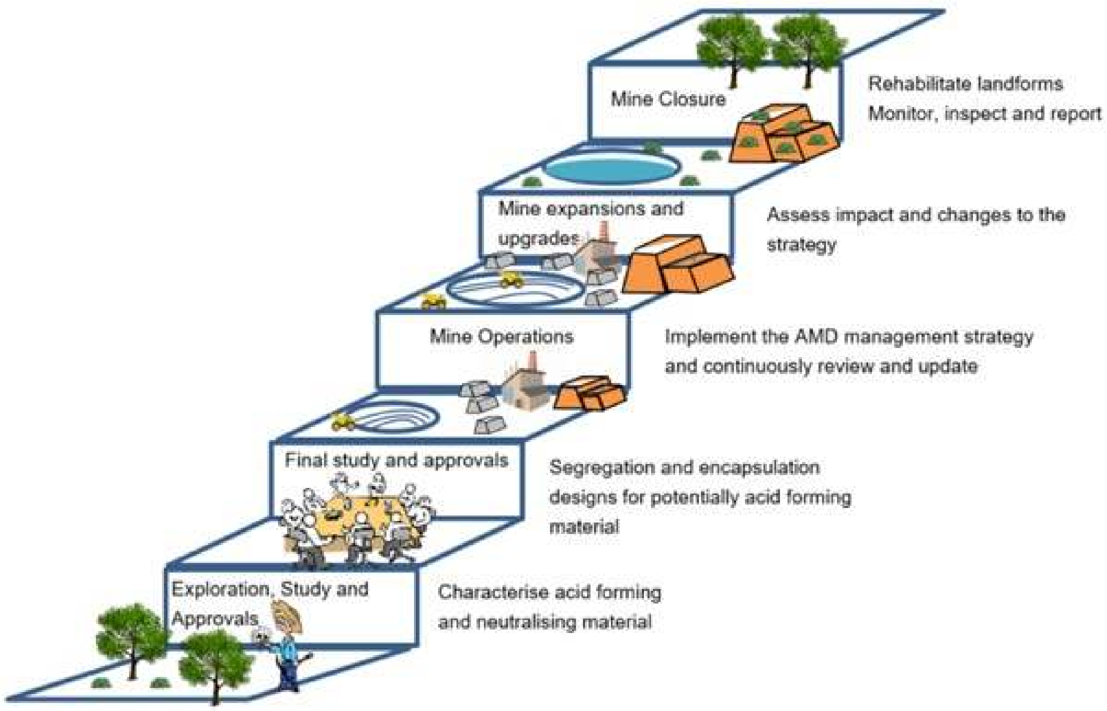
Winu

- Acid and Metalliferous Drainage Strategy and Management Plan

28th August 2025



Revision History

Prepared for:
Winu Study

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Version	Date	Author	Reviewer	Changes
4	28/08/2025	RG	Study team	Updated figures and pit lake/tailings text
3	29/07/2024	RG	Study team	Management plan finalised and geochemistry summary added
2	9/03/2023	RG	Study team	Illustrations added
1	11/06/2020	RG	Study team	Strategy created

INTRODUCTION

Mining and processing will unavoidably generate large volumes of mineral waste, which may be Non Acid Forming (NAF) or Potentially Acid Forming (PAF). Rio Tinto will:

- Minimise the generation of Acid and Metalliferous Drainage (AMD) (Figure 1);
- Limit the reactive mineral waste footprint;
- Ensure repositories are physically and chemically safe; and
- Practice progressive rehabilitation to return to agreed post-mining land uses.

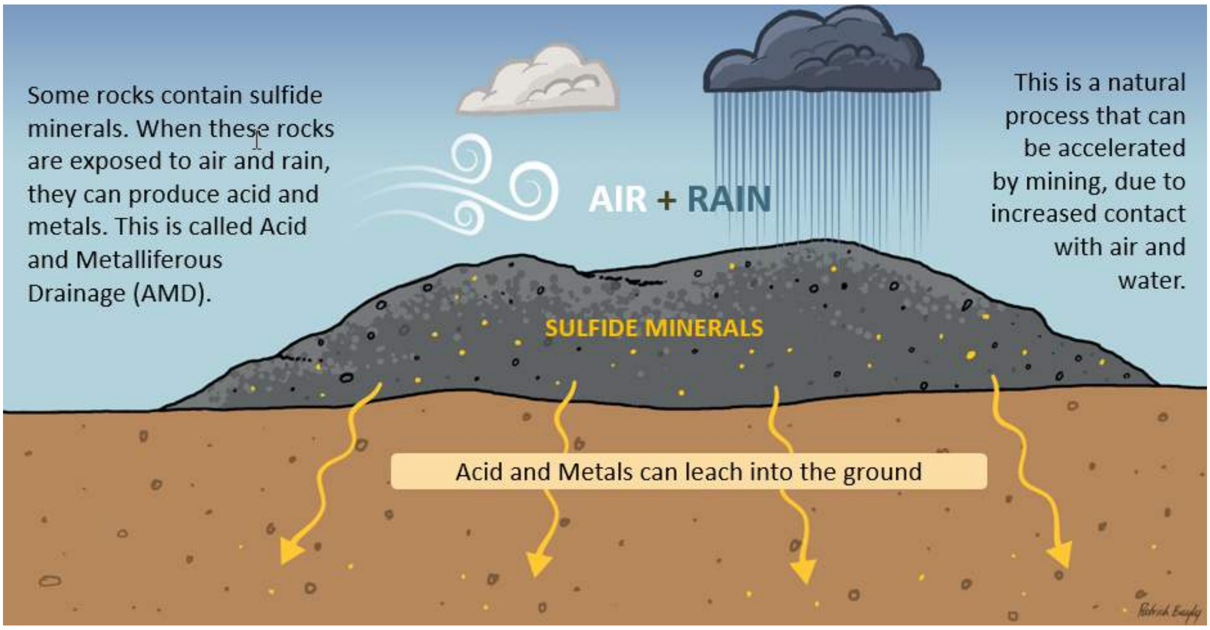


Figure 1: AMD formation.

The AMD strategy and management plan for Winu:

- Raises awareness of the importance of AMD management for Winu's long-term environmental and financial performance.
- Provides an overarching framework for new and existing programmes.
- Continues to drive improvement; and
- Communicate Rio Tinto's commitment for responsible AMD management with external stakeholders.
- Complies with the Rio Tinto E13 Chemically Reactive Mineral Waste Standard.

A general site layout for the Winu project, showing major landforms that are discussed in this document is shown in Figure 2.

