity than the tailings) is considered appropriate because it represents the majority of the TSF footprint.

Consideration	Explanation
Bleed Water	To account for the initial stages of slurry settling and bleed water after placement, assumptions were made on the water volume remaining available for infiltration at the surface. This was calculated as the difference between the water discharged with the slurry and the water entrained in the tailings at the initial settled density. This was applied as a constant surface flux at the top of the tailings column.
Groundwater Mounding	The groundwater table elevation applied as a starting condition is representative of regional levels and is not considered to be limiting with respect to infiltration.

III-3 TSF WATER BALANCE

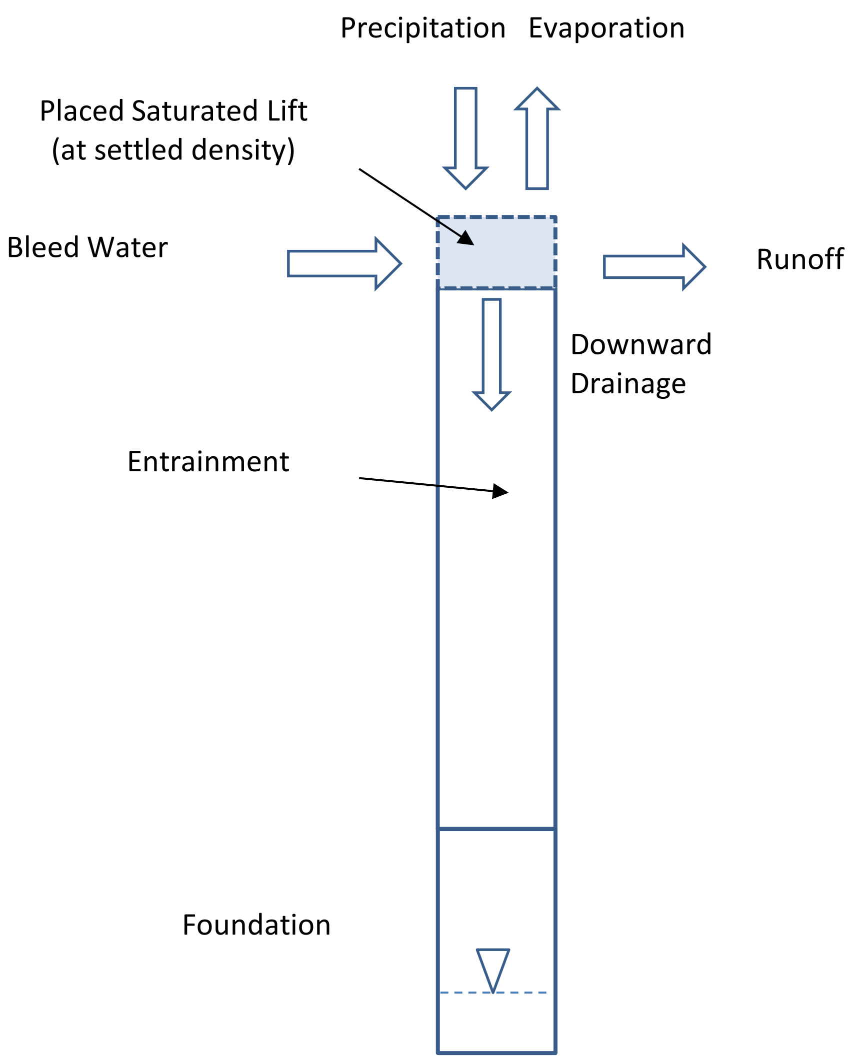
A simplified water balance of the TSF was completed to estimate the water flows for three periods of the mine life; these periods are: production ramp-up, full-production and production ramp-down.

The simplified water balance concept is shown in Figure III-2; input parameters and assumptions are summarized in Figure III-3, these are based on the design basis memorandum (DBM) in Appendix I and the tailings staging plan in Appendix IV. Seepage from the TSF that is lost to the system was estimated by others (M&A 2018).

The simplified water balance results are given on Figure III-2 and the estimated losses from the TSF system over the mine life are shown on Figure III-4.

Conceptual Model

one-dimensional column



Model Inputs

Parameter		Value	Assumption
Climate			
Precipitation (in/year)		20	1987 daily climate data from Superior climate station used in assessment. Assumed to be a "typical" year.
Potential Evaporation (in/year)		75	Calculated in Vadose/W using the 1987 daily climate data from Superior climate station
Tailings Properties (Scavenger Tailings)			
Specific Gravity		2.78	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see DBM, Appendix I)
Vertical Hydraulic Conductivity (kv) (in cm/s)		1E-06	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
Rate of Rise (ft/year)		10	Average over the mine-life (see tailings staging plan, Appendix II)
Slurry	Deposited solids content by weight (%)	65%	Weighted average of scavenger tailings deposited on beach (see DBM, Appendix I)
	Initial Void ratio (e)	1.48	*Calculated*
Placed (settled density)	Porosity (n)	0.45	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
	Final Void ratio (e)	0.82	*Calculated*
Bleed water	Water released per unit lift	0.36	*Calculated*
	Rate of water released per unit lift (per day)	0.012	*Calculated based on a monthly timestep for modeling*

