Andy Well Gold Project
Meeka Metals Limited

Gnaweeda Project:
Turnberry and St Annes Mining Areas
Tailings Characterisation

Revision No 1
November 2024

pendragon environmental solutions
ABN: 92 147 485 416

Leaders in Environmental Practice

Pendragon Environmental Solutions

ABN: 92 147 485 416

Address and Contact Details

[redacted]

Website: www.pendragonenvironmental.com

Limitations, Uses and Reliance

This document, once read in its entirety, may be relied upon for the purposes stated within the limits of:

Environmental investigations and assessments are undertaken in accordance with an agreed term of reference and timeframe and may involve intrusive investigations of subsurface conditions, generally at a few selected locations. Although due care, skill and professional judgement are applied in the interpretation and extrapolation of environmental conditions and factors to elsewhere, the potential for variances cannot be discounted. Therefore, the results, analyses and interpretations presented herein cannot be considered absolute or conclusive. Pendragon Environmental Solutions does not accept any responsibility for variances between the interpreted and extrapolated and those that are revealed by any means. Specific warning is given that many factors, natural or artificial, may render conditions different from those that prevailed at the time of investigation and should they be revealed at any time subsequently, they should be brought to our attention so that their significance may be assessed and appropriate advice may be offered. Users are also cautioned that fundamental assumptions made in this document may change with time and it is the responsibility of any user to ensure that assumptions made, remain valid.

The comments, findings, conclusions and recommendations contained in this document represent professional estimates and opinions and are not to be read as facts unless expressly stated to the contrary. In general, statements of fact are confined to statements as to what was done and/or what was observed; others have been based on professional judgement. The conclusions are based upon information and data, visual observations and the results of field and laboratory investigations and are therefore merely indicative of the environmental conditions at the time, including the presence or otherwise of contaminants or emissions. In addition, presentations in this document are based upon the extent of the terms of reference and/or on information supplied by the client, agents and third parties outside our control. To the extent that the statements, opinions, facts, conclusions and/or recommendations in this document are based in whole or part on this information, those are contingent upon the accuracy and completeness of the information which has not been verified unless stated otherwise. Pendragon Environmental Solutions does not accept responsibility for omissions and errors due to incorrect information or information not available at the time of preparation of this document and will not be liable in relation to incorrect conclusions should any information be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed. Neither will we be liable to update or revise the document to take into account any events, emergent circumstances or facts occurring or becoming apparent after the date of this document.

Within the limitations imposed by the terms of reference, the assessment of the study area and preparation of this document have been undertaken and performed in a professional manner, by suitably qualified and experienced personnel, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

This document has been prepared for the purposes stated herein. Every care was taken in the interpretation of environmental conditions and the nature and extent of impacts, presentation of findings and recommendations which are provided in good faith in the general belief that none of these are misleading. No responsibility or liability for the consequences of use and/or inference by others is accepted.

The above conditions must be read as part of the document and must be reproduced where permitted. Acceptance of this document indicates acceptance of these terms and conditions.

Report

Title:	Andy Well Gold Project Meeka Metals Limited Gnaweeda Project: Turnberry and St Annes Mining Areas Tailings Characterisation
File:	PES23038
Author(s):	[redacted]
Client:	Meeka Metals Limited
Contact:	[redacted]
Synopsis:	This documents details the materials characterisation of tailings from the Turnberry and St Annes deposit which are to be deposited in the Suzie Pit at the Andy Well Gold Project and has been prepared taking due cognisance of a request for information from DEMIRS and the Western Australian Department of Mines and Petroleum (DMP), now the Department of Mines, Energy and Industry Regulation (DEMIRS) Draft Guidance *Materials Characterisation Baseline Data Requirements for Mining Proposals*, March 2016.

[redacted]

Table of Contents

Figures

Tables

Appendices

Executive Summary

Meeka Metals Limited intends disposing of tailings from processing oxide ores from the Turnberry and St Annes mining areas at their Gnaweeda Project into the mined-out Suzie Open Pit at Andy Well.

Scope of Works

The scope of works, with reference to the request for information from the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) pertaining to the leachability of contaminants with environmental significance from the tailings, included:

- A review of geological, geotechnical, hydrological and hydrogeological data, information and reports.
- Facilitate sampling and analytical laboratory testing to characterise tailings materials in terms of their potential to cause acid mine and metalliferous drainage.
- The geochemical laboratory analytical work included: pH ($pH_{1:5}$, pH_f, pH_{fox} and pH_{ox}), Electrical Conductivity, Total Sulfur (as %S), Sulfate-Sulfur ($S\text{-}SO_4$), Chromium Reducible Sulfur (CRS), Net Acid Generation (NAG), Acid Neutralising Capacity (ANC), Net Acid Producing Potential (NAPP), Acid Buffering Characterisation Curve (ABCC), Total Inorganic and Organic Carbon, Total Metals and Leachable Metals (at pH's of 5, 7 and 9), Cation Exchange Capacity (CEC), Exchangeable Cations, Exchangeable Sodium Percentage (ESP), Bulk Density and Emerson Aggregate Test (EAT).
- Compile a report with recommendations on the assessment and management of the tailings materials.

This technical document has been prepared, taking due cognisance of the *Draft Guideline - Materials Characterisation - Baseline Data Requirements for Mining Proposals* of the WA Department of Mines and Industry Regulation (DMIRS, 2016).

Objectives

This document details the characterisation of waste rock materials across the Bottle Creek mining area and their potential for acid mine and metalliferous drainage impacting environmental factors. The primary objectives are to ensure that the quality of land, soils, sediment and surface and ground water are maintained, to protect environmental values and existing and potential future uses and to facilitate decommissioning and closure in an ecologically sustainable manner.

Summary and Conclusions of Salient Findings

The deposition of tailings, highly alkaline, non-acid forming and non-saline albeit potentially containing arsenic in leachates, in the Suzie pit will extend over a period of 8.5 months. The design incorporates a return water system with perimeter monitoring/seepage recovery bores that can be equipped with pumps, if necessary, to return water to the plant. Water for processing ore at Andy Well will be drawn from dewatering of the underground mine.

Tailings deposition and compaction are likely to result in a permeability of 10^{-8}m/s and will tend to seal permeable zones in the walls of the Susie Pit, reducing the amount of seepage that will occur once the tailings levels rise to above the current groundwater levels in the surrounding bedrock.

A numerical groundwater model to assess the fate of seepage from the pit in a worst-case scenario where seepage continues after tailings deposition and consolidation (Rockwater, 2024) indicated that:

- Seepage flows will be radially away from the Suzie Pit to distances of 220m to 300m across strike after 100 years to 400m along strike to the south-west and will take 70 to 100 years to reach the Wilbur Pit 830m to the north. This pit forms a groundwater sink due to low water inflows and high evaporative losses.

- There are no pastoral bores within the potentially impacted zone with the closest pastoral bore, i.e. the Bonus Bore, 1.9 km to the south.
- Areas around the pit are classified as *Low Potential Terrestrial Groundwater Dependent Ecosystems (GDE's*, Groundwater Dependent Ecosystems Atlas, Bureau of Meteorology).

The impact of seepage containing Arsenic on groundwater at Any Well was assessed as:

- Probability: likely to happen to almost certain; and
- Consequence: moderate, short-term impact (<5 years) contained within a small area;

resulting in a risk rating of high (level of impact).

There are several options to manage and mitigate this potential impact:

- Maintain as small a pool on the tailings as possible by returning water from the tailings to the plant.
- Undertake and complete the project as soon as the tailings have consolidated.
- Closure measure should include a cover with compacted NAF materials, clayey if possible, and shaped in shallow dome to promote runoff and inhibit infiltration.

A Conceptual Site Model (CSM) for disposing the Andy Wells and Gnaweeda tailings materials in the Suzie Open Pit identifies potential Source-Pathway-Receptor (SPR) linkages for environmental and health receptors.