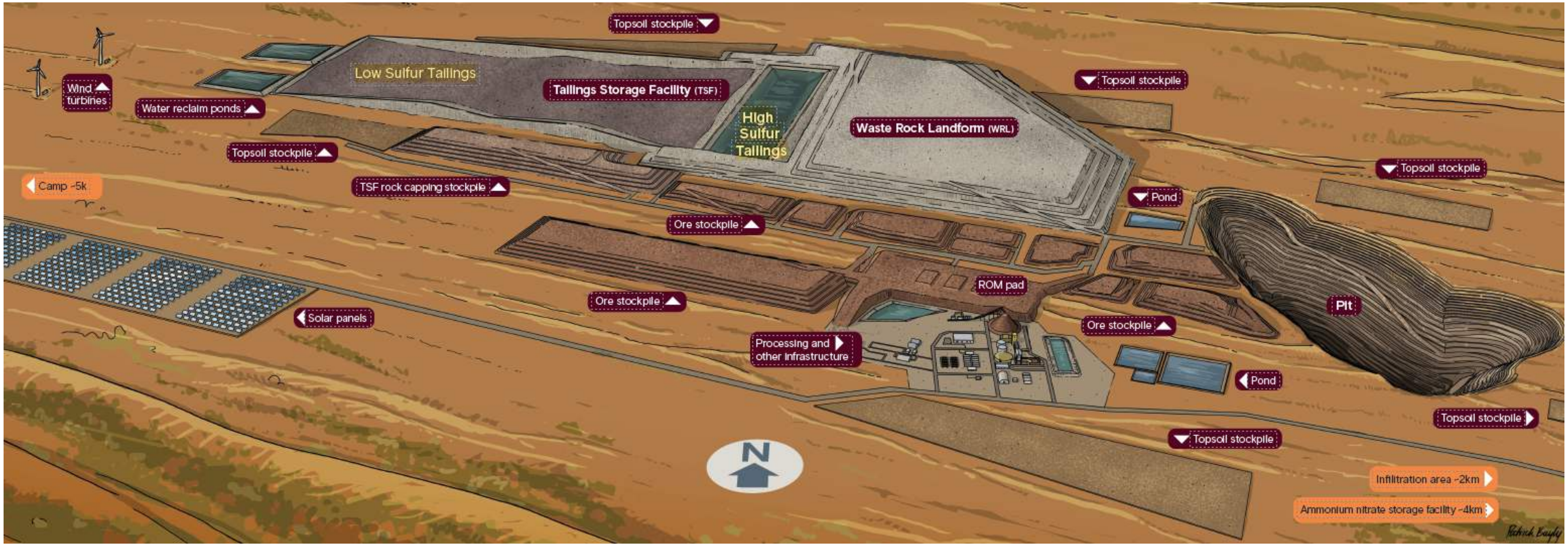


Figure 2: Mine site layout.

ENVIRONMENTAL GEOCHEMISTRY

The regional geology at Winu is characterised by low-grade metasedimentary rock with granitoid intrusions. The tenement is covered by an overburden composed of sand and a sequence of permian mudstones, sandstones and diamictites. The deposit itself is hosted in low-grade metasedimentary rock dominated by siltstones and sandstones, with some igneous intrusions. Based on the supergene profile, the deposit is divided into an oxide and overburden zone, an enrichment zone (secondary sulfides) and a hypogene zone (primary sulfides) (Figure 3). This sequence is, however, not uniform and the zones may have highly localised expressions.

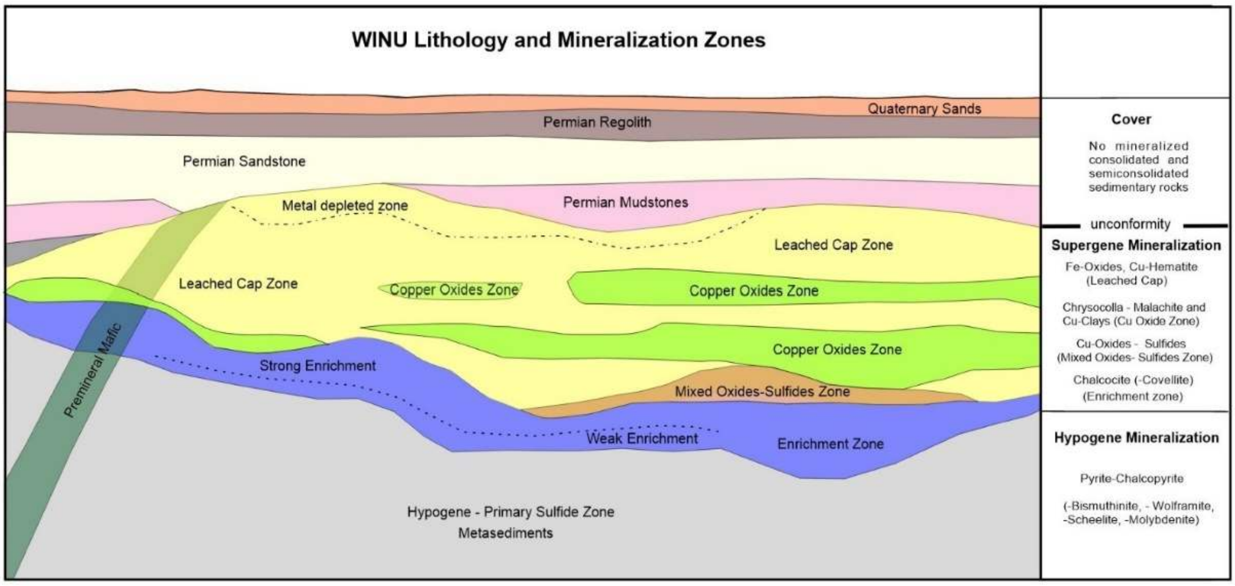


Figure 3: Lithological zones of the Winu deposit.

WASTE

Within the oxide/overburden, most samples are classified as NAF, however there can be some material classified as PAF (or classified as uncertain), particularly in the permian reduced clays (Table 1).

Based on a combination of the sulfur concentrations for the lithology, Acid Base Accounting (ABA) and mineralogy, the following wastes can be managed as NAF (~70% of all waste):

- Sand
- Permian regolith
- Permian sandstone
- Oxidised permian clay
- Oxide zone
- Perched oxides
- Leached cap (excluding mafics)

Pre-mineral mafics should be managed as PAF material (~0.25% of all waste material).

Other waste lithologies, particularly in the deeper primary sulfide zones, will need to consider both the neutralising potential and acid forming potential to designate material as either PAF or NAF.

Table 1: Sulfur waste drill hole assays by lithology (Cu <= 0.2%) and preliminary AMD risk classification (ignoring the presence of carbonates at depth).

			Count	Median	No. samples >0.2%S	Percent	95% percentile	Class
Cover		QA_sand	5,178	0.01	4	0%	0.02	NAF
		Permian_regolith	9,236	0.01	7	0%	0.02	NAF
		Permian_sandstone	22,341	0.01	13	0%	0.01	NAF
		Permian_clay_ox	10,585	0.01	41	0%	0.05	NAF
		Permian_clay_re	9,997	0.08	1,304	13%	0.42	Mixed
		Diamictite	1,067	0.06	75	7%	0.26	Mixed
Basement	Leach Cap	LC_postmin_maf	161	0.01	10	6%	0.22	Mixed
		LC_premin_maf	357	0.03	21	6%	0.25	Mixed
		Leached_cap	36,241	0.01	1,092	3%	0.10	NAF
	Cu Oxide	Oxide_zone	1,195	0.01	3	0%	0.03	NAF
		Perched_oxide	241	0.01	0	0%	0.03	NAF
		Mixed Zone	462	0.01	6	1%	0.10	NAF
	Secondary Sulfide	Strong_enrichment	530	0.14	233	44%	1.54	Mixed
		Weak_enrichment	3,762	0.34	2,341	62%	2.06	Mixed
	Hypogene	Postmineral_mafic	1,145	0.17	467	41%	0.74	Mixed
		MetaSandstone	129,238	0.25	73,782	57%	1.62	Mixed
		MetaSiltstone	4,620	0.25	2,660	58%	1.60	Mixed
		Premineral_mafic	1,963	1.97	1,750	89%	4.53	PAF

The environmental geochemistry test work supports a NAF or PAF classification criteria in geological and mining models based on the following criteria:

NAF = ANC/MPA ≥ 1.5 AND Total S ≤ 1.5%
OR Total S ≤ 0.2%

PAF = ANC/MPA < 1.5 OR Total S > 1.5%

Where:
MPA = Maximum Potential Acidity
(assuming sulfur is present as sulfides)
ANC = Acid Neutralisation Capacity
(based on carbon measurements with a correction for non neutralising siderite)

Key benefits of using these criteria are:

- All of the waste rock classified as NAF will have at least 1.5 times more acid neutralising capacity than maximum potential acidity, so this reduces the potential for generating AMD (MEND 2009).
- Use of the added 1.5% total sulfur cutoff ensures that none of the material classified as NAF will have extremely high sulfide content, which could release sufficient sulfate to pose salinity and metal uptake risks to vegetation and to runoff water.