Model Results

Tailings downward drainage (infiltration) (gpm/acre)	0.14

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TITLE: TAILINGS INFILTRATION

PROJECT No. M09441A20

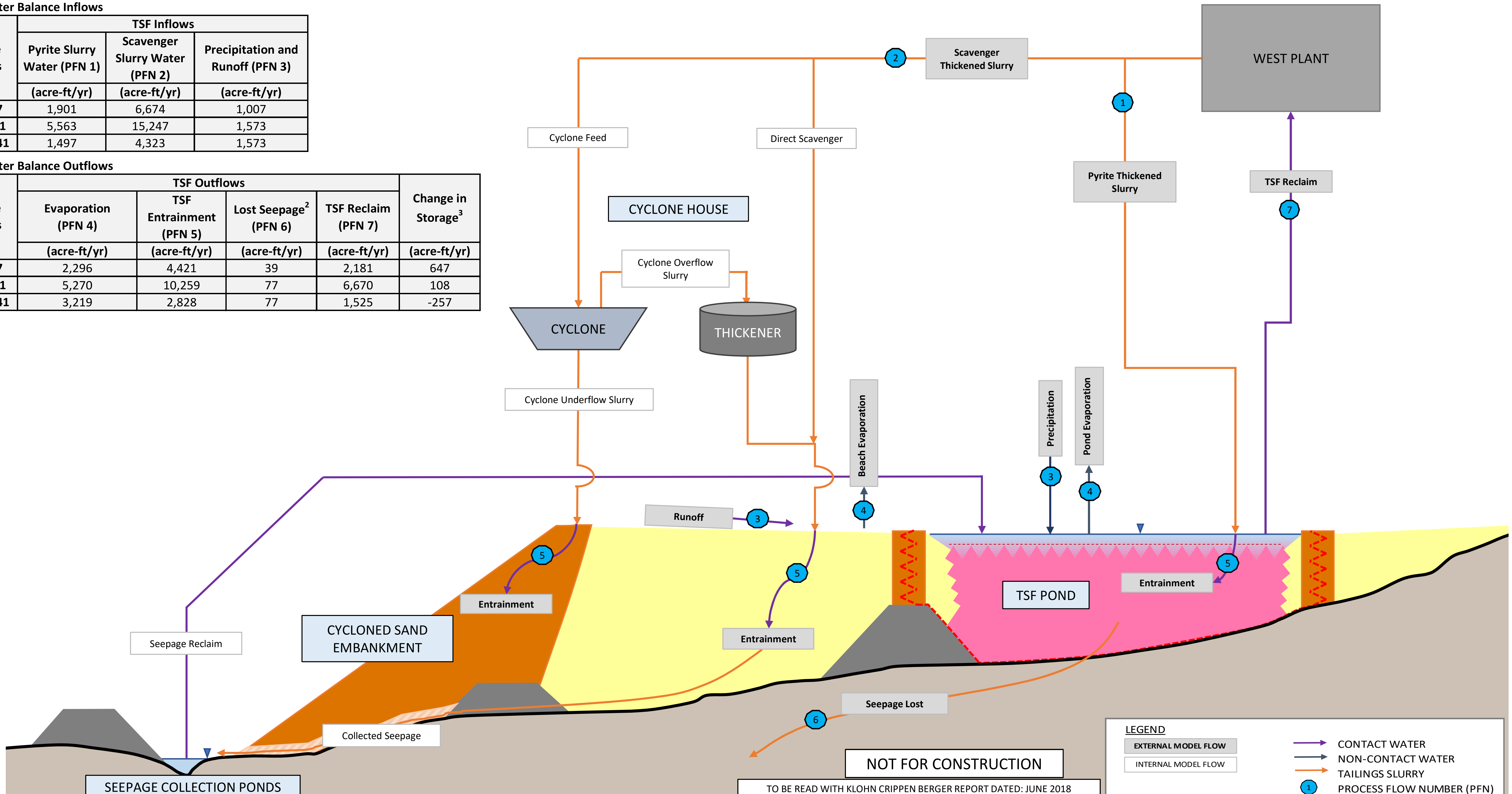
FIG No. III-1

TSF Water Balance Inflows

Mine Years	TSF Inflows: Pyrite Slurry Water (PFN 1)	Scavenger Slurry Water (PFN 2)	Precipitation and Runoff (PFN 3)
	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)
1 to 7	1,901	6,674	1,007
8 to 31	5,563	15,247	1,573
32 to 41	1,497	4,323	1,573

