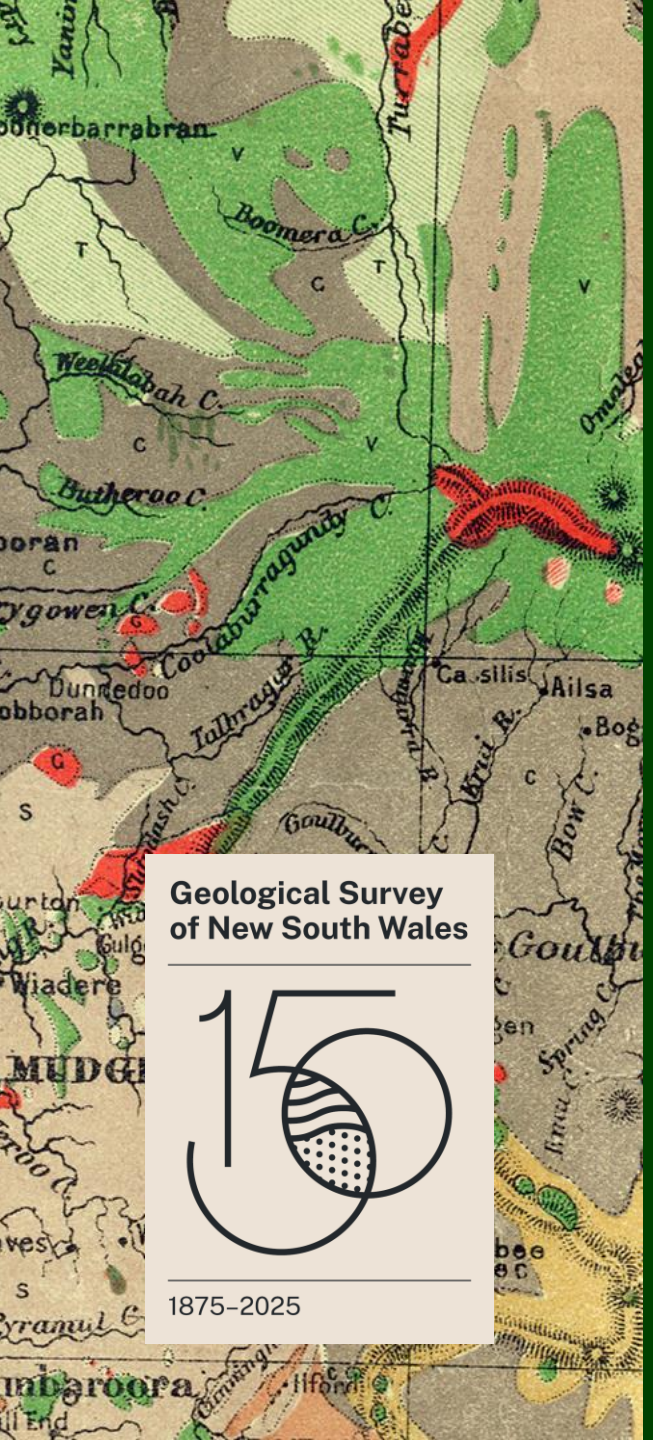



# Updates on critical mineral and high-tech metal-related projects being undertaken by the Geological Survey of NSW

NSW Mine Reuse Project

**Karen Montgomery**
Geoscientist

9 May 2025

NSW GOVERNMENT

# NSW Mine Reuse Project

1

- Supports the NSW Critical Minerals and High-tech Metals Strategy
- Drives discovery of new critical minerals by identifying potential for reprocessing opportunities
- Collaborates with the Sustainable Minerals Institute (SMI-University of Queensland), and Geoscience Australia (GA) with RMIT University

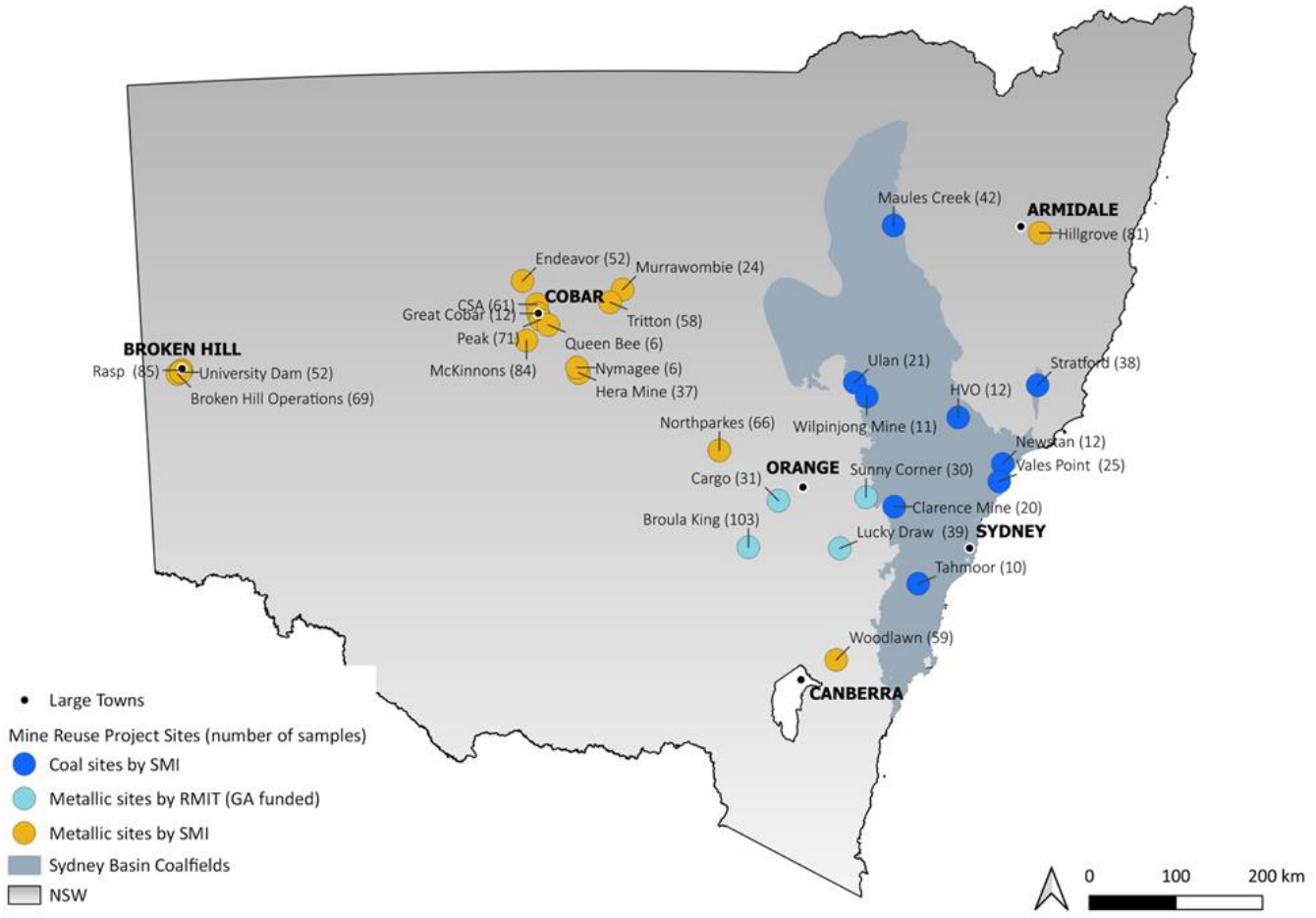
SMI and GSNSW staff conducting hand auger drilling at the Vales Point fly ash dam

NSW Mine Reuse Project

# Sites investigated

2

# Sites investigated




Map of sites investigated for the project

## Sampling conducted at 29 sites including legacy mines, mines on care and maintenance, and current operations

| Site type | Total SMI | Total RMIT |
|---|---|---|
| Coal | 9 | - |
| Metallic | 15 | 4 |
| Power | 1 | - |

# Sites investigated cont.

## Cobar

Endeavor (C&M), CSA (OP+legacy), Peak (OP), Hera (OP-C&M), Tritton and Murrawombie (OP), McKinnons (legacy), slag sites x 3 (legacy)