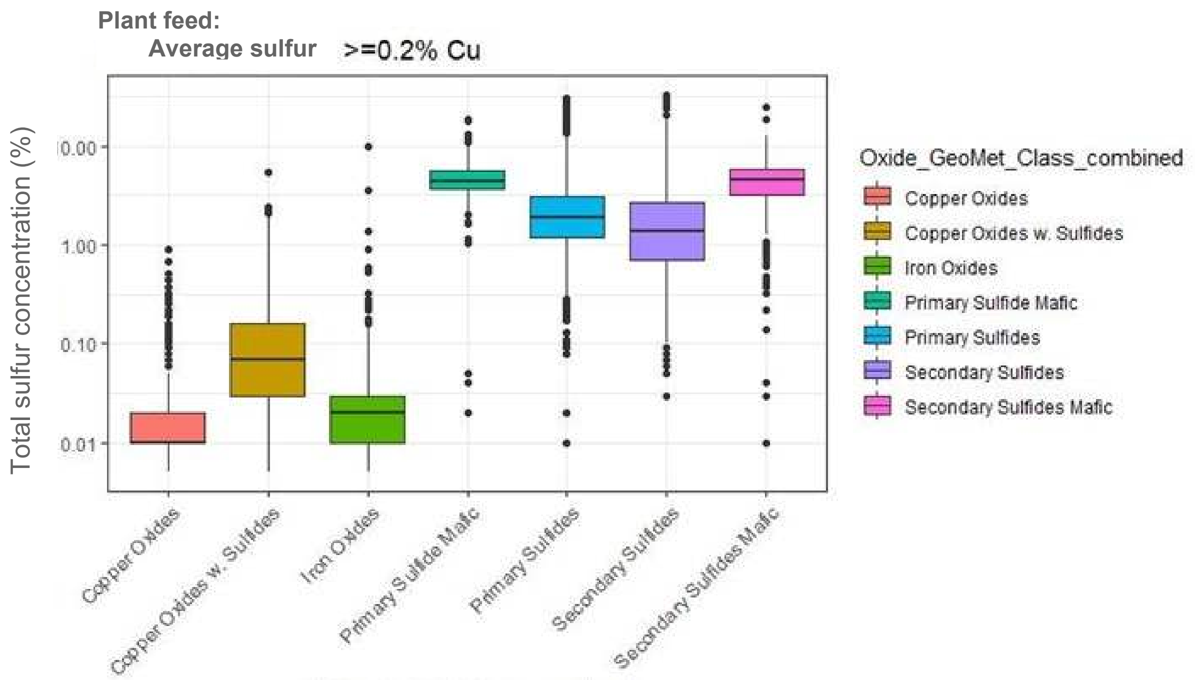
PLANT FEED

Several of the plant feed stockpiles may generate AMD (Figure 4):

- Mafic stockpile
- Primary sulfide stockpile
- Secondary sulfide stockpile
- Mixed oxide stockpile

The secondary sulfide and mafic stockpiles will likely present the greatest AMD generation risk, with potential for rapid AMD generation. The primary sulfide stockpiles are expected to have an acidification lag, with AMD unlikely if processed within 8 years (median lag time expected to be 29 years).

Whilst the oxide stockpile (average sulfur content of 0.02%) is unlikely to generate AMD, there should be sufficient groundwater monitoring around oxide plant feed stockpiles to assess neutral mine drainage risks. The oxide stockpiles (including iron oxides and copper oxides with sulfides) can be managed as NAF material, all other plant feed stockpiles should be managed as PAF.



Bars show -1.5 × inter quartile range (IQR), 25th percentile, median, 75th percentile, 1.5 × IQR.

Figure 4: Box and whisker plot of plant feed grade material and sulfur concentrations within the (2020) pit shell.

TAILINGS

Copper is removed from the plant feed material via grinding and flotation. A Carbon In Leach (CIL) process is proposed to recover gold. Following these processes, a tailings waste stream will be generated, and these tailings will be stored within a Tailings Storage Facility (TSF).

Changes were made to the metallurgical processing scheme to ensure the majority of the TSF contained low AMD risk tailings. This change involved separating the tailings into two streams: a small volume of High Sulfur (HS) tailings and the much larger volume of Low Sulfur (LS) tailings (Figure 5). The HS tailings will be managed sub-aqueously to avoid sulfide oxidation, minimise sulfuric acid generation and mitigate elevated metal concentrations. The Winu tailings have the following geochemical characteristics:

- Some LS tailings can be classified as PAF-LC (where LC refers to the low acid producing capacity) (i.e. median sulfide sulfur concentrations of 0.15% and 0.2% in the tailings from primary and secondary sulfide feeds respectively).
- Due to the very high sulfide concentrations (i.e. median 23% sulfide sulfur) and negligible ANC, all the HS tailings (excluding oxide feed) are classified as PAF.
- Under saturated conditions (in the case for HS tailings and most of the LS tailings), neutral pH is maintained for LS and HS tailings, confirming limited oxygen ingress and subsequent sulfide oxidation when Winu tailings are maintained saturated. There can be a first flush of elevated metals concentrations, thereafter, decreasing to very low concentrations.
- Under unsaturated conditions (in the case of LS tailings beaches), constituent release was low under neutral pH conditions. If the LS tailings acidify, then there could be elevated Al, Be, Cd, Co, Cu, Cr, Mn, Ni, Pb, Si, U, and Zn.
- Under saturated and unsaturated conditions, the cyanide concentrations in drainage from detoxified LS tails are low.
- The acidification lag due to neutralising minerals within the LS tailings are predicted to be months in PAF secondary sulfide feed samples with very high sulfur concentrations and 2 to 5 years in another sample with median sulfur concentrations. The PAF or uncertain primary sulfide feed tailings samples are expected to have an acidification lag of 1.5 to 47 years.

Figure 6 shows the predicted total sulfur concentrations of LS tailings over time. This is based algorithms of feed sulfur concentrations in the primary and secondary sulfide material with the tailings from metallurgical test work. On a monthly basis, there can be more variability of total sulfur concentrations however this is smoothed out as time steps get larger to quarterly or annual predictions. The average total sulfur concentration is similar for all time steps at 0.23%, 0.24% and 0.21% for monthly, quarterly and yearly time steps respectively.

Overall, the LS tailings are expected to be NAF due to the bulk of the tailings containing primary sulfide feed material (85%), the alkaline process solutions, the lag time until acidifications for those tailings classified as PAF and likely burial with new tailings, and the expected high degree of saturation. HS tailings are PAF, but if maintained in a saturated state are not expected to generate AMD.

More details on environmental geochemistry characteristics of Winu waste, plant feed and tailings can be found in Rio Tinto 2024a, 2024b, 2024c and 2024d.