Source/ Activity	Potential Contaminant of Concern	Potential Pathway	Potential Receptors	Potential Impacts	Proposed Controls and Contingencies
Suzie In-Pit TSF (deposition of tailings).	Arsenic in seepage from the tailings into groundwater.	Seepage/ infiltration.	Deep underlying groundwater (>25 m below surface; within 220m to 400m): non-potable.	Groundwater contamination.	Monitoring and recovery bores. Rehabilitate to minimise infiltration
Overtopping of Suzie In-Pit TSF due to insufficient freeboard.	Arsenic in tailings and water.	Unplanned direct discharge of tailings into the environment.	Native vegetation adjacent to and surrounding Suzie Pit.	Reduced vegetation health, and potential loss of vegetation.	Monitor, manage water balance, maintain adequate freeboard, water recovery.

Note:

This Conceptual Site Model excludes:

1. **Decant pipeline and/or tailings delivery pipeline failure: mine infrastructure.**
2. **Stormwater/Rainfall: stormwater diverted around pit; freeboard of a minimum 2m more than sufficient to contain 100-year storm event; rain falling in pit returned to plant.**
3. **Tailings Water: minimise pooling by recovery and return to plant.**
4. **Dust (dried tailings) lift-off from the surface of the TSF or embankments: contained at a level 2m below crest of pit.**

The salient findings of the Gnaweeda Project tailings characterisation include:

- The tailings are alkaline and non-saline.
- The tailings are non-acid forming.
- Laboratory leachate testing indicated that the tailings materials have the potential to leach elevated concentrations of Aluminium, Arsenic and Iron.

- There are distinct advantages of mixing the Turnberry and St Annes tailings to fully utilise pH, Acid Neutralising Capacity, Net Acid Production Potential, total and leachable metal concentrations to arrive at a material with more environmentally acceptable average concentrations.

The Suzie Pit at the Andy Well Project is a shallow pit that intersects a mineralised quartz-carbonate vein (porphyry) that has moderate permeability, and from which there have been groundwater flows of up to 1,000m^3/d during three months of mining and dewatering. The surrounding wall rocks are expected to be of low permeability, and the mineralised zone is reported to be of limited extent and connectivity hence any seepage from the pit is likely to be confined within proximity of the pit.

Emplacement and consolidation of tailings in the pit are likely to block the water-bearing joints and fractures and restrict seepage of tailings water from the pit. Numerical modelling demonstrated that in a worst case of no reduction in aquifer permeability resulting from tailings emplacement, and a continuing source of water for seepage from the pit, the impact will extend to less than 400m after 100 years.

There are no known pastoral bores or wells, or GDE that could be impacted by seepage from the tailings in the Suzie Pit.

Monitoring bores should be installed on the north-eastern and south-western sides of the pit into the primary sheared/fractured system/mineralised zone to a depth of 60m below the depth of the pit. These bores should be constructed with 150 mm Class 9 uPVC casing, with the bottom 20m of casing machine slotted to facilitate use as seepage recovery bores should it be required. The casing should be gravel-packed, with an annular seal set above the gravel; and protective steel surface casing installed, with a lockable cap.

The bores should be monitored quarterly for the following parameters:

- Field measurements: groundwater level, pH and EC/salinity monthly.
- Laboratory analysis for Electrical Conductivity, Total Dissolved Solids, Total Alkalinity, Calcium, Magnesium, Sodium, Potassium, Chloride, Sulphate, Nitrate and Dissolved Metals: Aluminium, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Thorium, Uranium, Vanadium and Zinc.

1. Introduction

1.1 Background

Meeka Metals Limited intends disposing of tailings from processing oxide ores from the Turnberry and St Annes mining areas at their Gnaweeda Project into the mined-out Suzie Open Pit at Andy Well (Figure 1.1).

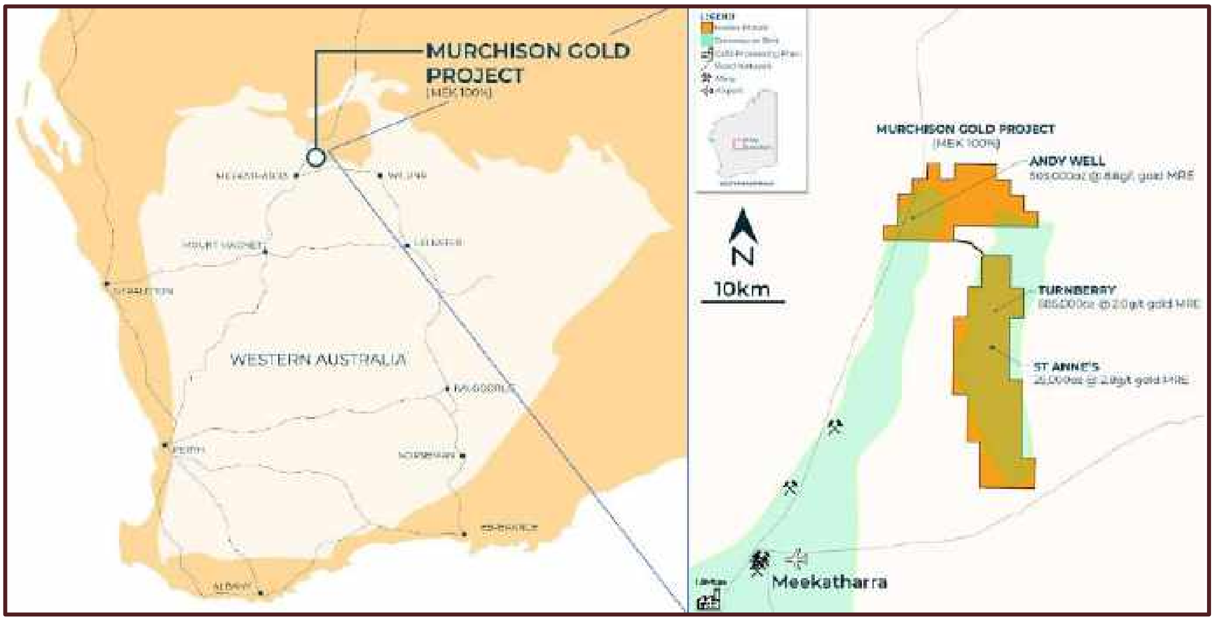


Figure 1.1 Project Location and Tenure.

1.2 Objectives

This document details the characterisation of tailings materials pertaining to the potential for impacts because of acid mine and metalliferous drainage on environmental factors. The primary objectives are to ensure that the quality of land, soils, sediment and surface and ground water are maintained to protect environmental values, existing and potential future uses and to facilitate decommissioning and closure in an ecologically sustainable manner.

1.3 Scope of Work

The scope of works, with particular reference to the request for information from the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) pertaining to the leachability of contaminants with environmental significance from the tailings, included:

The particular scope of reference included:

- A review of geological, geotechnical, hydrological and hydrogeological data, information and reports.
- Facilitate sampling and analytical laboratory testing to characterise tailings materials in terms of their potential to cause acid mine and metalliferous drainage.
- The geochemical laboratory analytical work included: pH ($pH_{1:5}$, pH_f, pH_{fox} and pH_{ox}), Electrical Conductivity, Total Sulfur (as %S), Sulfate-Sulfur ($S\text{-}SO_4$), Chromium Reducible Sulfur (CRS), Net

Acid Generation (NAG), Acid Neutralising Capacity (ANC), Net Acid Producing Potential (NAPP), Acid Buffering Characterisation Curve (ABCC), Total Inorganic and Organic Carbon, Total Metals and Leachable Metals (at pH's of 5, 7 and 9), Cation Exchange Capacity (CEC), Exchangeable Cations, Exchangeable Sodium Percentage (ESP), Bulk Density and Emerson Aggregate Test (EAT).

- Compile a report with recommendations on the assessment and management of the tailings materials.

This technical document has been prepared, taking due cognisance of the *Draft Guideline - Materials Characterisation - Baseline Data Requirements for Mining Proposals* of the WA Department of Mines and Industry Regulation (DMIRS, 2016).

1.4 Description of Operations

Information gleaned from supporting information for a works approval for Category 5 processing or beneficiation of metallic or non-metallic ores (Meeka Metals Limited, 2024) and relevant to this assessment include:

- The Suzie Pit located approximately 1km south of the main Andy Well Open pit, some 1.65ha in extent with a circular footprint is 152m long and 139m wide and 54m deep with pit wall angles at 60º, has the capacity to hold 474,045 tonnes (335,000m^3) of tailings, allowing for 0.7m of freeboard, sufficient to provide capacity to hold a 72 hour 1 in 100-year rainfall event.