## Broken Hill

Southern Ops (OP), Rasp (OP), University Dam (legacy)

## Lachlan

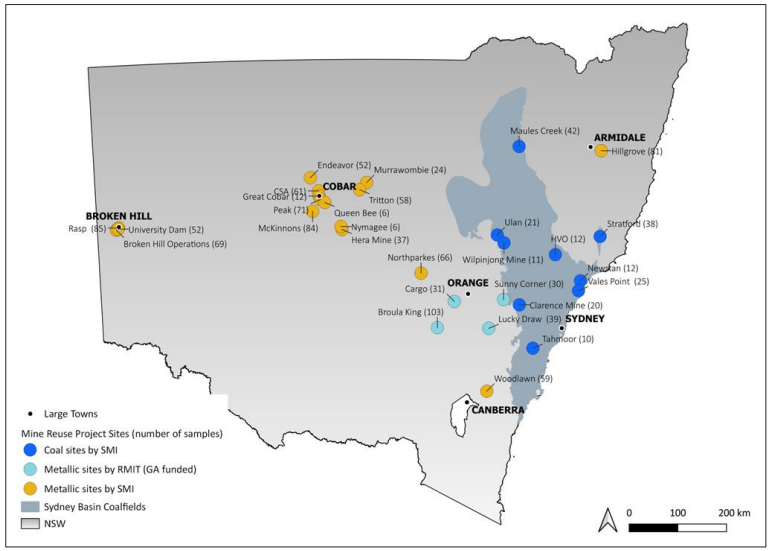
Northparkes (OP), Woodlawn (OP), Cargo

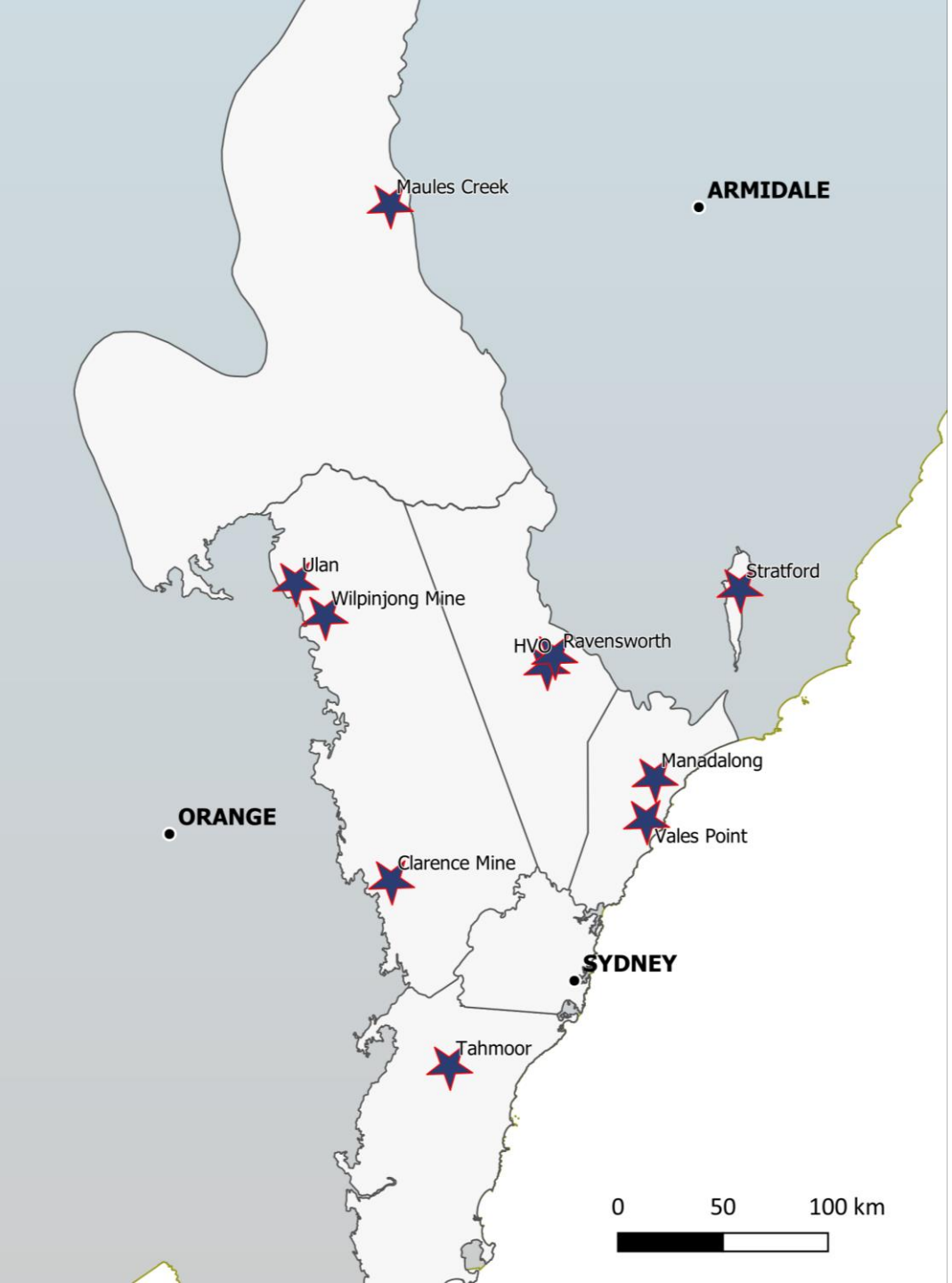
Broula King, Lucky Draw, Sunny Corner (RMIT)

## New England

Hillgrove (C&M)

- 20 metallic sites
- 10 deposit styles
- 4 metallogenic terrains
- 6 geographical locations






- 9 coal sites
- 3 basins
- 6 coalfields
- 1 power station

Sydney Basin

Newcastle Coalfield – Mandalong/Newstan Colliery

Southern Coalfield – Tahmoor Mine

Western Coalfield – Ulan + Wilpinjong, Clarence

Hunter Coalfield – Hunter Valley Operations

Gunnedah Basin – Maules Creek

Gloucester Basin – Stratford Colliery

Combusted Sydney Basin Coal – Vales Point power station

NSW Mine Reuse Project

# Work program and analysis undertaken

3

# Sampling/analysis–minerals sites

- Sampling by hand auger drilling to a max depth of 10m
- Auger holes sub-sampled on facies changes with approx. 80 samples per site collected
- Mineralogy and mineral chemistry on up to 12 selected samples per site

- Geochemical analysis of up to 80 samples per site for a 48-element suite (+ Au/PGE as required)
- XRD and MLA analysis on up to 10 samples per site
- LA-ICPMS analysis on approx. 10 selective samples per site
- Photography and logging
- Data analysis and reporting

Total of 19 sites, 135 auger holes, 821 samples, 139 XRD-MLA analysis


a) The University Dam site with auger drill locations
b) Laura and Adam from GSNSW hand augering at University Dam

# Sampling/analysis - coal sites

- Tailings samples collected by hand auger drilling or excavator bucket
- Fly-ash and bottom ash samples collected from power station
- Coarse coal rejects collected direct from CHPP
- Mineralogy and mineral chemistry 10 samples per site

- Geochemical analysis of up to 80 samples per site for a 48-element suite (+ Au/PGE as required)
- XRD and MLA analysis on up to 10 samples per site
- LA-ICPMS analysis on approx. 10 selective samples per site
- Photography and logging
- Data analysis and reporting