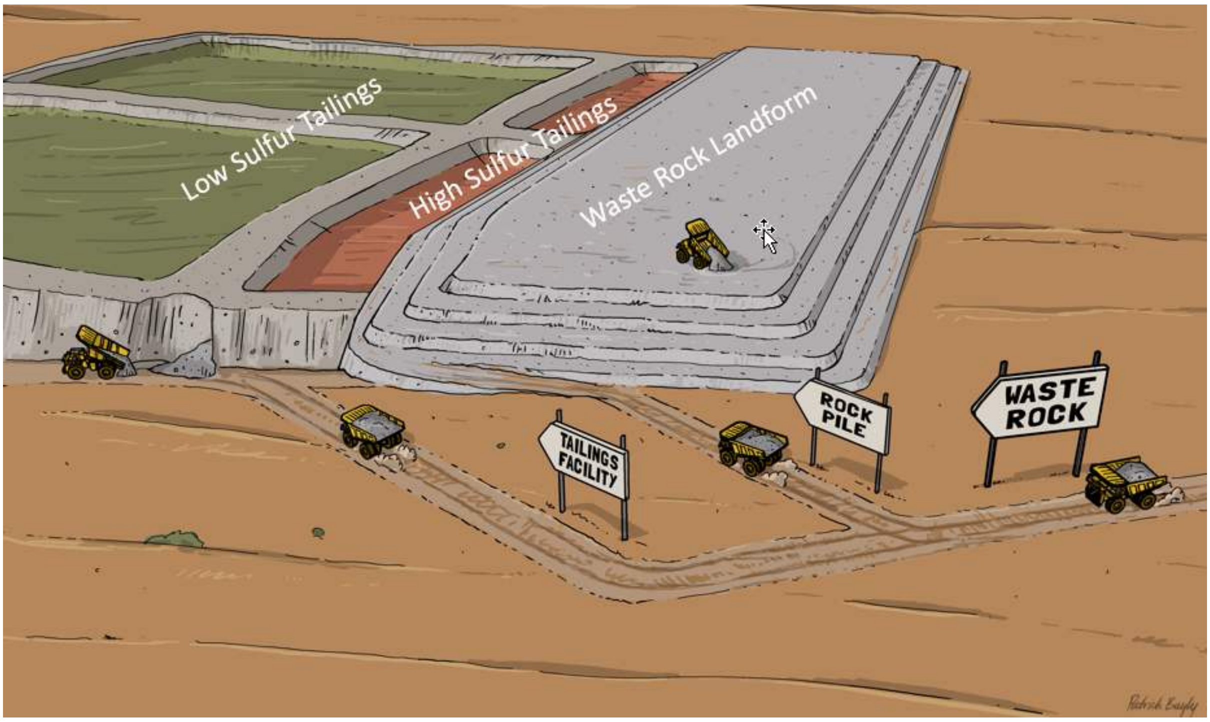


Figure 5: The Winu TSF and Waste Rock Landform (WRL).

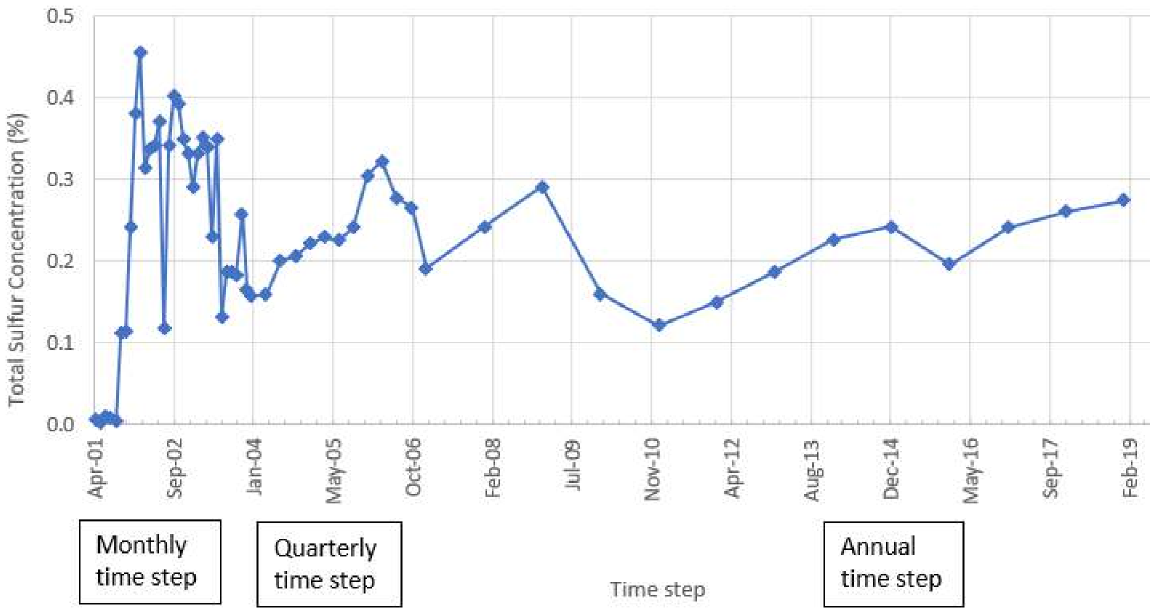


Figure 6: Predicted sulfur concentration in LS tailings (Schedule 40 2024 mine plan).

WINU'S AMD MANAGEMENT STRATEGY

Winu's AMD management strategy follows a hierarchical approach (Australian Government 2016), with prevention and minimisation of AMD generation prioritised and where this is not possible control and treatment will be undertaken (Figure 7).

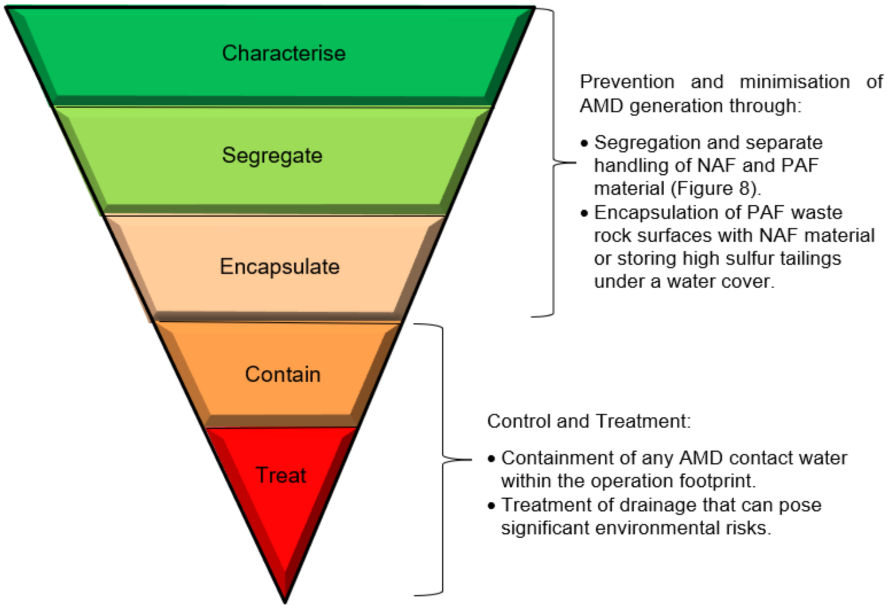


Figure 7: The hierarchical approach to AMD management at Winu.