  The pit is suitable for in pit tails disposal (SRE, 2024). Tailings will be pumped to the pit via a slurry pipeline from the processing plant. The pipeline will extend out over the crest of the pit, sufficiently far to prevent the deposition of tailings causing erosion of the pit walls. A central floating pontoon with a pump will recover water, which will then be pumped back to the processing plant.

  Tailings will be deposited to a level 2m below the pit crest when the remaining water will be removed, and the tailings allowed to settle and consolidate. Once dry enough to support machinery, the pit will be backfilled to ground level with compacted NAF waste material and then covered with a 200mm layer of topsoil to form a slight dome encouraging runoff rather than infiltration. The area will be allowed to revegetate naturally; however, seeding may be required should natural revegetation not occur quickly enough. The final landform will be a safe, stable, and non-polluting structure, that will in time, lend back in with the surrounding topography and ecosystem.

Looking north from the southern end.

Looking south from the northern end.

- The regional geology of the area, the northern margin of the Yilgarn Craton, comprises Archaean rocks, predominantly granitoids, with elongated, north-north-west striking belts of sedimentary and volcanic rock (greenstones) oxidised to depths of up to 120m.

  Superficial cover includes degraded laterite and ferruginised rubble and colluvium over areas of subdued relief which grade in to sheetwash deposits 5m to 8m thick and alluvium in surrounding watercourses related to north-westerly flowing tributaries to the Yalgar drainage system (SRE, 2024).
- The Suzie Pit is located on relativity flat ground with bunds and surface flows diverted around the pit to the west. The pit water level is currently 27m below the level of the pit crest. The pit is within the upper transition zone aquifer, which exists between 35m to 40m below ground level, in a highly fractured zone. The zone is highly oxidised with iron staining on fracture surfaces. The pit walls were found to be moderate to high permeability (SRE, 2024).
- Groundwater quality is:
  - fresh to slightly brackish with Total Dissolved Solids (TDS) between 990mg/L and 1,400mg/L;
  - slightly alkaline with pH varying between 7.9 and 8.1; and
  - of the sodium-chloride water type, typical of endpoint type groundwater with long residence times and little indication of recharge.
- Geochemical characterisation of the tailings undertaken during earlier studies found that:
  - The Andy Well ore materials were characterised as having low Maximum Potential Acidity (approximately 12kg/H_2SO_4/t) with elevated Acid Neutralising Capacity (approximately 195kg/H_2SO_4/t) resulting in a large negative Net Acid Producing Potential (approximately 183kg/H_2SO_4/t) and ANC/MPA Ratios of between 15.0 and 16.9 (markedly more than 2) hence was considered Non-Acid Forming (NAF). The sulphide sulphur and total sulphur concentrations differed by between 0.02% and 0.04% indicating that almost all the sulphur is present as sulphide, and from the mineralogy, likely to be dominated by pyrite.
  - Multi-elemental analysis indicated enrichment in Silver (Ag), Arsenic (As), Tellurium (Te) and Titanium (Ti). Silver occurs as a native metal or an alloy and is stable in air and water. Titanium readily reacts with oxygen to form TiO_2, a stable compound. Tellurium, a rare stable element in the earth's crust, has a strong affinity to Gold (Au) and Silver and is often present as gold tellurides. Arsenic concentration levels are well below the Health Investigation Levels (HIL-F) for commercial/industrial sites. Laboratory leachate testing indicated that under a range of conditions, metals were not readily leachable from the tailings.

The Suzie Pit Tailings Storage Facility Design Report (SRE, 2024) indicated that samples of ore from the Turnberry and St Annes mining areas did not contain significant concentrations of heavy metals and metalloids. Some samples contained elevated concentrations of arsenic (between 1,880mg/kg and 10,400mg/kg), however most samples contained arsenic at a concentration less than 240mg/kg. There were no other significant concentrations of metals within the ore. An assessment for leachability and acid formation revealed that most metals and metalloids were immobile under acidic and neutral leaching conditions, with concentrations of As, Be, Cd, Pb, Se, V and Hg below their limits of reporting. The metals and metalloids B, Cr, Co, Cu, Ni and Zn reported trace concentrations within the leaching solutions with concentrations generally increasing by a small margin under acidic conditions. Ba and Mn reported small concentrations within the leachates for most of the samples tested, with concentrations again increasing slightly from neutral to acidic leaching conditions.

2. Tailings Materials Characterisation

2.1 Characterisation of Tailings

2.1.1 Key Lithologies at the Gnaweeda Project

The Turnberry and St Annes deposits are located within the greenstone belt comprising a succession of metamorphosed mafic to ultramafic, felsic and metasedimentary rocks, with minor felsic to intermediate intrusives. The stratigraphy dips steeply east to sub-vertical with isoclinal folding along a north-north-east axis with a north-north-east trending foliation.

Lithologies at Turnberry are dominated by dolerites with the best mineralisation along a 1.7km north-north-east trending hosted within a magnetic quartz dolerite. The area is covered with transported colluvium to a depth of ~10m to 25m and is highly weathered with a depth to fresh rock of approximately 100m.

The local geology and stratigraphy of St Annes, from east to west, comprise of ultramafic meta-sedimentary rocks, siliciclastic sediments, basalt and felsic volcaniclastics which is highly weathered with a depth to fresh rock between ~100m and 160m covered with transported colluvium to a depth of ~25m. Mineralisation is aligned along an 800m north-north-east trending shear divided into the St Annes North and South zones.

The salient findings of waste materials characterisations at the Gnaweeda Project concluded:

- The waste materials possess neutral to alkaline and non-saline characteristics.
- Sulfides, hence Potentially Acid Forming (PAF) materials, are absent in the oxide and transitional materials, the target of the current mining plan, with limited and random occurrences at depth in the transitional and fresh rock lithologies.
- Sulfur concentrations were uniformly low with the dominant waste lithologies containing low available buffering capacities. The potential for AMD within the major waste lithologies is low, with the generally low buffering capacity sufficient to neutralise the negligible reported sulfide mineralisation.
- Multi-element composition and leaching tests indicated low metal and metalloid concentrations within solid materials and in both the neutral and acidic static leaches. Consequently, the development of metalliferous drainage following disturbance of the waste materials is low.

2.1.2 Sampling of Tailings

The ALS Metallurgy and Mineral Processing laboratory in Balcatta Perth prepared two composite samples of tailings (1kg each P80: 150µm) representative of the Turnberry and St Annes ore bodies from 15 tailings leach residues from each ore body, each weighing 800g.

2.1.3 Sample Analysis

The two composite samples were submitted to ALS Environmental Laboratories, a National Association of Testing Authorities (NATA) accredited laboratory, in Wangara Perth and analysed for the parameters listed in Table 2.1.

Table 2.1: Laboratory Test Program.

Analyte	Unit	Limit of Reporting (LoR)
Bulk Density	kg/m^3	1
Emerson Aggregate Test	-	-
pH value (1:5), pH_F, pH_{FOX} and NAG-pH (or pH_{ox})	pH Unit	0.1
Electrical Conductivity @ 25°C (1:5)	µS/cm	1
Total Sulfur (S), Sulfate-Sulfur (S-SO_4), Chromium Reducible Sulphur (CRS), Total Organic Carbon and Total Inorganic Carbon	%	0.005 to 0.01
Total Metals: Al, As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, U, V and Zn	mg/kg	1 to 50
Net Acid Generation (NAG at pH4.5 and 7.0)	pH Unit	0.01
Net Acid Producing Potential (NAPP)	kgH_2So_4/t	1
Acid Neutralising Capacity (ANC)	kgH_2So_4/t	1
Acid Buffering Characterisation Curve	-	-
Exchangeable Cations (Ca, Mg, K, Na), Cation Exchange Capacity CEC) and Exchangeable Sodium Percentage (ESP)	meq/100g and %	0.1
Total Metals: Aluminium, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Thorium, Uranium, Vanadium, Zinc	mg/kg	0.1 to 50
Leachable Metals (at pH 5, pH 7 and pH 9): Aluminium, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Thorium, Uranium, Vanadium, Zinc	mg/L	0.0005 to 1

2.1.4 Analytical Assessment

The purpose of this section is to discuss the analytical assessment (Appendix A) of the Gnaweeda Project tailings which are to be deposited in the Suzie Open Pit in the context of their potential for acid and metalliferous (neutral and saline) drainage and their total and leachable metal and metalloid concentrations in different pH regimes i.e. acidic (pH = 5, neutral (pH = 7) or alkaline (pH = 7).