**Total of 9 sites (8 coal mines, 1 power station), 19 auger holes, 211 samples, 74 XRD-MLA analysis**

Contractors conducting hand auger drilling from pontoon at Clarence Colliery

# Facies and statistical geochemical analysis

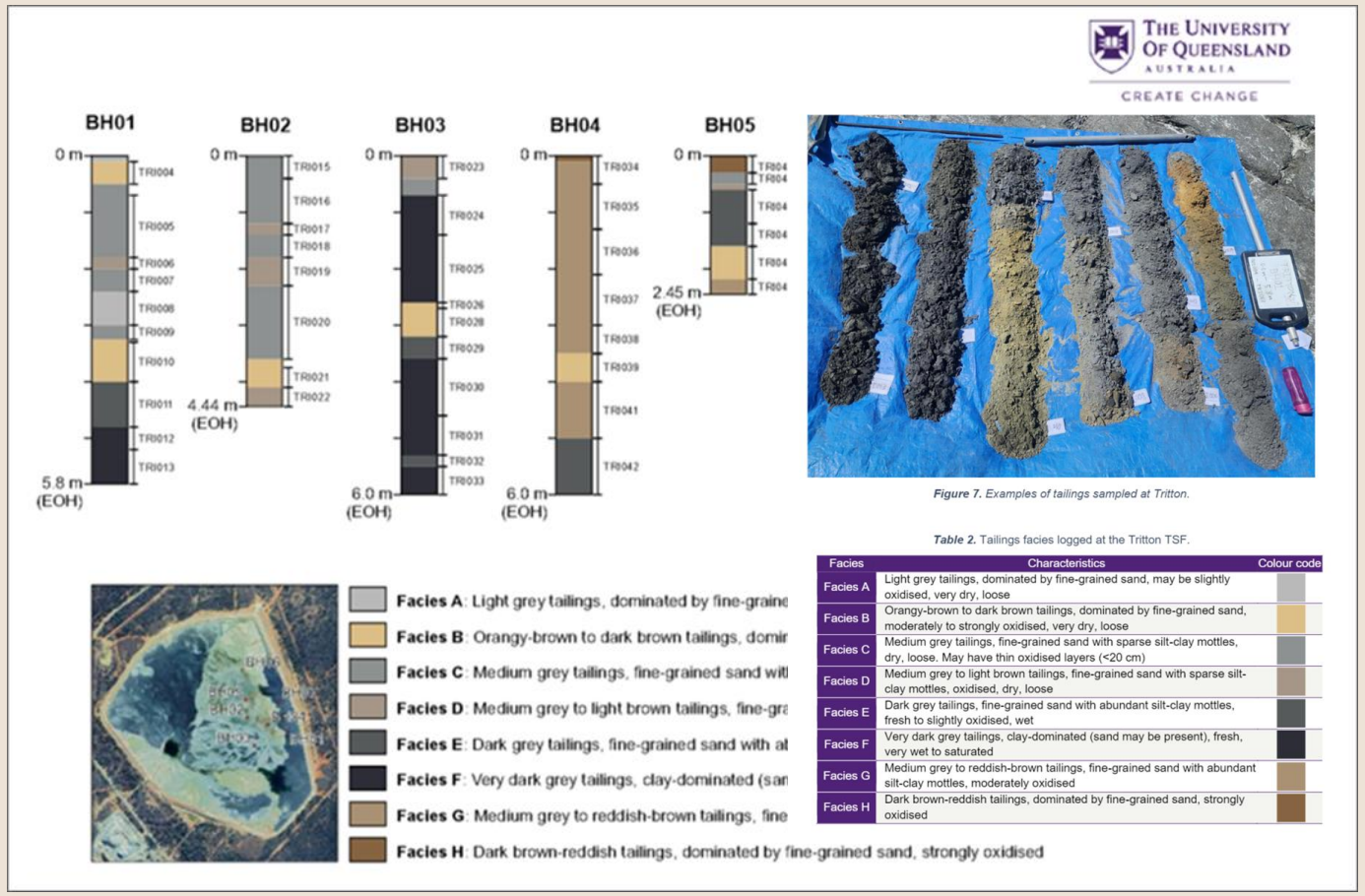



*Figure 7. Examples of tailings sampled at Tritton.*

*Table 2.* Tailings facies logged at the Tritton TSF.

| Facies | Characteristics | Colour code |
|---|---|---|
| Facies A | Light grey tailings, dominated by fine-grained sand, may be slightly oxidised, very dry, loose | |
| Facies B | Orangy-brown to dark brown tailings, dominated by fine-grained sand, moderately to strongly oxidised, very dry, loose | |
| Facies C | Medium grey tailings, fine-grained sand with sparse silt-clay mottles, dry, loose. May have thin oxidised layers (<20 cm) | |
| Facies D | Medium grey to light brown tailings, fine-grained sand with sparse silt-clay mottles, oxidised, dry, loose | |
| Facies E | Dark grey tailings, fine-grained sand with abundant silt-clay mottles, fresh to slightly oxidised, wet | |
| Facies F | Very dark grey tailings, clay-dominated (sand may be present), fresh, very wet to saturated | |
| Facies G | Medium grey to reddish-brown tailings, fine-grained sand with abundant silt-clay mottles, moderately oxidised | |
| Facies H | Dark brown-reddish tailings, dominated by fine-grained sand, strongly oxidised | |

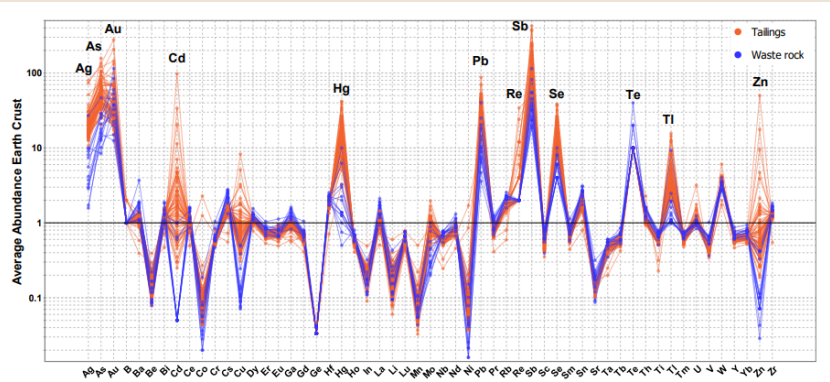



***Figure 9.*** *Bulk chemistry summary for the sampled mine waste at McKinnons (n tailings = 70; n waste rock = 14) compared to average crustal abundance values (Levinson, 1974).*

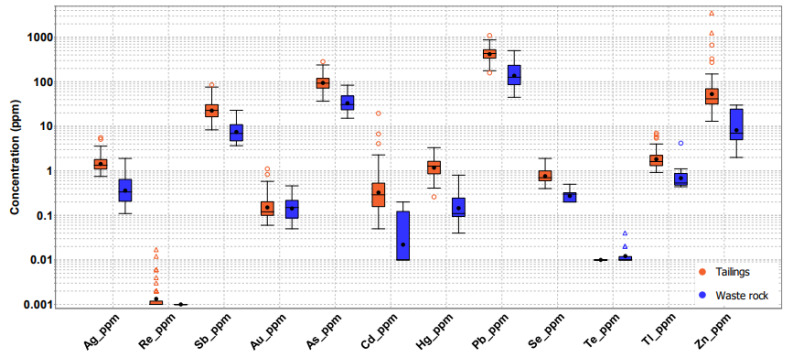



***Figure 10.*** *Tukey boxplot for selected elements measured in McKinnons mine wastes.*

# Spatial and downhole distribution analysis of geochemistry conducted

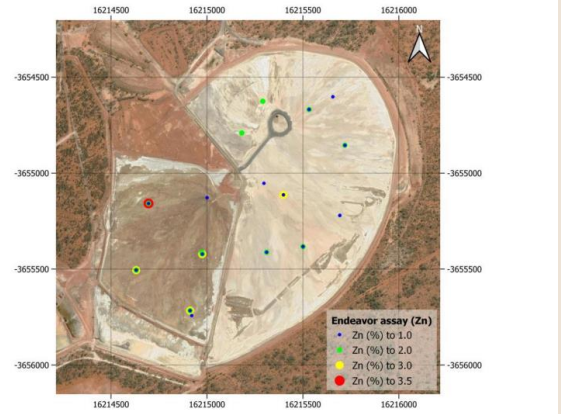



*Figure 17. Spatial plot of Zn (ppm) concentrations measured in the Endeavor tailings samples.*