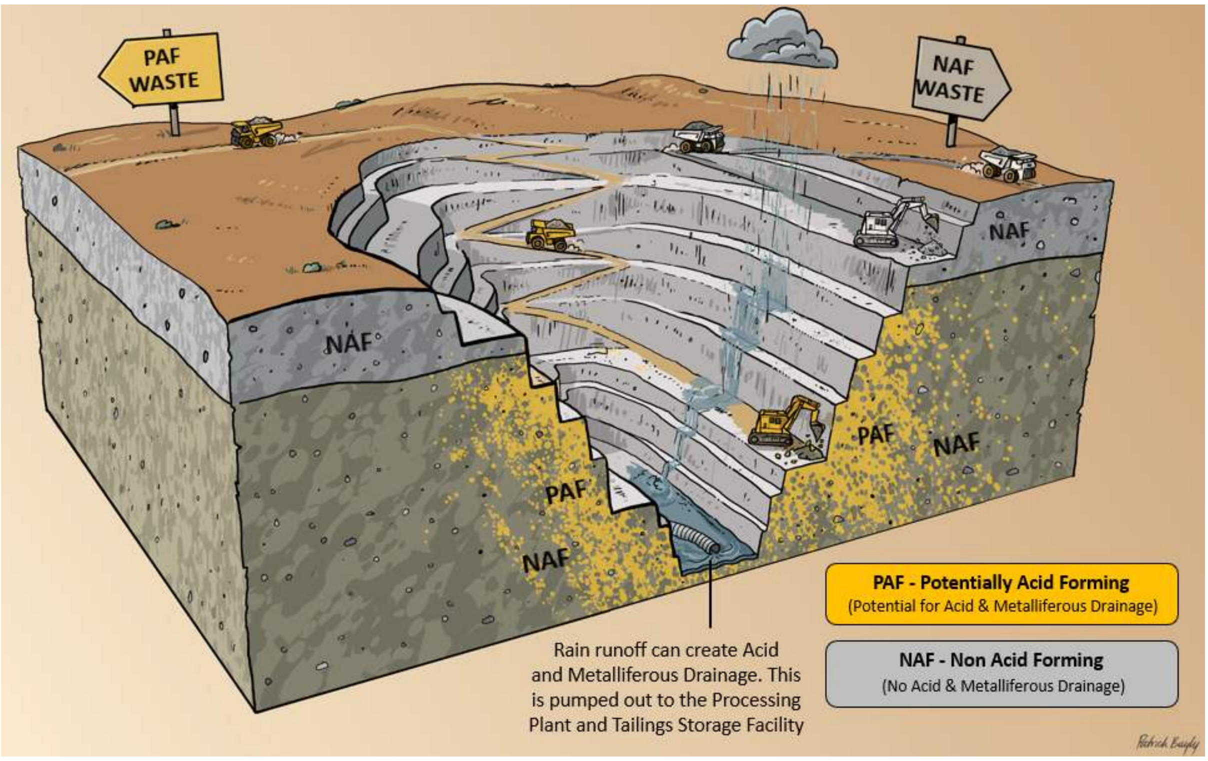


Figure 8: Separation of NAF and PAF waste rock.

The principles of the AMD management strategy at Winu follow a: plan, do, study and act framework and are summarised in Figure 9.

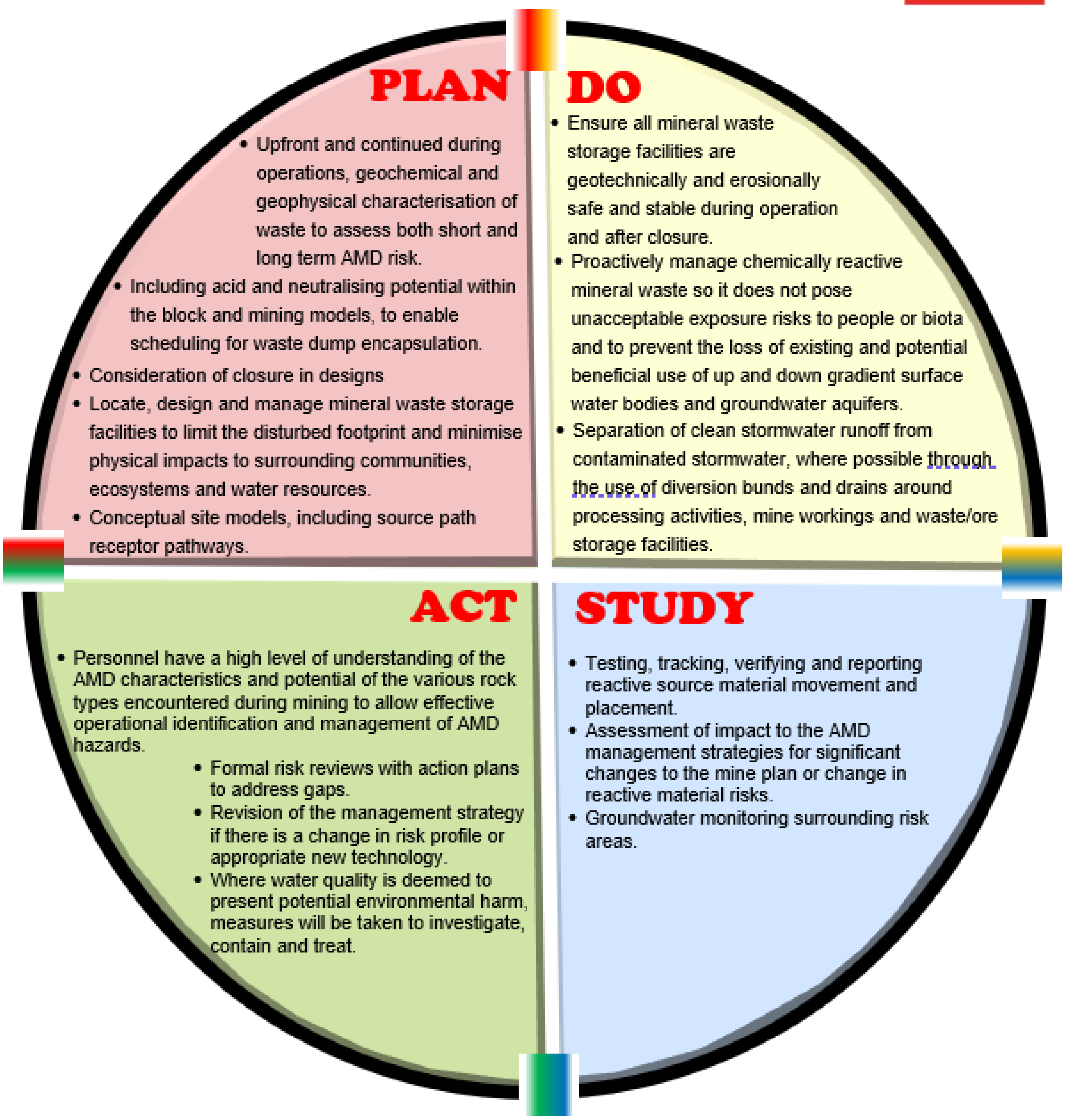


Figure 9: The Winu AMD management statement of principles.

WINU'S AMD MANAGEMENT PLAN

The major landforms and the corresponding management approach are summarised in Table 2, with further details on the major landform in the subsequent sections.

Table 2: Major landforms at Winu and the corresponding management plan.

Landform	Details	Class-ification	Management Plan
Topsoil	Fertile soil generally uppermost 30cm.	NAF	Transport to topsoil repository for storage until rehabilitation. Prioritise topsoil application for landform rehabilitation containing PAF material.
WRL	Oxides and overburden are predominately NAF. PAF material can be present in secondary and primary sulfide zones. Some neutralising potential at depth.	20 - 30% PAF waste 70 - 80% NAF waste	Encapsulate with NAF material during operations and closure to protect runoff water quality, minimise infiltration, control wind erosion and allow vegetation establishment. Install a low permeability NAF basal layer. See Figure 10 and Figure 11.
TSF	HS tailings are PAF. LS tailings are NAF or PAF with a lower acid generating capacity.	5 - 9% HS tailings 91 - 95% LS tailings (annual basis)	HS tailings will be disposed sub-aqueously (Figure 12). A liner will be placed under the TSF (Figure 13 and Figure 14). At closure the HS tailings will be encapsulated with NAF material to maintain saturation and reduce oxidation (Figure 14) (Green and Chapman 2022; Okane 2020; Okane 2024).
Plant feed stockpiles	Potential for acidic contact water, particularly during the wet season.	Mixture PAF and NAF	PAF stockpiles will be placed on top of a low permeability NAF basal layer. Stockpiles will be processed through the process plant or closed with NAF covers. AMD runoff collected in perimeter drains and transported to the processing plant, where lime adjustment occurs.
Process plant	Copper concentrate	PAF	Secure storage and transport required to avoid release to the environment.
Pit - operation	Potential for acidic contact water, particularly during the wet season.	PAF and NAF pit wall exposures	Water retained onsite and discharged into the process circuit.
Pit - closure	Potential for AMD and salinity in the pit lake. Likely groundwater sink at closure.	PAF and NAF pit wall exposures	Minimise contact of the pit lake with receptors.