Acid Mine Drainage (AMD)

pH characterises the chemical environment and is a measure of the acidity in the tailings materials. The two samples display a dominant neutral to alkaline environment with pH values greater than 6.2.

The classification of the analytical data employs primarily three methods, each refining the last:

- A worst-case Total Sulfur based Maximum Potential Acidity (MPA = 30.6 x %S) method.
- An Acid Potential Ratio (APR) which is calculated by dividing the Acid Neutralising Capacity (ANC) of the sample by the Total Sulfur-derived MPA (excluding a reduction for sulfate-sulfur).
- A Net Acid Production Potential (NAPP) value, calculated by subtracting ANC from MPA (excluding a reduction for sulfate-sulfur).

Based on this approach, the tailings were classified as follows:

- Total Sulfur concentrations vary between 0.02%S (St Annes) and 0.55%S (Turnberry).

  The Total Sulfur distribution provides an initial, conservative indication of the potential acid generation capacity of a sample/material. The assessment assumes that all sulfur is present as reactive pyrite. It is therefore an inherently conservative assessment as it discounts non-acid forming sulfur species or any inherent neutralising capacity.

- The Acid Potential Ratio (APR = ANC:MPA) vary between 5.0 (Turnberry) and 7.2 (St Annes).

  This ratio is an alternative way of reporting laboratory data to ascertain initial AMD risk and provides an indication of the relative margin of safety (or factor of safety) with respect to the potential for net acid generation (INAP, 2009).

  Generally speaking, and depending on the mineralogy, an APR of less than 1 indicates the material is likely to be acid forming (PAF) as it contains more acid generating than acid neutralising minerals. An APR ratio of between 1 and 2 generally indicates an area of uncertainty (UC) that requires additional investigation, while an APR of greater than 2 generally indicates that the material is likely to be self-buffering upon oxidation, again depending on which minerals are present (AMIRA 2002). High ANC:MPA values indicate a high probability that the material may remain circum-neutral in pH and should not be problematic by generating acid rock drainage.

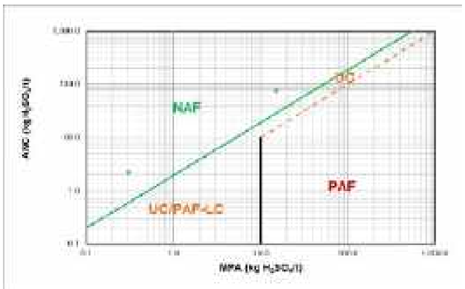
  Maximum Potential Acidities (MPAs) vary between 15.1 and 0.3kgH_2SO_4/t. The same sample (Turnberry) with a Total Sulfur concentration >0.3%S have a MPA above the accepted *low capacity* value of 10kgH_2SO_4/t (DITR, 2007).

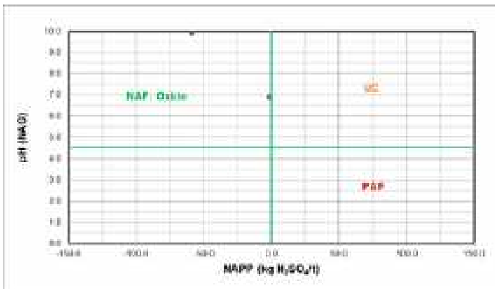
  Acid Neutralisation Capacities (ANCs) vary between 75.9 (Turnberry) and 2.2kgH_2SO_4/t (St Anne).

- Net Acid Producing Potential (NAPP = MPA-ANC) vary between -60.8 (Turnberry) and -1.9kgH_2SO_4/t (St Annes).

  NAPP calculates a theoretical net acid producing (or consuming) value of a sample by subtracting the theoretical Acid Neutralising Capacity (ANC) of a sample from the Maximum Potential Acidity (MPA) of a sample (Total Sulphur in this instance). This calculation identifies the severity and extent of the potential of the materials to produce acid across the site in general.

- Graphical illustrations indicate that both the tailings' samples classify as NAF.





Saline Drainage

Electrical Conductivity (EC) is a measure of the salinity of a soil or rock. Drainage of water from saline rocks may release water with high salt concentrations (saline drainage) which may impact and deteriorate the ecological function and particularly water quality in the downstream environment.

The Cation Exchange Capacities (CEC's) of the tailings materials vary between 3.0meq/100g (St Annes) and 16.8meq/100g (Turnberry) hence vary between low (<10 indicative of soils prone to leaching and nutrient loss with a low water holding capacity) and medium (10 to 15 which is typical range for loams with a moderate nutrient and water holding capacity).

The exchangeable sodium percentage (ESP) of the tailings vary between 1.7 (Turnberry) and 9.0 (St Annes) hence vary between non sodic and sodic (when the ESP is greater than 6). The Turnberry tailings have an Emerson Class of 4 (no dispersion) whilst the St Annes tailings have an Emerson Class of 2 (some dispersion).

Total Metals/Metalloids

The most dominant metals are Iron, Aluminium and Manganese (Appendix A). Regarding potential contamination from the tailings once deposited in the Suzie Pit, the following are relevant:

- Barium, Beryllium, Boron, Cadmium Mercury and Selenium are absent.
- Chromium, Cobalt, Copper, Lead, Thorium, Uranium, Vanadium and Zinc occur in low concentrations and in all instances below the relevant ASC NEPM Areas of Ecological Significance Investigation Levels.
- Arsenic occurs in concentrations between 61mg/kg (Turnberry) and 854mg/kg (St Annes) exceeding the ASC NEPM Areas of Ecological Significance Investigation Level of 40mg/kg.
- Nickel occurs in concentrations between 39mg/kg (St Annes) and 56mg/kg (Turnberry) exceeding the ASC NEPM Areas of Ecological Significance Investigation Level of 30mg/kg.

A geochemical abundance index (GAI, Förstner *et. al*., 1993) was calculated to assess enrichment of the tailings by metals/metalloids:

GAI = log[(Cn/(1.5*Bn)),2]

where Cn is the measured content of the n^{th} element in the sample and Bn is the average crustal abundance of the element. The Average Crustal Abundance values were sourced from the GARD Guide, Chapter 5 (INAP, 2009) and where no value was available for a particular element, values were obtained from *Environmental Chemistry of the Elements* (Bowen, 1979).

The GAI is expressed in integer increments from 0 to 6, where a value of 0 indicates that the element is present at a concentration less than, or similar to, the average crustal abundance; and a GAI value of 6 indicates a 96-fold enrichment above the median crustal abundance. Generally, a GAI of 3 or greater signifies enrichment that may warrant further examination; this is particularly the case with some environmentally important *trace* elements, such as arsenic, chromium, cadmium, copper, lead, selenium and zinc, more so than with major rock-forming elements, such as aluminium, calcium, iron, manganese and sodium.

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality or public health, but their significance should still be evaluated. Cognizance should be taken of:

- Whilst some element concentrations can be elevated relative to the median crustal abundance, the nature of an ore deposit implies that background levels are generally expected to be elevated.
- If a sample is enriched relative to the average crustal abundance, there is no direct correlation that that sample will also leach metals/metalloids at elevated concentrations. The mobility, bioavailability and toxicity of metals/metalloids are dependent on many factors including mineralogy, adsorption/desorption and the environment in which it occurs.
- Because an element is not enriched does not mean it will never be a concern, because under some conditions (e.g. low pH) the solubilities of common environmentally important elements such as aluminium, copper, cadmium, iron and zinc increase significantly.

The GAI calculations (Appendix A) for tailings materials indicate that only one element, namely Arsenic, is enriched: Turnberry has a GAI of 3 and St Annes 7.