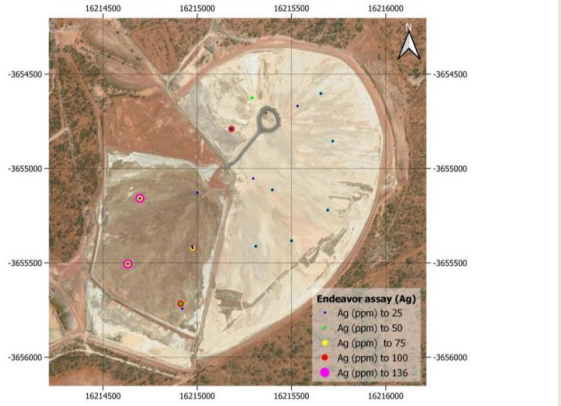
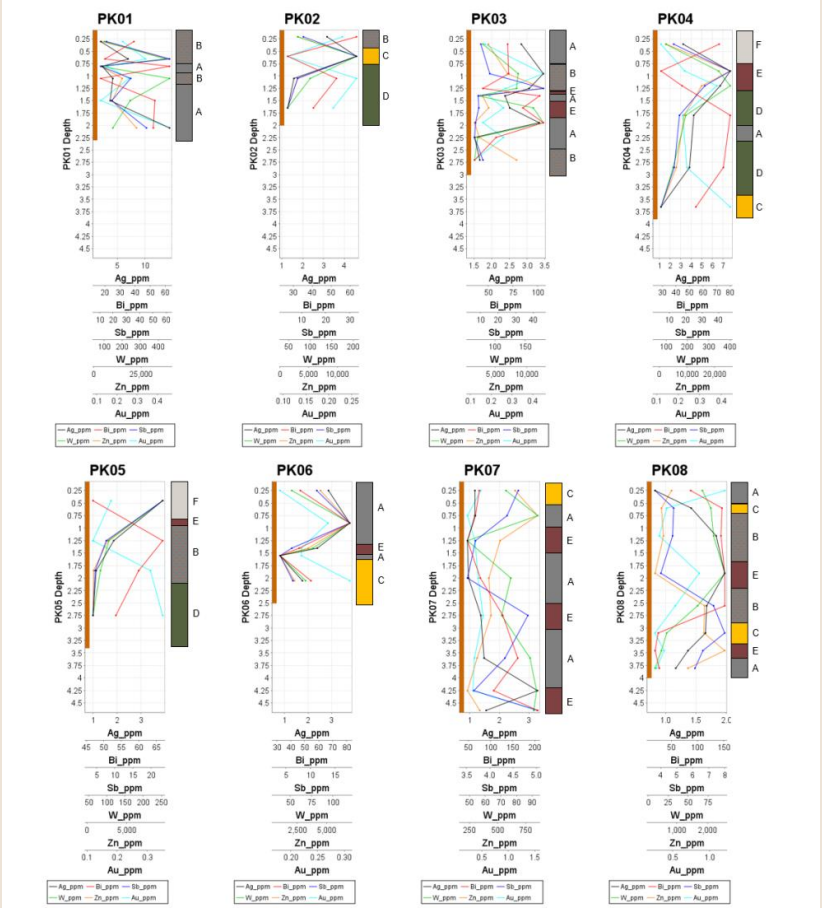



*Figure 18. Spatial plot of Ag (ppm) concentrations measured in the Endeavor tailings samples.*



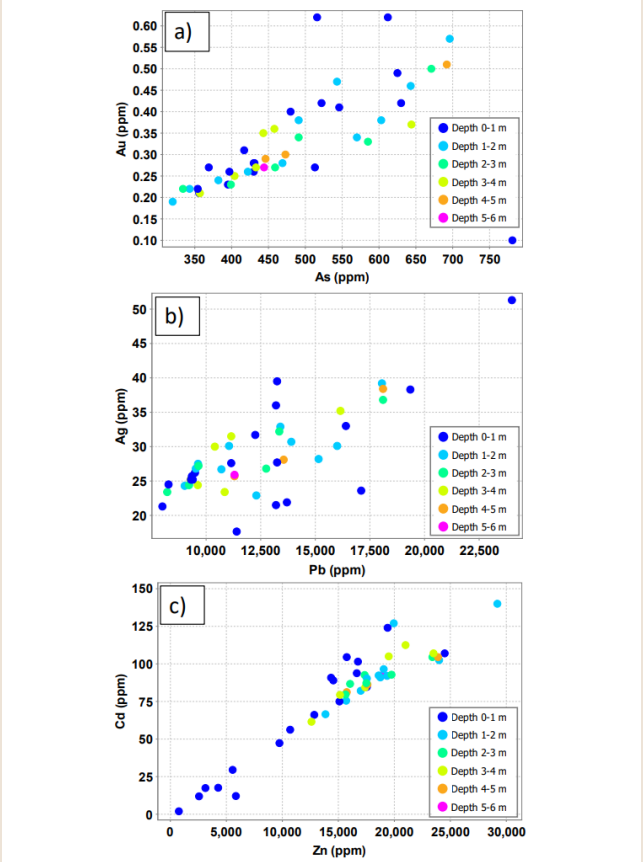




*Figure 14. Bivariate plots of selected elements for the Woodlawn tailings (n = 45); a) As (ppm) vs Au (ppm), b) Pb (ppm) vs Ag (ppm), c) Zn (ppm) vs Cd (ppm).*

# Mineralogy, mineral abundance, PSD and mineral chemistry

MINERALOGY (MLA)

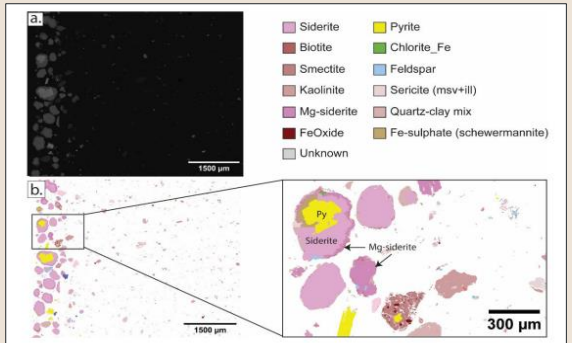



*Figure 17. a) Back scattered electron (BSE) and b) classified mineralogy image for the tailings sample (HVO008) as determined by MLA. This sample is dominated by siderite (36 wt. %), Mg-siderite (15 wt. %), quartz-clay mix (13 wt. %), kaolinite (9 wt. %) and pyrite (7.5 wt. %).*

PARTICLE SIZE DISTRIBUTION (MLA)

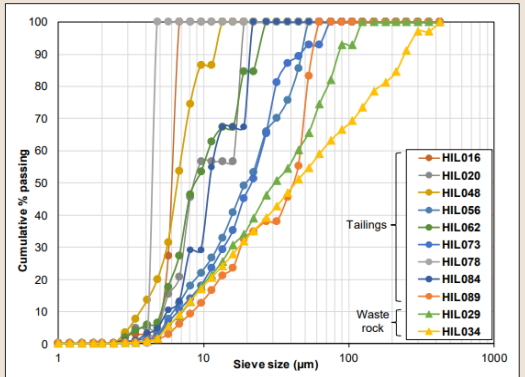



*Figure 56. Mineral grain size distribution for stibnite as determined by MLA.*

MINERAL ABUNDANCE (MLA)

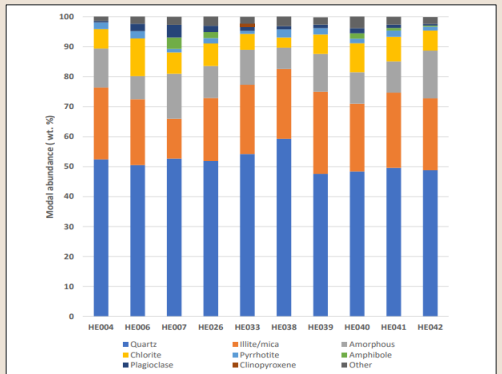
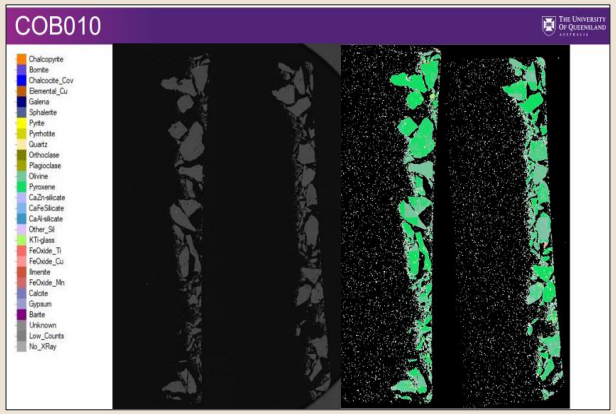