TSF Water Balance Outflows

Mine Years	TSF Outflows: Evaporation (PFN 4)	TSF Entrainment (PFN 5)	Lost Seepage[2] (PFN 6)	TSF Reclaim (PFN 7)	Change in Storage[3]
	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)
1 to 7	2,296	4,421	39	2,181	647
8 to 31	5,270	10,259	77	6,670	108
32 to 41	3,219	2,828	77	1,525	-257



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Notes:
1. See Figure III-3 for process flow summary tables and equations.
2. Estimated lost seepage was provided by M&A (2018).
3. Change in storage reflects change in water volume stored in the TSF Pond and Seepage Collection Ponds, and excludes water entrained in tailings.

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TITLE: OPERATIONAL WATER BALANCE SCHEMATIC AND RESULTS

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	III-2

Process Flow 1 - Pyrite Slurry Water

Years	Pyrite Production[3] (million ton/yr)	Pyrite Solids Content[3] (%)	Pyrite Water Content	Pyrite Slurry Water (PFN 1) (acre-ft/yr)
1 to 7	2.7	50%	1.00	1,901
8 to 31	7.6	50%	1.00	5,563
32 to 41	2.0	50%	1.00	1,497

Slurry water is calculated based on the tailings production schedules and slurry percent solids using Equation 1 below.

$$slurry\ water\ (tons) = tailings\ mass\ (tons)\ x\ \frac{(100\% - slurry\ \%\ solids)}{slurry\ \%\ solids}$$ **(Equation 1)**

Process Flow 2 - Scavenger Slurry Water

Years	Thickened Scavenger[3] (million ton/yr)	Scavenger Solids Content[3] (%)	Scavenger Water Content	Scavenger Slurry Water (PFN 2) (acre-ft/yr)
1 to 7	17.2	65%	0.54	6,674
8 to 31	38.5	65%	0.54	15,247
32 to 41	10.6	65%	0.54	4,323

Precipitation on ponds is calculated using Equation 2 below.

$$Precipitation\ on\ Ponds = pond\ area\ x\ precipitation$$ **(Equation 2)**

Process Flow 3 - Precipitation and Runoff

Years	Pond Area[4] (acre)	Total TSF Area[4] (acre)	Precipitation[3] (ft/yr)	Runoff Coeff.[1]	Precipitation and Runoff (PFN 3) (acre-ft/yr)
1 to 7	178	3417	1.52	0.15	1,007
8 to 31	511	4018	1.52	0.15	1,573
32 to 41	514	3999	1.52	0.15	1,573

Runoff from beach, embankment and natural ground areas is calculated using Equation 3 below.

$$Runoff = (TSF\ area\ - pond\ area)\ x\ runoff\ coeff.\ x\ precipitation$$ **(Equation 3)**

Process Flow 4 - Evaporation

Years	Evaporation[3] (ft/yr)	Pond Area[4] (acre)	Wetted Beach Area (acre)	Evaporation (PFN 4) (acre-ft/yr)
1 to 7	6.0	178	205	2296
8 to 31	6.0	511	367	5270
32 to 41	6.0	514	23	3219

Evaporation is calculated using Equation 4 below.

$$Evaporation\ = (pond\ area + wetted\ beach\ area)\ x\ evaporation$$ **(Equation 4)**

Process Flow 5 - TSF Entrainment

Years	Production Rates (million ton/yr)				Total Water Entrained (acre-ft/yr)	Collected Seepage[2] (acre-ft/yr)	TSF Entrainment (PFN 5) (acre-ft/yr)
	Cyclone Underflow	Cycloned Overflow	Total Scavenger	Pyrite			
1 to 7	5.7	6.7	4.8	2.7	4484	63	4421
8 to 31	12.0	14.2	12.3	7.6	10572	313	10259
32 to 41	1.2	1.4	8.0	2.0	3367	538	2828

Tailings Properties

Property	Cyclone Underflow	Cyclone Overflow	Total Scavenger	Pyrite
Specific Gravity[3]	2.78	2.78	2.78	3.54
Placed Dry Density (pcf)[3]	113	81	81	106
In-Situ Saturation[3]	0.5	1	1	1
In-Situ Water Content	0.10	0.41	0.41	0.31

Entrainment is calculated as the water stored in the pores of the tailings at the placed saturation using Equation 5 below.

$$water\ entrained\ in\ tailings\ (tons) = tailings\ mass\ (tons)\ x\ in\ situ\ tailings\ water\ content$$ **(Equation 5)**

In situ tailings water content is calculated using Equation 6 below.

$$in\ situ\ water\ content = \frac{saturation\ x\ (\frac{specific\ gravity\ of\ tailings\ x\ density\ of\ water}{dry\ density\ of\ tailings} - 1)}{specific\ gravity\ of\ tailings}$$ **(Equation 6)**

Total Water Entrained is the sum of water entrained in cyclone underflow, cyclone overflow, total scavenger and pyrite tailings. TSF Entrainment is then calculated using Equation 7 below.

$$TSF\ Entrainment = Total\ Water\ Entrained\ - Collected\ Seepage$$ **(Equation 7)**

Notes:
1. Runoff coefficient applies to beach, embankment and natural ground areas
2. Water released from tailings reporting to downstream seepage collection.
3. Values taken from DBM (Appendix I).
4. Values taken from Tailings Staging (Appendix II).