Metalliferous Drainage (Leachable Metals)

The tailings samples were subjected to laboratory leachate testing (Appendix A) at a pH of 5 (indicative of an acidic environment), a pH of 7 (neutral environment) and a pH of 9 (an alkaline environment):

Table 2.2: Leachable Metals (concentrations in mg/L are indicated in brackets).

pH	Turnberry	St Annes
5	Barium (0.3), Lead (0.02), Manganese (4.59) and Nickel (0.02)	Arsenic (0.027), Barium (0.4), Boron (0.1), Manganese (0.50) and Nickel (0.01)
Metals/Metalloids exceeding an Assessment Level	Lead, Manganese and Nickel: ADWG and NEPM-ASC	Arsenic: ADWG, NEPM-ASC and ANZG Manganese: ADWG and NEPM-ASC
7	Aluminium (0.73), Arsenic (0.009), Barium (0.007), Boron (0.06), Chromium (0.002), Iron (0.69), Lead (0.002), Manganese (0.008) and Nickel (0.001)	Aluminium (0.79), Arsenic (0.108), Barium (0.006), Boron (0.06), Chromium (0.004), Copper (0.002), Iron (0.69), Lead (0.006), Manganese (0.010) and Nickel (0.002)
Metals/Metalloids exceeding an Assessment Level	Aluminium and Iron: ADWG	Aluminium and Iron: ADWG Arsenic: ADWG, NEPM-ASC and ANZG
9 (the most likely scenario during and post pit deposition of tailings)	Aluminium (2.70), Arsenic (0.052), Beryllium (0.071), Iron (2.42) and Thorium (0.02)	Arsenic (0.311), Beryllium (0.071) and Iron (0.52)
Metals/Metalloids exceeding an Assessment Level	Aluminium and Iron: ADWG Arsenic and Beryllium: ADWG, NEPM-ASC and ANZG	Iron: ADWG Arsenic and Beryllium: ADWG, NEPM-ASC and ANZG

Notes:

Metals and Metalloids with single detections: Copper and Thorium.

Metals and Metalloids absent in leachates: Cadmium, Cobalt, Mercury, Selenium, Uranium, Vanadium and Zinc.

Metal and Metalloid concentrations were assessed against:

1. **Australian Drinking Water Guidelines (ADWG): Table 10.6 Guideline values for Aesthetic and Health.**
2. **NEPM ASC Table 1C Groundwater Investigation Levels (GILs) Drinking Water.**
3. **ANZG, 2023: Draft Livestock Drinking Water Guidelines (Cattle).**

The dominant land use across the area, other than gold mining and prospecting, is pastoral mainly cattle grazing hence the most appropriate guideline is the Draft Livestock Drinking Water Guidelines.

In view of the above, due cognisance must be taken of:

- The characteristics of the existing groundwater regime containing water having alkaline pH's (between 7.9 and 8.2) with a marginal elevated salinity i.e. brackish (Total Dissolved Solids vary between 1,100mg/L [Suzie Pit] and 5,500mg/L [DWB5]) which impacts the beneficial use of groundwater, particularly regarding potable water. Groundwater is of a sodium chloride type with relatively high bicarbonate concentrations and elevated nitrate concentrations at around 50mg/L at the health guideline for drinking water (Rockwater, 2024). Groundwater contains low concentrations of dissolved metals except for arsenic in Suzie Pit (0.043 mg/L; exceeding the 0.01mg/L guideline of the Australian Drinking Water Guidelines and the NEPM ASC as well as the 0.025mg/L guideline for livestock).
- Cognisance must also be taken that the laboratory method involves leaching a finely ground sample with a 1:20 solid:liquid extraction after tumbling end over end for more than 24 hours at various pH levels; conditions which are seldom met in the environment hence much lower concentrations can

be expected during actual operations.

- Aquifers at Andy Well are largely restricted to the mineralised zones, which cut the basaltic rock, hence they are of limited extent along strike and interconnection between zones across strike (Rockwater, 2024). During mining of the Suzie Pit, dewatering flows of up to 1,000m^3/d (11.6L/s) were recorded, primarily from storage in the mineralised zones. Since mining ceased, the pit lake level in Suzie Pit has stabilised at 457mAHD, 18m below the original static water level (between 5m and 7m below surface), with groundwater inflow and rainfall balancing evaporative losses. The current water balance for the pit indicates low groundwater inflows at about 27m^3/d (0.3L/s), from throughflow along the mineralised zone. The cross-cutting dolerite dyke is likely to truncate groundwater flows from north of the deposit (Rockwater, 2024. Regional groundwater flow is towards the north-north-west towards the Yalgar River, a tributary of Murchison River.

3. Implications for Mining

The deposition of tailings, highly alkaline, non-acid forming and non-saline albeit potentially containing arsenic in leachates, in the Suzie pit will extend over a period of 8.5 months. The design incorporates a return water system with perimeter monitoring/recovery bores that can be equipped with pumps, if necessary, to return water to the plant. Water for processing ore at Andy Well will be drawn from dewatering of the underground mine (alkaline pH of 8.0, average TDS of 2,174mg/L, average Chloride of 672mg/L, average Sodium of 262mg/L and average Sulfate of 300mg/L).

Tailings deposition and compaction are likely to result in a permeability of 10^{-8}m/s and will tend to seal permeable zones in the walls of the Susie Pit, reducing the amount of seepage that will occur once the tailings levels rise to above the current groundwater levels in the surrounding bedrock.

A numerical groundwater model to assess the fate of seepage from the pit in a worst-case scenario where seepage continues after tailings deposition and consolidation (Rockwater, 2024) indicated that:

- Seepage flows will be radially away from the Suzie Pit to distances of 220m to 300m across strike after 100 years to 400m along strike to the south-west and will take 70 to 100 years to reach the Wilbur Pit 830m to the north. This pit forms a groundwater sink due to low water inflows and high evaporative losses.
- There are no pastoral bores within the potentially impacted zone with the closest pastoral bore, i.e. the Bonus Bore, 1.9 km to the south.
- Areas around the pit are classified as *Low Potential Terrestrial Groundwater Dependent Ecosystems (GDE's*, Groundwater Dependent Ecosystems Atlas, Bureau of Meteorology).

The impact of seepage containing Arsenic on groundwater at Any Well was assessed as:

- Probability: likely to happen to almost certain; and
- Consequence: moderate, short-term impact (<5 years) contained within a small area;

resulting in a risk rating of high (level of impact).

There are several options to manage and mitigate this potential impact:

- Maintain as small a pool on the tailings as possible by returning water from the tailings to the plant.
- Undertake and complete the project as soon as the tailings have consolidated.
- Closure measure should include a cover with compacted NAF materials, clayey if possible, and shaped in shallow dome to promote runoff and inhibit infiltration.

A Conceptual Site Model (CSM) for disposing the Andy Wells and Gnaweeda tailings materials in the Suzie Open Pit is detailed Table 3.1 which identifies potential Source-Pathway-Receptor (SPR) linkages for environmental and health receptors.

Table 3.1: Conceptual Site Model.

Source/ Activity	Potential Contaminant of Concern	Potential Pathway	Potential Receptors	Potential Impacts	Proposed Controls and Contingencies
Suzie In-Pit TSF (deposition of	Arsenic in seepage from the tailings into	Seepage/ infiltration.	Deep underlying groundwater (>25 m below surface;	Groundwater contamination.	Monitoring and recovery bores.

Source/ Activity	Potential Contaminant of Concern	Potential Pathway	Potential Receptors	Potential Impacts	Proposed Controls and Contingencies
tailings).	groundwater.		within 220m to 400m): non-potable.		Rehabilitate to minimise infiltration
Overtopping of Suzie In-Pit TSF due to insufficient freeboard.	Arsenic in tailings and water.	Unplanned direct discharge of tailings into the environment.	Native vegetation adjacent to and surrounding Suzie Pit.	Reduced vegetation health, and potential loss of vegetation.	Monitor, manage water balance, maintain adequate freeboard, water recovery.