WASTE ROCK LANDFORM AND PLANT FEED STOCKPILES

PAF waste material within the WRL will be encapsulated within NAF material and bunded. As such, AMD run-off is not expected. Grouping all PAF material together (Figure 10) and encapsulating in NAF material decreases the amount of oxidation that will occur in the underlying PAF material, but it does not prevent it. This approach is referred to as source control and ensures the WRL is built from the beginning to minimise AMD risk, rather than leaving the AMD management to mine closure. This approach represents leading practice for management of PAF waste material (INAP 2020).

A basal layer will be placed under PAF waste and plant feed landforms, to raise the PAF material above the original ground and prevent direct contact of PAF material with any water flowing at the interface of the original ground and the WRL. Additionally, a low permeability basal layer can slow net infiltration from the WRL into groundwater.

Several additional design features will reduce the AMD risks from the PAF landforms during construction, including:

- Lowering the tip height to reduce particle segregation and reducing the potential to form high permeability zones (i.e. instead of end dumping from 80m, the PAF plant feed stockpiles and WRL will be built bottom up in ~10m layers).
- Trafficking and compaction during construction at reduced lift heights which further reduces the risk of convective gas flow occurring within the landform.
- For waste rock, placement of PAF material away from the batters which reduces the risk of exposure of these materials to oxygen supply by advection.

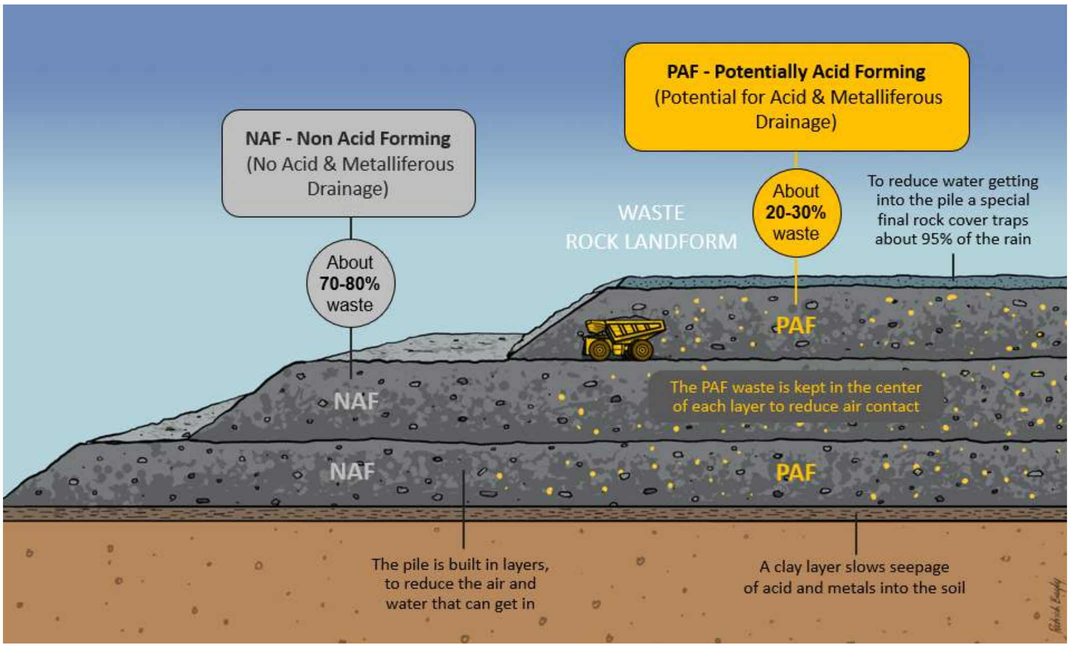


Figure 10: Storage of PAF waste rock within the WRL to minimise AMD generation.

The top surface of the WRL will be rehabilitated with a store and release cover (Figure 11). Conceptual modelling indicates that a cover thickness of 2.5m will prevent approximately 95% of the incident rainfall from migrating through the cover before being removed by evaporation. Cover thickness of 3m and 4m were modelled and demonstrated that no additional benefit is derived from emplacing a thicker cover (Okane 2020).

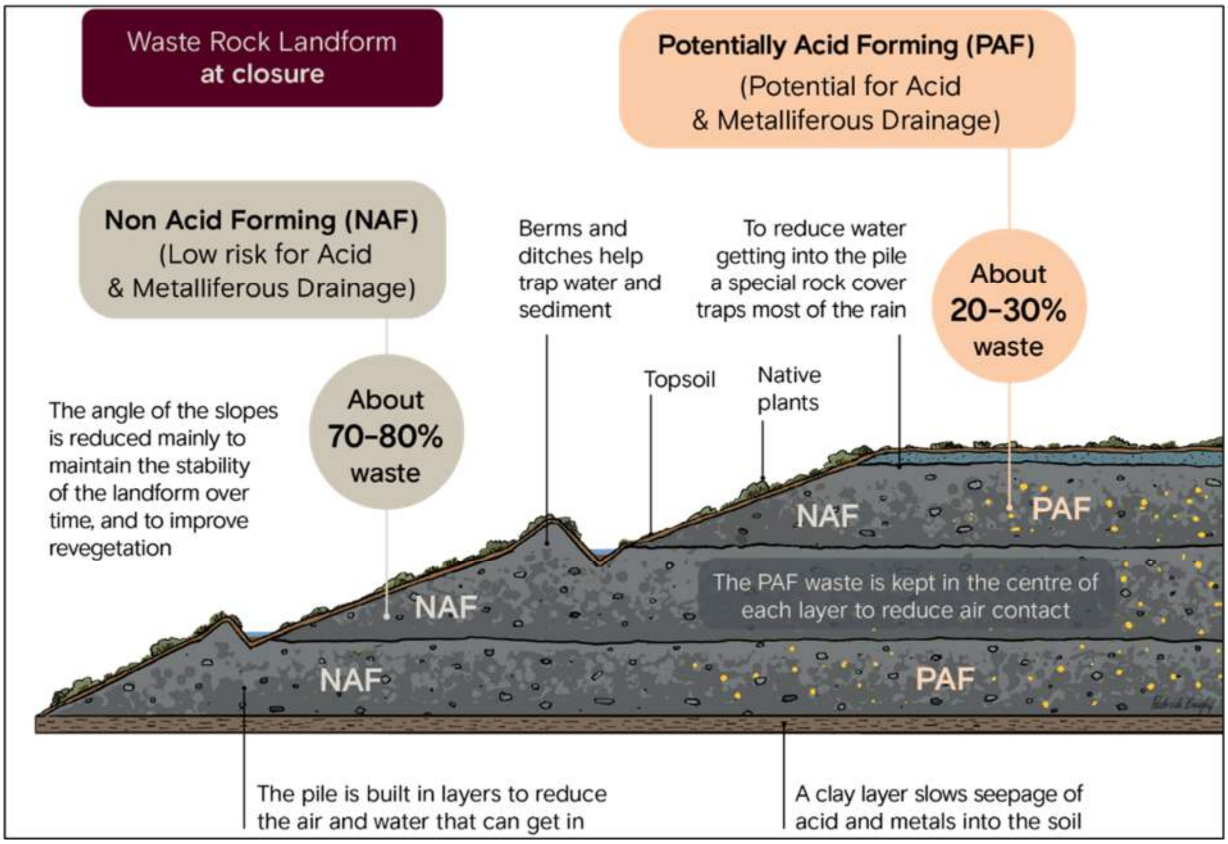


Figure 11: The WRL at closure.