*Figure 21. Mineralogy of samples from Hera as determined by X-ray diffraction.*

MINERALOGY (MLA)




MINERALOGY (XRD)

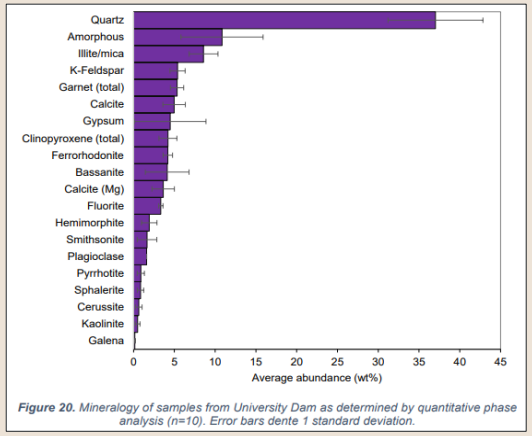



*Figure 20. Mineralogy of samples from University Dam as determined by quantitative phase analysis (n=10). Error bars dente 1 standard deviation.*

MINERAL CHEMISTRY (LA-ICP-MS)

Analysis of LA-ICP-MS patterns shows that Ag, Bi and Sb do not appear zoned within galena, indicating they likely occur as substitutions in the crystal lattice (**Figure 35**). Similarly, in chalcopyrite, pyrite and pyrrhotite; Ag, Sb and Bi appear to be evenly distributed throughout the mineral (**Figure 36** and **Figure 37**).

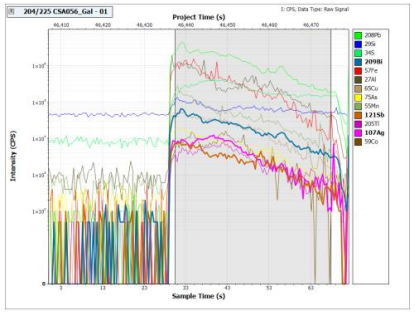



*Figure 35. Laser ablation trace for selected elements in a galena spot sample showing counts for Ag, Bi and Sb are relatively consistent throughout the mineral matrix.*

MINERAL ASSOCIATIONS (MLA)

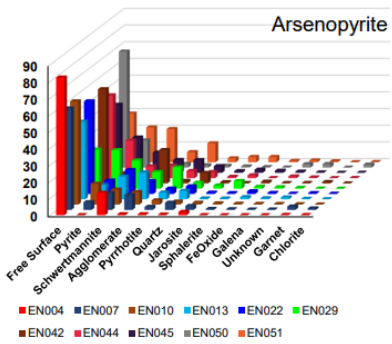



*Figure 31. Mineral associations for arsenopyrite as determined by MLA.*

MINERAL CHEMISTRY (LA-ICP-MS)

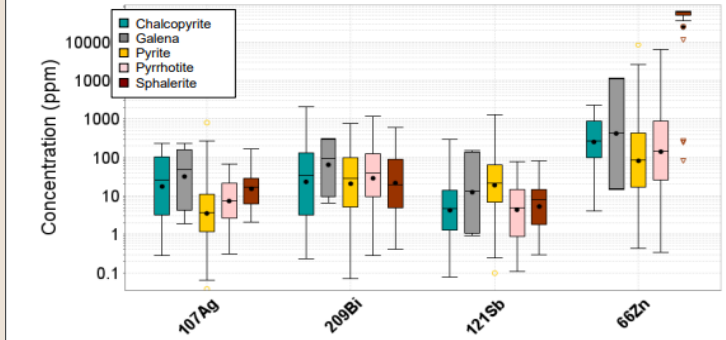



*Figure 34. Tukey log plot showing concentrations of Ag, Bi, Sb and Zn across targeted laser ablation spots in chalcopyrite, galena, pyrite, pyrrhotite and sphalerite.*

NSW Mine Reuse Project

# Key results summary for elevated NSW critical minerals

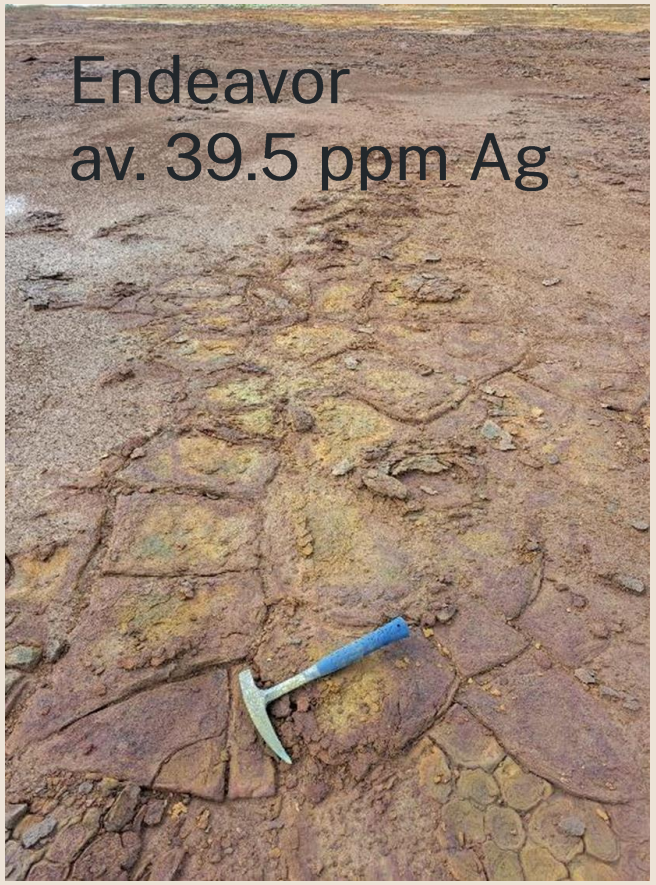
4

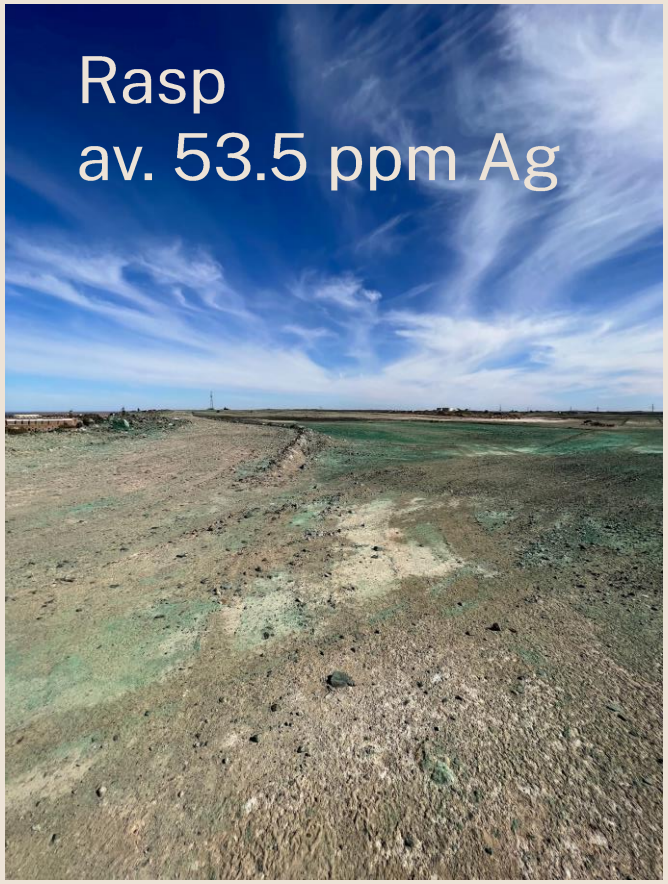

# ‘Critical minerals’ as identified in the NSW Critical Minerals and High-tech Metals Strategy are found in elevated* concentrations in mining waste material in NSW.