Note:

This Conceptual Site Model excludes:

5. **Decant pipeline and/or tailings delivery pipeline failure: mine infrastructure.**
6. **Stormwater/Rainfall: stormwater diverted around pit; freeboard of a minimum 2m more than sufficient to contain 100-year storm event; rain falling in pit returned to plant.**
7. **Tailings Water: minimise pooling by recovery and return to plant.**
8. **Dust (dried tailings) lift-off from the surface of the TSF or embankments: contained at a level 2m below crest of pit.**

4. Conclusions and Recommendations

4.1 Conclusions

The salient findings of the Gnaweeda Project tailings characterisation include:

- The tailings are alkaline and non-saline.
- The tailings are non-acid forming.
- Laboratory leachate testing indicated that the tailings materials have the potential to leach elevated concentrations of Aluminium, Arsenic and Iron.
- There are distinct advantages of mixing the Turnberry and St Annes tailings to fully utilise pH, Acid Neutralising Capacity, Net Acid Production Potential, total and leachable metal concentrations to arrive at a material with more environmentally acceptable averages.

The Suzie Pit at the Andy Well Project is a shallow pit that intersects a mineralised quartz-carbonate vein (porphyry) that has moderate permeability, and from which there have been groundwater flows of up to 1,000m^3/d during three months of mining and dewatering. The surrounding wall rocks are expected to be of low permeability, and the mineralised zone is reported to be of limited extent and connectivity hence any seepage from the pit is likely to be confined within proximity of the pit.

Emplacement and consolidation of tailings in the pit are likely to block the water-bearing joints and fractures and restrict seepage of tailings water from the pit. Numerical modelling demonstrated that in a worst case of no reduction in aquifer permeability resulting from tailings emplacement, and a continuing source of water for seepage from the pit, the impact will extend to less than 400m after 100 years.

There are no known pastoral bores or wells, or GDE that could be impacted by seepage from the tailings in the Suzie Pit.

4.2 Recommendations

Monitoring bores should be installed on the north-eastern and south-western sides of the pit into the primary sheared/fractured system/mineralised zone to a depth of 60m below the depth of the pit. These bores should be constructed with 150 mm Class 9 uPVC casing, with the bottom 20m of casing machine slotted to facilitate use as seepage recovery bores should it be required. The casing should be gravel-packed, with an annular seal set above the gravel; and protective steel surface casing installed, with a lockable cap.

The bores should be monitored quarterly for the following parameters:

- Field measurements: groundwater level, pH and EC/salinity monthly.
- Laboratory analysis for Electrical Conductivity, Total Dissolved Solids, Total Alkalinity, Calcium, Magnesium, Sodium, Potassium, Chloride, Sulphate, Nitrate and Dissolved Metals: Aluminium, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Thorium, Uranium, Vanadium and Zinc.

References

AMIRA, 2002: Project P387A Prediction & Kinetic Control of Acid Mine Drainage - ARD Test Handbook. AMIRA International Limited, Melbourne.

ANZECC & ARMCANZ (2000): Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Australian Government, Department of Industry Tourism and Resources, 2006: Mine Closure and Completion. Leading Practice Sustainable Development Program for the Mining Industry.

Bowen HJM, 1979: Environmental Chemistry of the Elements, Academic Press, New York.

Department of Industry, Tourism and Resources (DITR, 2016): Preventing Acid and Metalliferous Drainage.
Hazelton P, Murphy B (2007). Interpreting Soil Test Results. NSW Government Department of Natural Resources.

Department of Industry, Tourism and Resources (DITR, 2007): Managing Acid and Metalliferous Drainage. Manual in the Leading Practice Sustainable Development Program for the Mining Industry series. Department of Industry, Tourism and Resources, (DITR) Canberra. February 2007.

Department of Mines and Petroleum, 2016: Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals.

Förstner U., Ahlf W. and Calmano W., 1993: Sediment Quality Objectives and Criteria Development in Germany. Water Science and Technology. V 28:307-316.

INAP, 2009: Global Acid Rock Drainage Guide (GARD Guide) http://www.inap.com.au/GARDGuide.htm The International Network for Acid Prevention.

Meeka Metals Limited, 2024: Andy Well Mine Works Approval Supporting Information Document, Category 5 processing or beneficiation of metallic or non-metallic ores, Tenement M51/870 held by Andy Well Mining Pty Ltd.

National Environment Protection (Assessment of Site Contamination, ASC NEPM) Measure 1999 (updated 2013).

Pendragon Environmental Solutions, 2023: Technical Memorandum Waste Characterisation: Turnberry and St Annes Deposits.

Rengasamy P, Churchman GJ (1999). Cation Exchange Capacity, Exchangeable Cations and Sodicity. Soil Analysis an Interpretation Manual. CSIRO: Melbourne.

Rockwater, 2024: Suzie In-Pit TSF, Andy Well, Hydrogeological Assessment Report for Meeka Metals Limited.

Soil and Rock Engineering Pty Ltd (SRE), 2024: Suzie Pit Tailings Storage Facility Design Report.

Abbreviations

Abbreviations	
ADWG	Australian Drinking Water Guideline
AHD	Australian Height Datum
AMIRA	Australian Mineral Industries Research Association
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASLP	Australian Standard Leaching Protocol
CSM	Conceptual Site Model
DEMIRS	Western Australian Department of Energy, Mines and Industry Regulation and Safety
DO	Dissolved Oxygen
DWER	Western Australian Department of Water and Environmental Regulation
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Western Australian Environmental Protection Authority
LoM	Life of Mine
GDE	Groundwater Dependent Ecosystem
MCP	Mine Closure Plan
MP	Mining Proposal
NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999 (updated 2013), abbreviate to: ASC NEPM.
ORP	Oxidation Reduction Potential
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
WRL	Waste Rock Dump
Units	
cm	centimetre
d	day
ha	hectare
hr	hour
kg	kilogram

Abbreviations	
km	kilometre
m	metre
mm	millimetre
mg/L	milligram per litre
µg/L	micro-gram per litre
min	minute
yr	year
s	second
t	tonnes
µS/cm	micro-Siemens per centimetre

Discipline

Acronym	Parameter Definition/(Determination)	Unit
ABA	The Acid Base Accounting test was developed in 1974 to evaluate coal mine waste and was modified by Sobek *et al.* in 1978. Acid-Base Accounting is a test to assess the potential of a material to produce both acid and neutralisation potential.	
ABCC	Acid Buffering Characteristics Curves	
AC	Acid Consuming, materials with a capacity to neutralise acid.	kgH_2SO_4/ton
AFP	Acid Formation Potential is the potential for a material to produce acid.	kgH_2SO_4/ton
AMD	Acid Metalliferous/Mine Drainage – originates when sulfide material is exposed to the atmosphere. This causes the formation of sulfuric acid and the potential outflow of acidic and usually highly metal-rich water into the environment. Potential sulfide-bearing material includes waste rock from overburden, interburden, and processed ore (tailings).	
AMDMP	Acid Mine Drainage Management Plan	
ANC	Acid Neutralising Capacity (Laboratory Analysis) - is the measure of acid neutralising capacity, usually expressed by carbonates (e.g. calcite and dolomite) and silicates.	kgH_2SO_4/ton
APR	Acid Potential Ratio (Calculation) – is the ratio of ANC/MPA and is used to classify material as either NAF or PAF (see definitions below).	
APP	Acid producing potential; also referred to acid generating potential (AGP).	kgH_2SO_4/ton
ARD	Acid Rock Drainage – the use of this term indicate natural weathering and oxidation unmined outcrops of sulfide bearing materials.	
CaO	Calcium Oxide.	%
CEC	Cation Exchange Capacity	
EDS	Energy Dispersive Spectroscopy (EDS) Analyses	
Fe	Iron	
GAI	Geochemical Abundance Index.	
ICPMS	Inductively Coupled Plasma Mass Spectrometry	
INAP	International Network for Acid Prevention	