TAILINGS STORAGE FACILITY

The HS tailings cell will be lined with linear High-Density Polyethylene (HDPE) or equivalent geomembrane, with a downstream-raised zoned embankment. A compact sand layer will also be built at the base of the cell. The TSF design includes the WRL abutting and wrapping around the HS tailings storage cell as an increased control preventing failure.

The HS tailings cell will be operated with a minimum depth of 0.5m water cover at all times, to reduce the potential for acid generation (Figure 12). The HS tailings slurry will be heavily dosed with lime to ensure water pumped to the ponds and used for processing is close to neutral, or alkaline pH. The LS tailings cell(s) will be lined with Polyvinyl Chloride (PVC) or equivalent and upstream raises using soil with rockfill backing for closure (Figure 13). The final liner selection will be based upon liner laboratory testing and further review by industry experts

The surface water from the internal slopes of the embankments will be directed into the TSF cells. Water runoff from the outer slopes will be collected in drainage channels and directed to water ponds for use as processing water. Two reclaimed water ponds will be constructed to receive supernatant from the TSF during operations (Figure 13). HS tailings supernatant will only be directed to ponds during periods of excess water; however, since the HS tailings are not expected to oxidise the pH is expected to be circum-neutral.

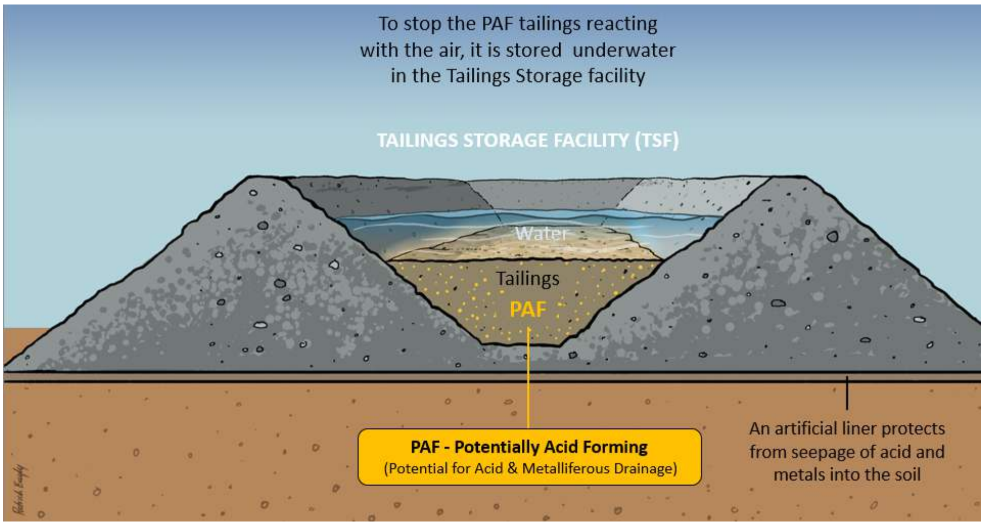


Figure 12: Subaqueous storage of HS tailings to prevent AMD generation.

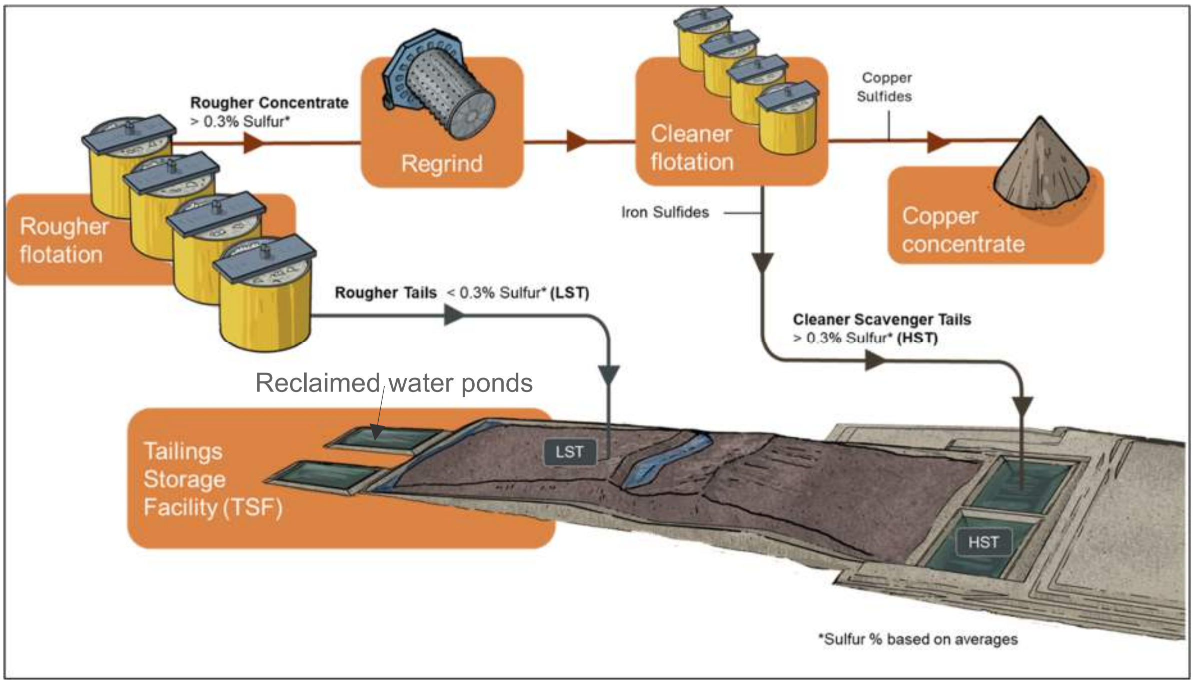


Figure 13: Storing the waste from the process plant in the TSF.

The primary objective of the HS tailings final cover is to maintain a high degree of saturation in the HS tailings and consequently minimise oxygen ingress (Figure 14). This cover system objective is achieved by preventing the upward movement of water from the HS tailings by decoupling the saturated HS tailings from the evapotranspiration zone.

Based on the modelling and test work results (Okane 2020 and Okane 2024), it is anticipated that a final cover of > 6m of LS tailings followed by 0.5m of metasediment (for erosion protection) will be sufficient to decouple the saturated tailings from the evapotranspiration zone and maintained a high degree of saturation (< 85%) in the HS tailings. This cover can be described as a 'tension saturated' cover system.

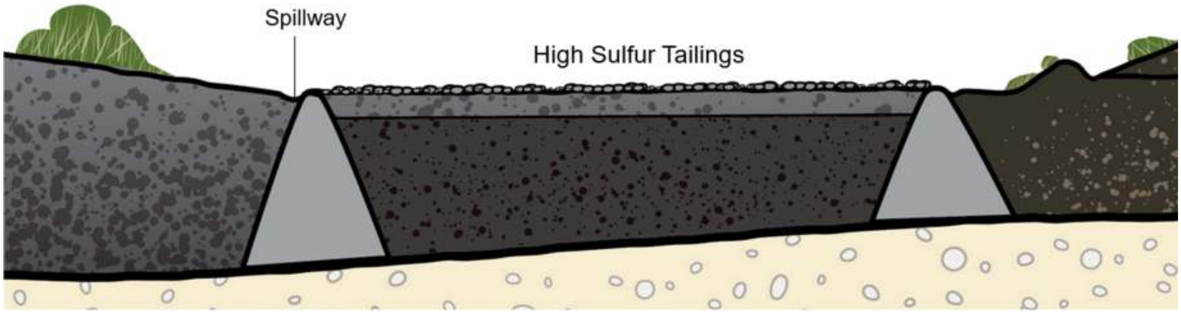


Figure 14: Permanent storage of HS tailings in the TSF.