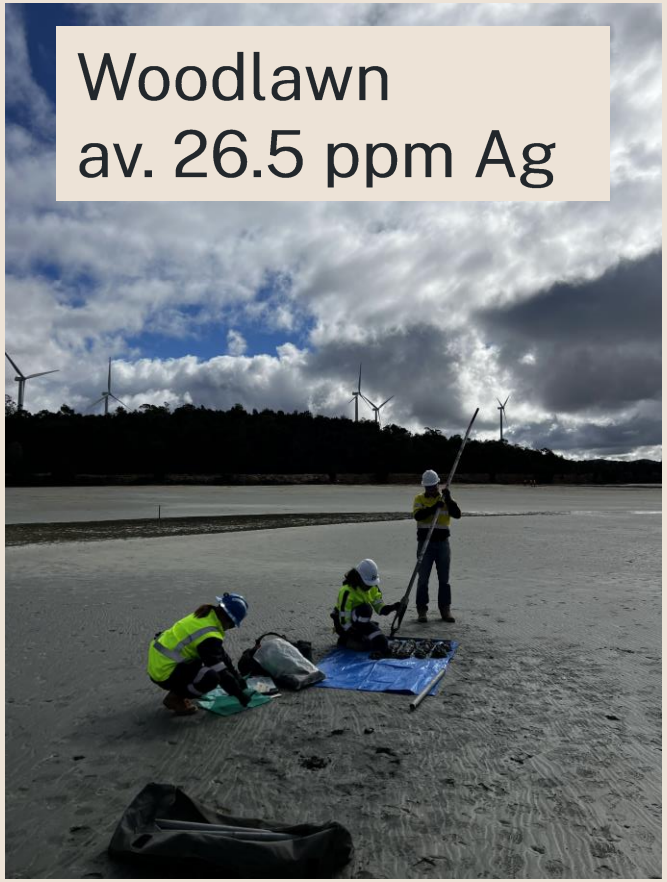
*Identified as greater than 100 times average crustal abundance

Hand auger samples at the McKinnons tailings storage facility

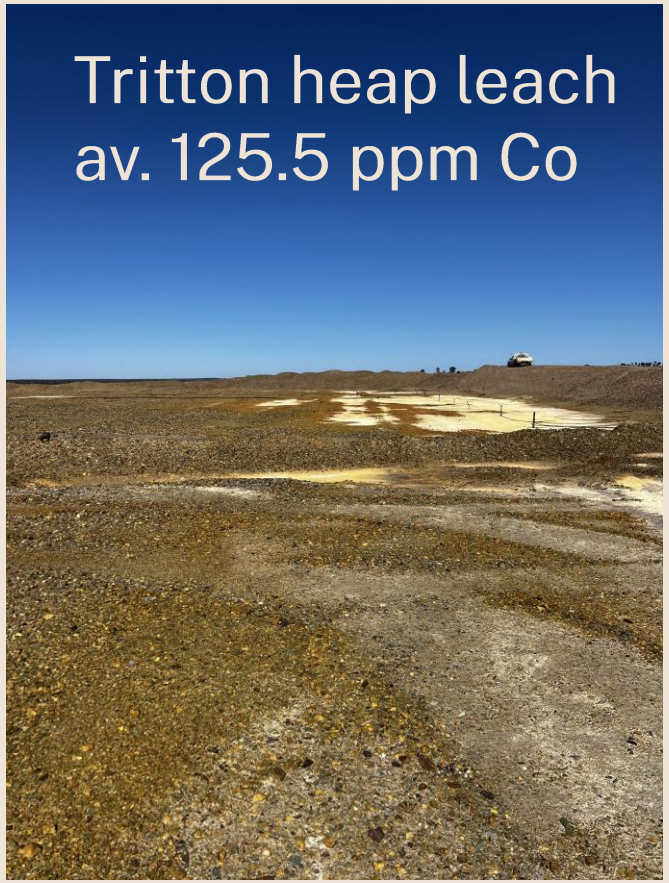
# Highest concentrations of silver identified in the tailings at Endeavor, Rasp and Woodlawn