Acronym	Parameter Definition/(Determination)	Unit
KNAG	Kinetic Net Acid Generation	
Kinetic Testing	Tests results provide information on the rate of sulphide reaction over time, time periods for reaction, and control techniques which can optimise treatment and control to address the specific severity and duration of reaction.	
LC	Low Capacity.	
LoR	Limit of Reporting or Detection Limit	
MgO	Magnesium Oxide.	%
MPA	Maximum Potential Acidity or APP (Acid Production Potential) (Calculation) - It is determined by multiplying the Sulfide-S values (in %) by 30.6, which accounts for the reaction stoichiometry for the complete oxidation of pyrrotite and pyrite by O_2 to $Fe(OH)_3$ and H_2SO_4. MPA does not take into account the effect of any acid consuming materials in the rock material.	kgH_2SO_4/ton
NAF	Non-Acid Forming (Calculation). Materials are classified as NAF if either: - Sulfide-S < 0.3%, or - Sulfide-S ≥ 0.3% and NAPP is negative with ANC/MPA ≥ 2.0 (see also PAF definition below)	
NAG	Net Acid Generation or NAP (Net Acid Production) (Laboratory Analysis) –hydrogen peroxide is used to accelerate the oxidation of sulphides present in the material. The acid produced may be partially or totally consumed by acid neutralising components in the material. The pH of the solution is determined and then titrated to pH 7. This gives a value for the Net acid or neutralizing potential of the sample.	kgH_2SO_4/ton
NAPP	Net Acid Producing Potential (Calculation) - NAPP = MPA - ANC. Conceptually, a negative NAPP indicates all acid produced is neutralised and a positive NAPP indicates the material is net acid producing.	kgH_2SO_4/ton
NNP	Net Neutralising Potential (Calculation) - NNP = ANC - MPA. Conceptually, a positive NNP indicates all acid produced is neutralised and a negative NAPP indicates the material is net acid producing. NNP is a conservative measure as it tends to overestimate the acid producing potential because it does not differentiate between acid producing and non-acid producing forms of sulfur.	kgH_2SO_4/ton
NPR	Net Potential Ratio	
PAF	Potential Acid Forming (Calculation). Materials are classified as PAF if either: - Sulfide-S ≥ 0.3% and NAPP is positive, or - Sulfide-S ≥ 0.3% and NAPP is negative, but ANC/MPA < 2.0 (see also NAF definition above).	
PAFLC	Potentially Acid Forming – Low Capacity	
ROM	Run of Mine	
SEM	Scanning Electron Microscopy (SEM) Analyses	
SOR	Sulfide Oxidation Rate - Sulfide reaction over period of time.	$mgSO_4$/kg/ week
Static Testing	A static test determines both the total acid generating and total acid neutralizing potential of a sample.	
Sulfide-S	Sulfide Sulfur (Calculation) – is the sulfur in the material present as sulphide. Sulfide Sulfur = Total-S - Sulfate-S	%(w/w)
Total-S	Total Sulfur (Laboratory Analysis) – is the total sulfur in a material in all its forms.	%(w/w)
UC	Uncertain Waste Rock Classification	
WAD CN	Weak Acid Dissociable Cyanide	
XRF	X-Ray Fluorescence	

Appendices

Appendix A: Tailings Characterisation.

Appendix A: Tailings Characterisation.

Analyte	Meeka					Doray			Meeka		Doray				Meeka		Doray					Doray	
	SA OX1	SA OX2	SA OX3	TB OX 1	TB OX 2	TB OX 3	TB OX 4	TB OX 5	TB TR 1	TB TR 2	TB TR 3	TB TR 4	TB TR 5	TB TR 6	TB FR 1	TB FR 2	TB FR 3	TB FR 4	TB FR 5	TB FR 6	AW 1	AW Tails Assay	
Al	2.04	8.44	9.28	9.28	9.28	9.72	7.64	7.4	7.44	9.28	5.6	7.72	7.2	5.76	5.64	5.84	6.2	6.6	6.4	8.8	2.2		
As	550	1430	2620	140	120	30	130	140	170	80	240	40	200	90	1790	210	100	1880	200	10400	40	13	0.51
Ba	75	320	210	300	300	160	520	220	200	50	640	200	200	120	90	75	420	140	200	560	40		
Co	5	20	35	35	80	40	20	60	105	50	20	40	80	120	55	50	40	40	40	40	20		0.081
Cr	50	190	30	50	50	250	75	25	20	40	425	400	100	1250	30	20	225	100	150	100	275		
Cu	94	64	62	240	480	388	216	168	40	280	210	258	148	374	76	348	192	88	198	90	45		3.8
Fe	2.56	5.72	4.22	8	8.44	7.06	5.24	6.62	12.5	9.22	5.56	6.54	9.36	8.08	9	9.98	5.34	6.5	6.34	5.96	3.08		0.71
Mn	100	900	200	700	1200	500	1100	1500	2200	600	400	900	900	700	1100	1000	600	1000	1100	1300	600	180	15
Ni	25	95	155	75	135	140	60	60	65	130	140	180	80	1120	80	25	120	60	80	140	100	23	3
Pb	55	<5	<5	<5	<5	80	40	25	<5	<5	85	215	55	35	10	10	30	50	35	35	60	6.2	0.35
S	55	<5	<5	<5	<5	0.06	0.04	0.02	<5	<5	0.06	0.12	0.04	0.06	4.04	4	0.66	1.2	0.96	2.06	0.21		
Sr	12	50	86	28	30	15	40	35	76	22	35	40	50	20	60	200	35	65	45	135	20		
Ti	0.1	0.38	1.46	4000	4200	4400	4200	6200	5400	5000	2600	3200	5800	3200	5400	7000	3400	3600	3200	4200	1000		
V	144	236	444	260	244	220	170	385	308	258	105	140	230	120	232	288	95	180	155	120	75		
Zn	34	110	114	94	110	178	76	58	142	164	112	174	116	80	40	48	180	126	150	140	105	5.4	1.4
Ca	<10	<10	<10	<10	<10	0.0625	0.1875	0.3625	<10	<10	0.0875	1.1	0.35	0.0875	4.4	5.9	0.8625	4.44	3.6	0.76	2.01	250	370
Mg	800	2000	1200	1.48	1.84	0.64	0.92	0.84	2.2	3.12	1.2	3.96	3.76	9.48	2.4	1.44	2.48	2.8	3.76	1.16	2.24	43	4.5
Na	460	980	900	0.06	0.056	0.04	0.155	0.05	1.04	0.066	0.115	0.47	0.62	0.095	2.16	2.24	0.17	0.67	0.66	1.23	2950	530	680
K	0.6	2.4	1.6	1.4	1.2	0.625	1.45	0.825	0.6	0.4	0.975	1.03	0.675	0.85	4600	5000	2.13	1	0.98	2.53	1000	44	53
S-2	55	<5	<5	<0.02	<0.02	<0.02	<0.02	<0.02	0.06	<0.02	<0.02	0.12	0.04	0.04	3.66	3.8	0.64	1.16	0.92	2.08	0.18		
Ctot	50	190	30	50	50	0.12	0.09	0.45	20	40	0.12	0.27	0.09	0.09	1.08	0.39	0.48	1.38	1.29	0.69	0.6		
Corg	5	20	35	35	80	<0.03	0.09	0.27	105	50	0.09	0.12	0.06	0.06	0.06	0.06	0.09	0.15	0.09	<0.03	0.09		
P	100	100	200	75	135	250	250	500	65	130	250	250	1000	250	600	600	500	500	500	1250	500		
SiO2	55	<5	<5	59.2	58	57.8	59.4	59.6	52.6	55.2	66.8	56.8	52.8	50.4	52.8	58.2	62.2	50.2	52.6	56.2	77.4		
pH																						9.2	9.6
Total Dissolved Solids																						2500	3100
WAD Cyanide																						22	44
Free Cyanide																							41
Sulphate in water																						550	580
Electrical Conductivity																						4300	5000
Bicarbonate Alkalinity																						<5	<5
Chloride																						930	1200

Notes:

ppm or mg/kg

The data above is a quick compilation of head assays from each deposit and by oxidation (ox/tr/fr where relevant) before any processing (ie geology head assay). But, the last two columns are tails assays from that actual Andy well processing plant when it was in operation. These relate to fresh rock from Andy well. We can discuss further but I included the head assay data so you could see the element composition prior to processing as I assumed of these concentration were really low, even with any post processing leaching would this be of concern? Maybe?

Au removed from assya data

Analytes removed from analyses (they are generally below their limits of reporting and have no assessment level): Ag, B, Be, Bi, Cd, Hg, Li, Mo, Se, Y.