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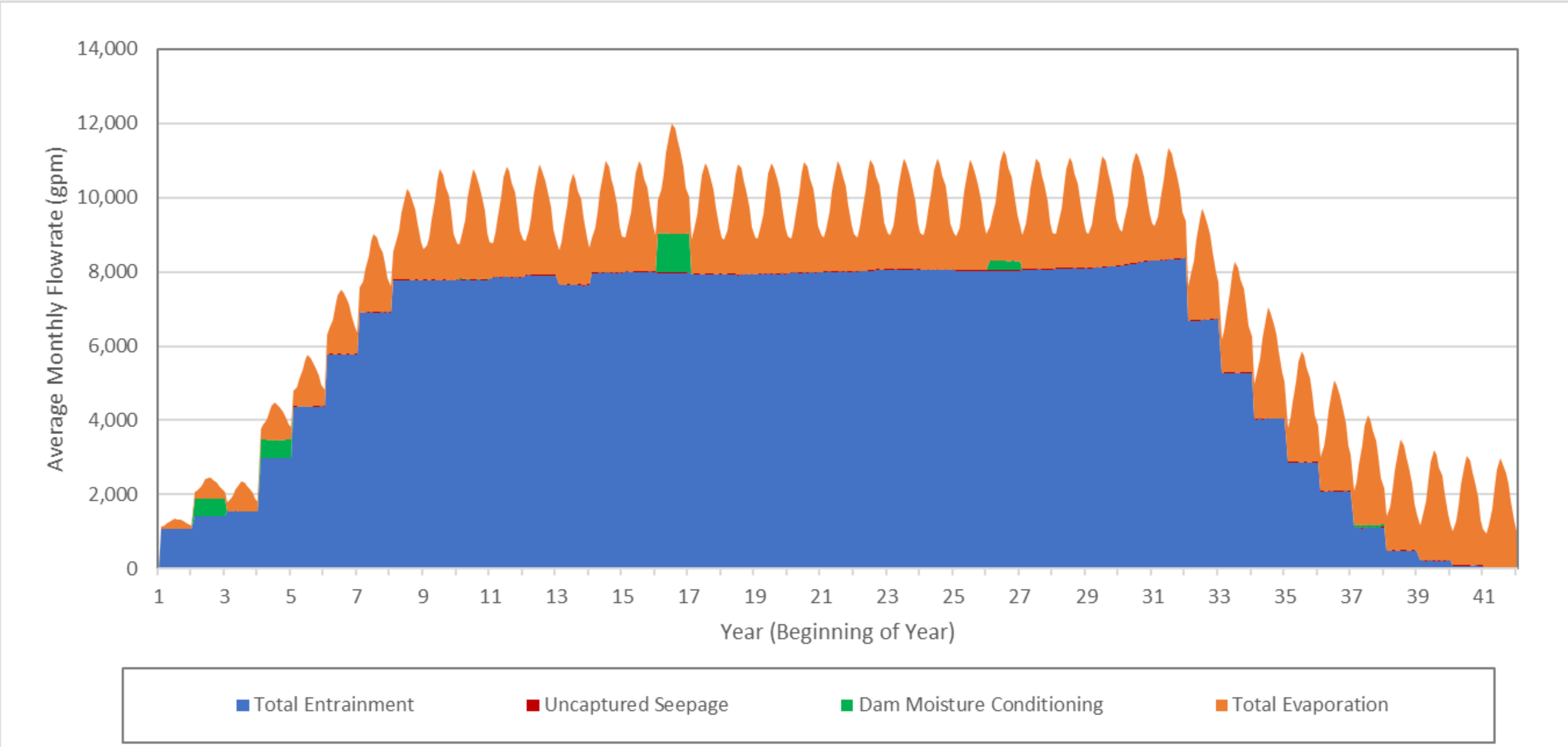
TITLE: OPERATIONAL WATER BALANCE ASSUMPTIONS

SCALE: AS SHOWN | PROJECT No. M09441A20 | FIG No. III-3

Figure III-4 TSF System Losses during Operation



Notes:

1. Dust management losses include water applied to the unreclaimed area of the embankment.
2. Total evaporation includes both pond evaporation and evaporation of bleed water on the tailings beach.

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