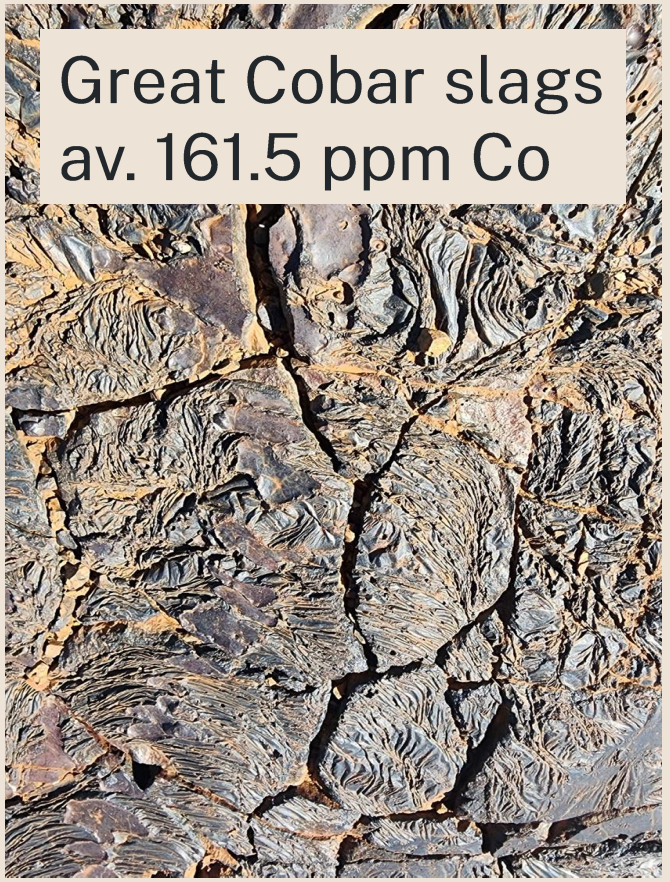


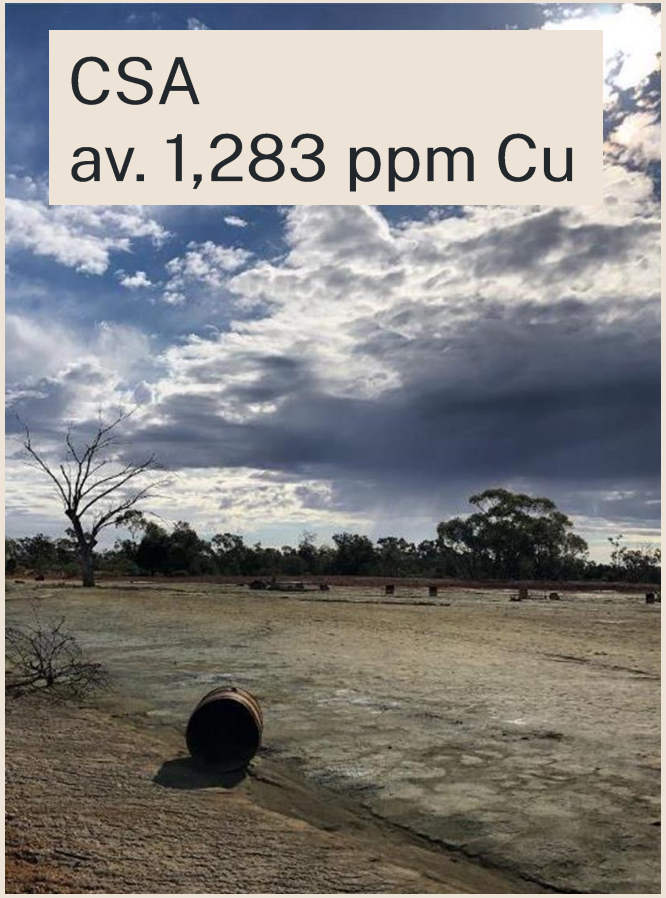



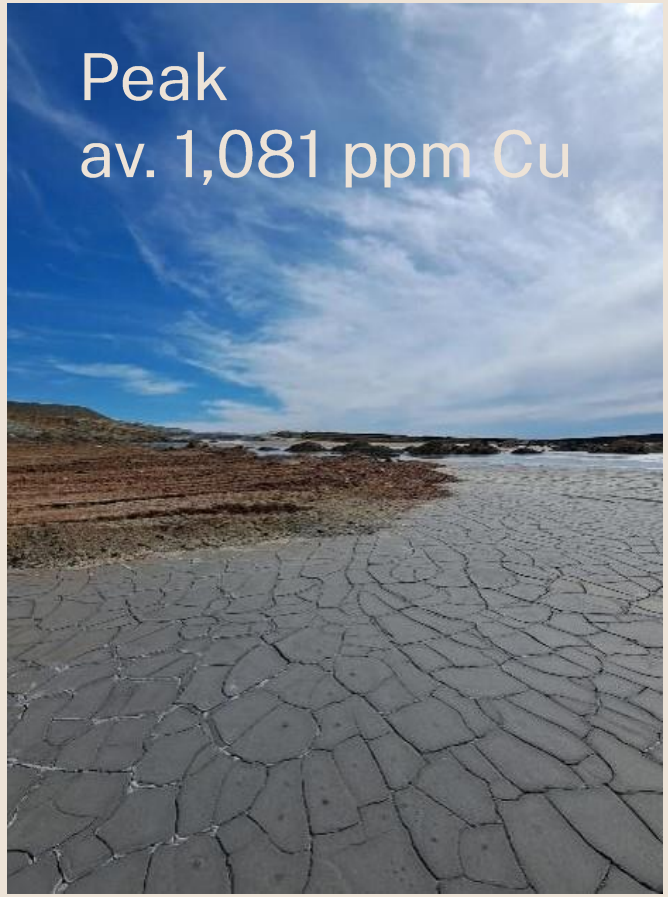
# Most elevated cobalt values identified in the Tritton tailings, Murrawombie heap leach and the Great Cobar slags

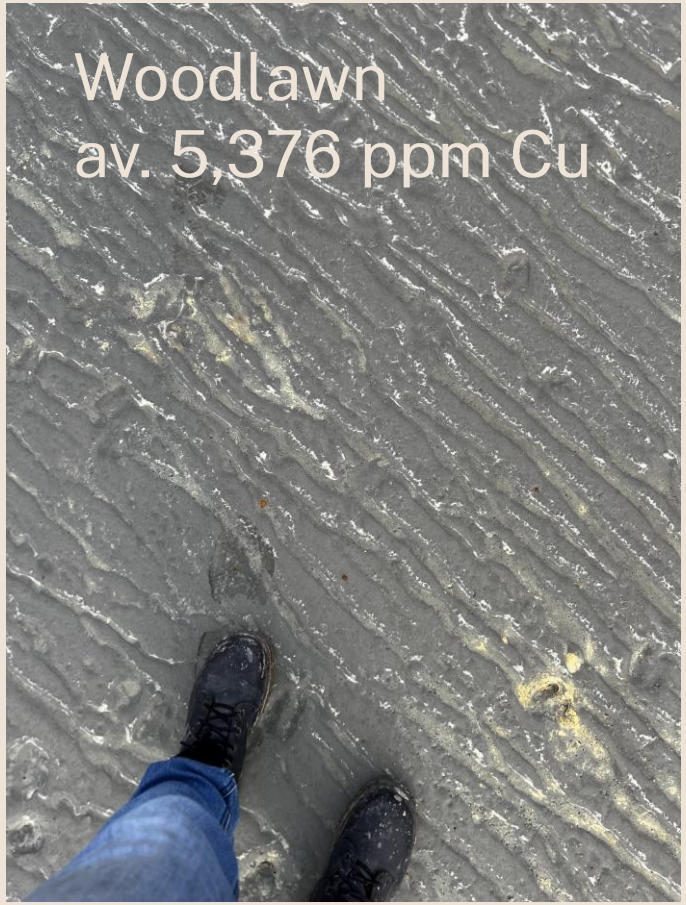



# Highest values of copper identified in tailings at CSA, Peak, Woodlawn and Tritton, and slag material at the Nymagee and Queen Bee sites in Cobar