											Field Screen					Net Acid Generation									
Sample ID	Laboratory Certificate	S	S-S0$_4$	TOS	S_{CR}	TIC	TOC	TC	$EC_{(1:5)}$	$pH_{(1:5)}$	pH_f	pH_{fox}	Field Screen Reaction Rate	pH_{KCl}	pH_{ox}	pH_{ox}	$NAG_{pH\ 4.5}$	$NAG_{pH\ 7.0}$	Maximum Potential Acidity MPA (or Acid Forming Potential, AFP)	Acid Potential Ratio (APR)	ANC Fizz Rating	Acid Neitralising Capacity (ANC)	Net Acid Production Potential (NAPP)		Waste Material Classification
				$TOS=S-S-SO_4$																			Laboratory	NAPP=AP-ANC	
		%							μS/cm	pH units				pH units			kgH_2SO_4/t		MPA=TOS*30.6	APR=ANC/MPA		kgH_2SO_4/t			
Turnberry Tailings	EP2414617; 1 Oct 2024	0.55	0.06	0.50	0.51	0.96	0.03	0.99	87	9.3	9.3	6.3	2 - Moderate	9.6	8.8	9.9	<0.1	<0.1	15.1	5.0	2 - Moderate	75.9	-59.1	-60.8	NAG pH>4.5; NAPP negative; APR>2 - Non Acid Forming
St Annes Tailings	EP2414617; 1 Oct 2024	0.02	0.01	0.01	0.02	<0.02	0.06	0.07	83	9.2	9.2	6.2	2 - Moderate	8.9	7.6	6.9	<0.1	1.2	0.3	7.2	0 - None	2.2	-1.6	-1.9	NAG pH>4.5; NAPP negative; APR>2 - Non Acid Forming

Note: Samples did not contain Titratable Actual Acidity and/or Titratable Peroxide Acidity.

Sample ID	Laboratory Certificate	Color (Munsell)	Texture	Emerson Class	Classification	Bulk Density kg/m^3
Turnberry Tailings	EP2414617; 1 Oct 2024	Gray (5Y 6/1)	Silty Loam	4	No Dispersion; Carbonate or Gypsum present	1,240
St Annes Tailings	EP2414617; 1 Oct 2024	Light Reddish Brown (2.5YR 6/4)	Silty Clay Loam	2	Some Dispersion	1,160

Sample ID	Laboratory Certificate	EC (1:5)	pH (1:5)	Ca	Mg	K	Na	Cation Exchange Capacity (CEC)	Exchangeable Sodium Percent (ESP)
				(exchangeable)					
		µS/cm		cmol(+)/kg or meq/100g					%
Turnberry Tailing	EP2414617; 1 Oct 2024	87	9.3	15.9	0.5	<0.1	0.3	16.8	1.7
St Annes Tailing	EP2414617; 1 Oct 2024	83	9.2	2.2	0.5	<0.1	0.3	3.0	9.0

Sample ID	Laboratory Certificate	Aluminium	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Thorium	Uranium	Vanadium	Zinc
		mg/kg																		
Turnberry Tailings	EP2414617; 1 Oct 2024	10,700	61	<10	<1	<50	<1	54	26	74	32,300	16	613	<0.1	56	<5	3	0.3	20	66
St Annes Tailings	EP2414617; 1 Oct 2024	1,710	854	20	<1	<50	<1	39	10	36	25,800	42	327	<0.1	39	<5	1	0.2	34	39
ASC NEPM Areas of Ecological Significance (most stringent; indicative only); clay content > 10%		**ns**	**40**	**ns**	**ns**	**ns**	**ns**	**130**	**ns**	**270**	**ns**	**470**	**ns**	**ns**	**30**	**ns**	**ns**	**ns**	**ns**	**90**
Average Crustal Abundance GARDGuide		**71,000**	**6**	**500**	**6**	**10**	**0.4**	**70**	**8**	**30**	**40,000**	**35**	**1,000**	**0.06**	**50**	**0.4**	**9**	**2**	**90**	**90**
Global Abundance Index GAI = log2 [C / (1.5*S)]																				
Turnberry Tailings		-3	3	-	-	-	-	-1	1	1	-1	-2	-7	-	0	-	-2	-3	-3	-1
St Annes Tailings		-6	7	-5	-	-	-	-1	0	0	-1	0	-8	-	-1	-	-5	-4	-2	-2
GAI Assessment (a GAI of 3 or above is considered significant and such an enrichment may warrant further examination)																				
Turnberry Tailings		0	3	-	-	-	-	0	1	1	0	0	0	-	0	-	0	0	0	0
St Annes Tailings		0	7	0	-	-	-	0	0	0	0	0	0	-	0	-	0	0	0	0

Sample ID (EP2414617; 1 October 2024)	Leachable Metals																		
	Aluminium	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Thorium	Uranium	Vanadium	Zinc
	mg/L																		
Acetic Acid Leachate (pH=5)	0.1	0.005	0.1	0.001	0.1	0.001	0.01	0.01	0.01	0.05	0.01	0.01	0.001	0.01	0.01	0.001	0.001	0.01	0.1
Turnberry Master Comp P80: 150 um	<0.1	<0.005	0.3	<0.001	<0.1	<0.001	<0.01	<0.01	<0.01	<0.05	0.02	**4.59**	<0.001	**0.02**	<0.01	<0.001	<0.001	<0.01	<0.1
St Anne's Master Comp P80: 150 um	<0.1	**0.027**	0.4	<0.001	0.1	<0.001	<0.01	<0.01	<0.01	<0.05	<0.01	**0.50**	<0.001	0.01	<0.01	<0.001	<0.001	<0.01	<0.1
DI Water Leachate (pH=7)	0.01	0.001	0.001	0.001	0.05	0.0001	0.001	0.001	0.001	0.05	0.001	0.001	0.0001	0.001	0.01	0.001	0.001	0.01	0.005
Turnberry Master Comp P80: 150 um	**0.73**	0.009	0.007	<0.001	0.06	<0.0001	0.002	<0.001	<0.001	**0.69**	0.002	0.009	<0.0001	0.001	<0.01	<0.001	<0.001	<0.01	<0.005
St Anne's Master Comp P80: 150 um	**0.79**	**0.108**	0.006	<0.001	0.06	<0.0001	0.004	<0.001	0.002	**0.69**	0.006	0.010	<0.0001	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
Leachate (pH=9)	0.1	0.050	<1.0	0.001	-	0.001	0.01	0.01	0.01	0.050	<0.10	<0.10	0.001	<0.10	<0.10	0.001	0.001	<0.10	<1.0
Turnberry Master Comp P80: 150 um	**2.70**	**0.052**	<1.0	**0.071**	-	<0.010	<0.10	<0.10	<0.10	**2.42**	<0.10	<0.10	<0.001	<0.10	<0.10	0.012	<0.010	<0.10	<1.0
St Anne's Master Comp P80: 150 um	<1.0	**0.311**	<1.0	**0.071**	-	<0.010	<0.10	<0.10	<0.10	**0.52**	<0.10	<0.10	<0.001	<0.10	<0.10	<0.010	<0.010	<0.10	<1.0
Australian Drinking Water Guidelines: Table 10.6 Guideline values for physical and chemical characteristics	**0.2 (A)**	**0.01 (H)**	**2 (H)**	**0.06 (H)**	**4 (H)**	**0.002 (H)**	**ns**	**ns**	**2 (H) 1 (A)**	**0.3 (A)**	**0.01 (H)**	**0.5 (H) 0.1 (A)**	**0.001 (H)**	**0.02 (H)**	**0.01 (H)**	**ns**	**0.02 (H)**	**ns**	**3 (A)**
ASC NEPM Table 1C Groundwater Investigation Levels (GILs) Drinking Water	**ns**	**0.01**	**2**	**0.06**	**4**	**0.002**	**ns**	**ns**	**2**	**ns**	**0.01**	**0.5**	**0.001**	**0.02**	**0.01**	**ns**	**0.017**	**ns**	**ns**
ANZG, 2023: Draft Livestock Drinking Water Guidelines (Cattle)	**5**	**0.025**	**ns**	**0.06**	**5**	**0.01**	**0.050**	**1**	**1**	**ns**	**0.10**	**10**	**0.002**	**1**	**0.02**	**ns**	**0.2**	**0.1**	**20**
Notes:	**A denotes Aesthetic, H Health and ns not specified.**																		
	0.3	**Concentration exceeds Limit of Reporting (LoR or Detection Limit). LoRs have been raised for some samples due to matrix interferences.**																	
	0.052	**Concentration exceeds lowest assessment level (colour coded)**																	