At closure, the LS cells will be capped with a 0.5m layer of NAF metasediment rock and a 0.2m layer of topsoil. Further details will be provided in the Mine Closure Plan and will be refined through further study prior to mine closure. Spillways and retention bunds will be constructed on top of the covered TSF to control water discharge during heavy rainfall events. The spillways will direct water away from the HS tailings cells to the LS tailings cells and will be constructed of durable NAF material and a maximum gradient of 1:10. Any long term seepage is expected to migrate towards the pit lake (Figure 15).

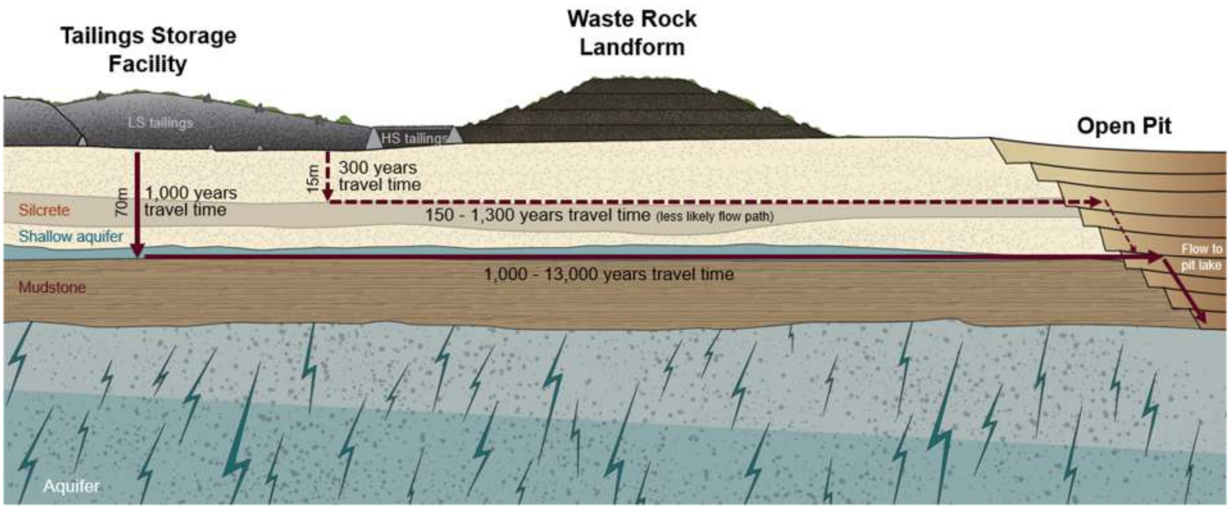


Figure 15: Final TSF landforms and expected flow paths for any seepage.

PIT VOID

The open pit is predicted to act as a long-term, evaporative hydraulic sink, with no expected discharge to the environment (HGL 2024). The final water level (excluding TSF seepage) is approximately 150m below ground and expected 90 years post-closure. Some PAF material will be above the final water level and the pit lake will be approximately 300m deep.

Groundwater is the major source of water to the pit and dominates the chemistry of the pit lake during filling and post closure (Figure 16). The pit lake chemistry is predicted to have a circum-neutral pH, despite some PAF material remaining above the final equilibrium water level. There is abundant buffering capacity to maintain circum-neutral conditions over the long term (i.e. centuries to millennia). Long-term pit lake chemistry will be driven by evapo-concentration, resulting in gradual increases in constituent concentrations through time.

The WRL and TSF seepage are expected to migrate towards the pit lake (Figure 15) and this has been included within pit lake water quality predictive modelling (HGL 2024). Any seepage that enters the pit lake is expected to be small relative to large mass of alkaline water already within the lake.

An ecological risk assessment found a very low risk to the key environmental receptor of birds.

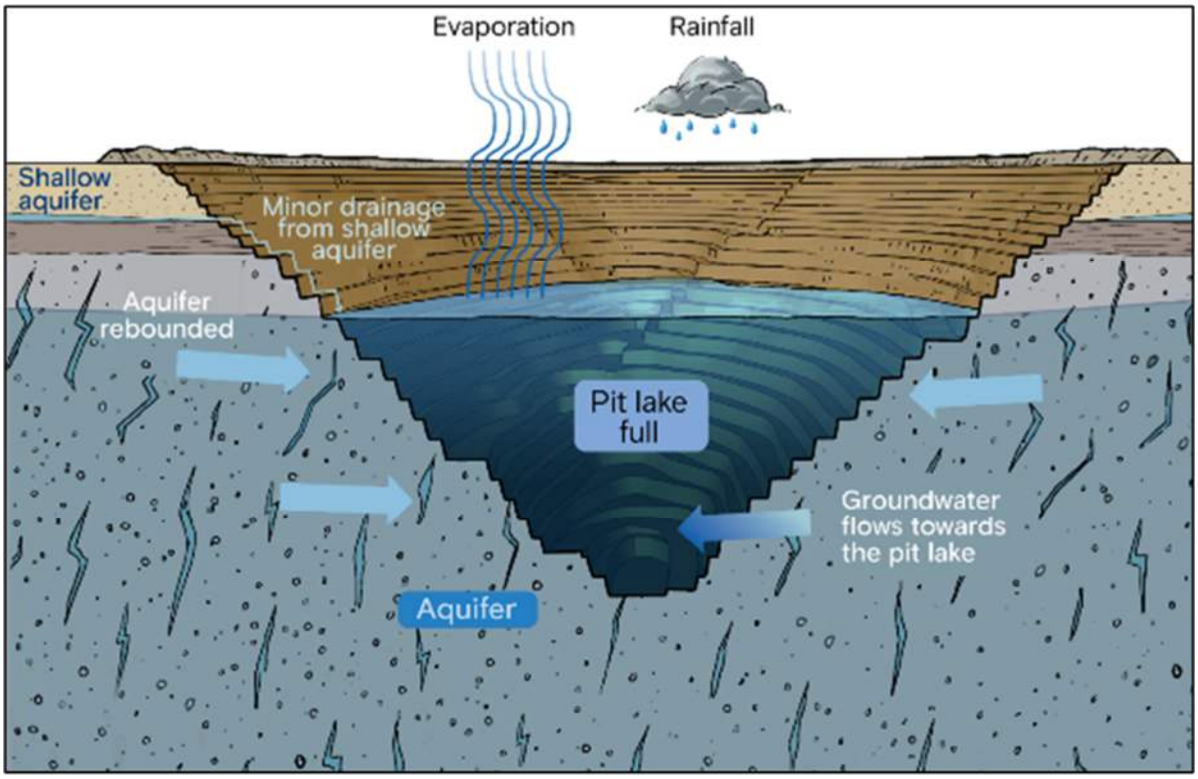


Figure 16: A pit lake within the mine void post closure.

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Rio Tinto (2024b), Winu waste characterisation – Secondary sulfide (enriched) zone.

Rio Tinto (2024c), Winu waste characterisation – Primary sulfide (hypogene) zone.

Rio Tinto (2024d), Winu waste characterisation – Tailings.