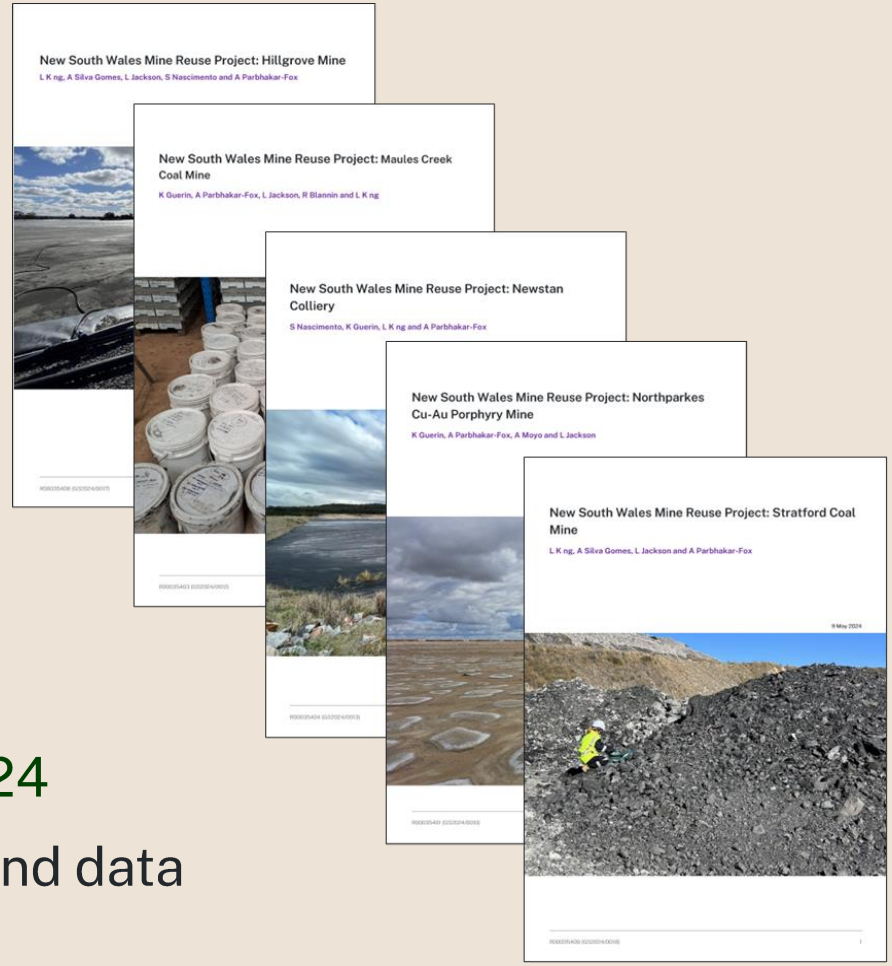



NSW Mine Reuse Project

# New reports and data now available

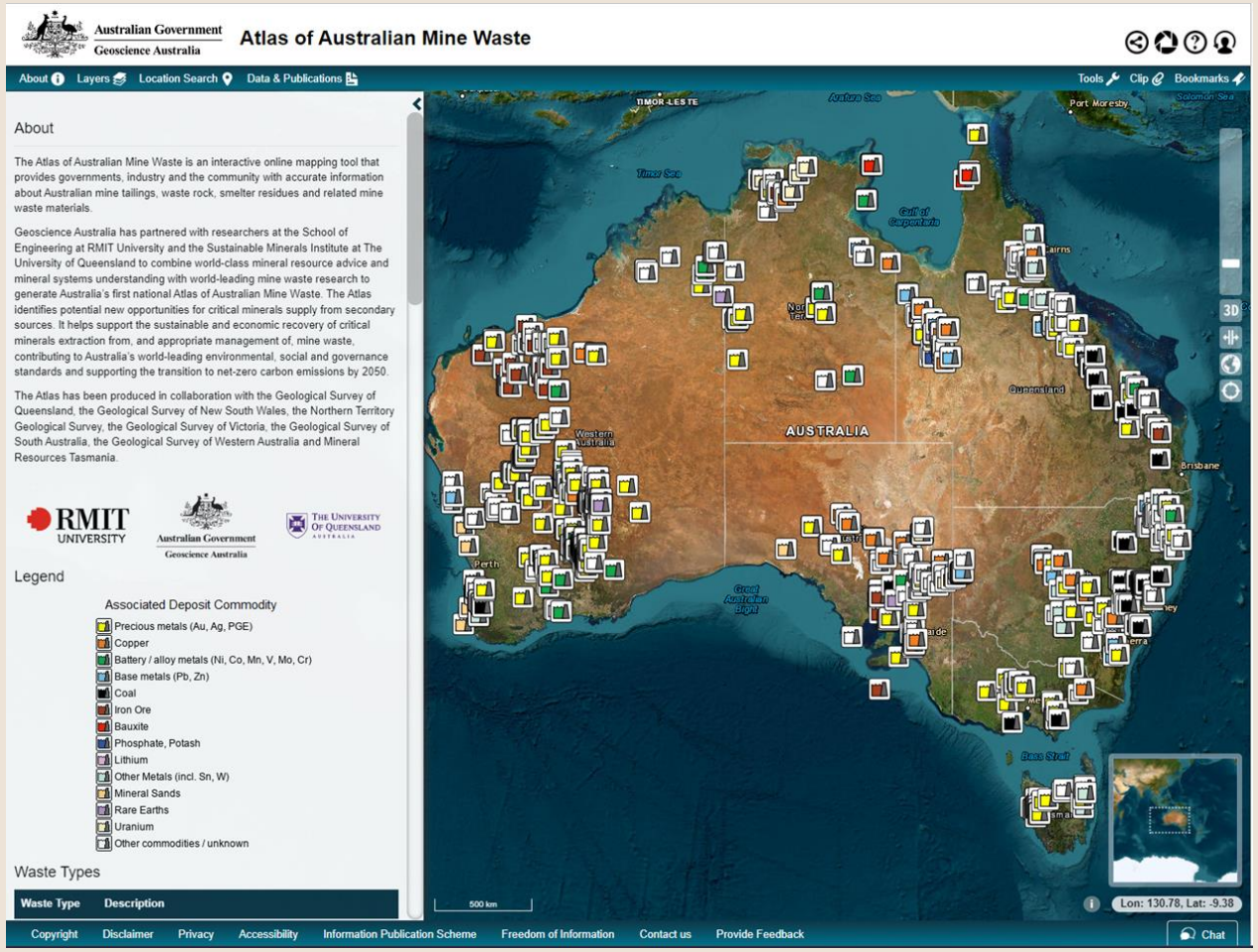
5

# A summary report, 5 data files and 21 reports completed by SMI


- GS2024/0024
- All reports and data

# Geoscience Australia and RMIT University




- The data will be included in the national Atlas of Australian Mine Waste – GA developed database with mine waste information across Australia
- GA funded investigations at 4 metalliferous sites with the Exploring for the Future Program (EFTF)

Screen image of the Atlas of Australian Mine Waste

NSW Mine Reuse Project

# Future opportunities and potential study areas

6

# Promising sites

Endeavor – Ag (39.5 g/t), As, Au (0.34 g/t), Cd, Pb, Sb, Tl, Zn (1.21%)

Woodlawn – Ag (26.5 g/t), As, Au (0.32 g/t), Bi, Cd, Cu (0.54%), Hg, In, Pb, Sb, Se, Te, Tl, Zn

Hillgrove – Ag (1.79 g/t), As, Au (1.82 g/t), Bi, Pb, Sb (2.29%), Se, Te, W (235 ppm)

Tritton – As, Cd, Cu (0.24%), Re, Se, Te

McKinnons – As, Au (0.18 g/t), Cd, Sb

Broken Hill – Ag, As, Cd, Mn, Sb, Se, Te, W, Zn

Hand auger drilling at Woodlawn tailings storage facility

# Cobar region

- Reprocessing for recovery of valuable metal incl. Co, Bi, Au, Ag, W, and Zn (i.e. Endeavor)
- Studies to understand potential of ore sand (i.e. high silica at Hera)
- Metallurgical studies aimed at the extraction potential of elevated metals such as Co and Te assoc. with pyrite dominant tailings at Tritton
- Investigate reprocessing opportunities for removal of sulfides to create non-acid forming tailings for rehabilitation benefits

Tailings storage facility (TSF) at the McKinnons legacy mine site


# Broken Hill region

- Perilya's Southern Operations has several tailings facilities; A, B, C, and D
- The current operational facility, TSF-D (accepting residue from Potosi, North and Southern Operations mine) was chosen for this study
- Less than 10 m depth from the surface of the TSF-D was tested by hand auger drilling
- Large volume of untested tailings material in Broken Hill
- With high quartz content (av. 28–42 wt %) and good rail access, studies into ore sand viability – initially focused on separation and physical characteristic testing

Location of tailings facilities B, C and D at Southern Operations

# Hillgrove

- Elevated W (264 ppm), Au and Sb should be investigated from the tailings material
- Recommend sampling by auger or higher capacity drilling at the Eleanora Dam
- Potential for environmental clean-up at the Metz WRD with high Au (0.75 g/t) and Sb (1.03%)
- Other metals such as As, Bi, Lu, Sb, Se and Te may add value if reprocessing was to occur – further studies required

Karen (GSNSW), Zendong (SMI) and Tom (Red River Resources – now Larvotto Resources) at the Metz waste rock dump at Hillgrove Operations

NSW Mine Reuse Project

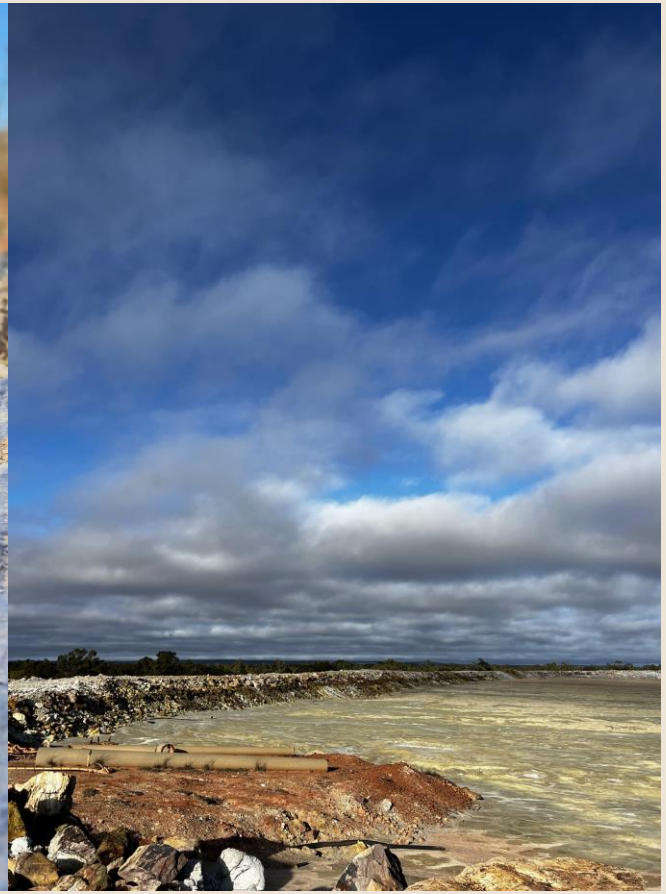
# Acknowledgements

7

# Acknowledgements


- Staff from the Sustainable Minerals Institute (SMI) at UQ including Group Leader Associate Professor Anita Parbhakar-Fox and NSW program leads Kristy Guerin and Lexi K ng
- Numerous GSNSW staff
- Management and staff members at all sites involved


# Thank you



**Karen Montgomery**
Karen.Montgomery@regional.nsw.gov.au