



NSW's largest geophysical acquisition campaign

Astrid Carlton

Geological Survey of NSW

astrid.carlton@regional.nsw.gov.au

SUMMARY

The Geological Survey of New South Wales (GSNSW) precompetitive geophysical data coverage is set to expand during 2023. A geophysical acquisition campaign totalling \$4.4 M will cover approximately one fifth to a sixth of the state with new geophysical data. Data acquired will support multiple projects including those that aim to drought proof NSW and support critical mineral exploration. All acquired data will be publicly available through [MinView](#), the GSNSW online application for discovering geoscientific information. GSNSW is working collaboratively with other state and federal government agencies to acquire 7 regional geophysical surveys. The surveys include airborne electromagnetic (AEM), airborne magnetic and radiometric (AMR), airborne gravity and reflection seismic data. Most of the surveys focus on central NSW, an area prospective for minerals with ongoing water security issues. Each geophysical survey's purpose, location and specifications is discussed herein.

Key words: Pre-competitive, geophysics, NSW.

GSNSW MISSION

GSNSW is in the Mining, Exploration & Geoscience division of the Department of Regional NSW. Its main purpose is to increase our knowledge of NSW geology to ensure the state has the mineral resources it needs. GSNSW undertakes geophysical surveys to provide baseline geophysical information at regional and tectonic scales to improve our understanding of geology and mineral systems. All data acquired is publicly available and can be used by other government agencies, academic organisations, agricultural and exploration industries, and the public. Explorers use GSNSW geophysical data as baseline, framework data to de-risk exploration.

GOVERNMENT GEOPHYSICAL SURVEYING

The Australian Government has undertaken geophysical surveys since the 1950s. As technology has improved, high-resolution, positionally accurate, large-scale geophysical surveys became possible. During the 1990s GSNSW completed regional geophysical surveys under the ExploreNSW and Discovery2000 initiatives, often in collaboration with Geoscience Australia (GA). Over the past 3 decades GSNSW and GA have increased geophysical data coverage over NSW, attracting explorers to the state with pre-competitive geophysical data. Geophysical acquisition continues under the New Frontiers Initiative, which is increasing the coverage, resolution and availability of geophysical data to the public and explorers.

The scale and resolution of government geophysical surveys differs from those undertaken by explorers. Explorers focus on specific prospects, completing small, very high-resolution surveys, while government surveys cover large regions with high-resolution data. For instance, an explorer may undertake an airborne magnetic and radiometric survey over their prospect (a few 10s of km wide) with a line spacing of 50 m, whereas GSNSW would undertake an AMR survey over 50 × 100 km area at 200 m line spacing. By undertaking regional surveys, GSNSW ensures greater coverage of baseline data for geoscientists to undertake geological interpretation and mapping.

CURRENT NSW GOVERNMENT GEOSCIENCE PROJECTS

GSNSW geophysical acquisition campaign supports multiple projects, including:

- the [Critical Minerals and High-Tech Metals Strategy](#). The strategy outlines the NSW Government's vision to build on our existing potential and position as a major global supplier and processor of critical minerals and high-tech metals. GSNSW supports the strategy by acquiring pre-competitive data in areas that have potential for gold and copper mineralisation.
- the [Future Ready Regions](#) (FFR) strategy. FFR is the NSW Government's commitment to build strong communities and diversified regional economies that are not just built to survive drought but are able to thrive as an economic powerhouse. GSNSW is participating in the Future Ready Regions program to help

drought-proof regional NSW by identifying areas with potential deep groundwater and those that could store groundwater (in times of surplus).

- the Mineral Exploration Cooperative Research Centre (MinEx CRC) project. MinEx CRC is a national collaborative project that includes state and federal government, research organisations and industry. It is focused on developing safer, more productive and environmentally friendly drilling methods for use in areas where rocks are under cover. GSNSW is acquiring geophysical data to increase our knowledge of mineral systems in areas under cover and along strike of known mineralised terrain. The knowledge gained will be used to inform the National Drilling Initiative that will test the new drilling technologies in NSW.

GEOPHYSICAL SURVEYS

Bancannia Trough AEM

The Bancannia Trough AEM survey (Figure 1 and Table 1) was completed in 2022 in collaboration with GA. This survey supports the Future Ready Regions program by covering an area prospective for deep groundwater east of Broken Hill. The southern end of the Bancannia Trough is known to host groundwater (Baarda, 1968) in the Ravendale Formation, a Devonian basin dominated by siltstone, with typical 'red-beds'. Groundwater occurs in the Nundooka and Salmon sandstones, which both thicken at the southern end of the basin where the AEM survey was flown. The Nundooka Sandstone has poor to excellent porosity and permeability (Wiltshire, 1969). The Ravendale Formation outcrops over a length of 5 kilometres (NSW Seamless Geology, 2022). The AEM data was used to map the Ravendale Formation underground and provides insights into other potential groundwater resources. Mapping results will inform a drilling project scheduled for 2023.

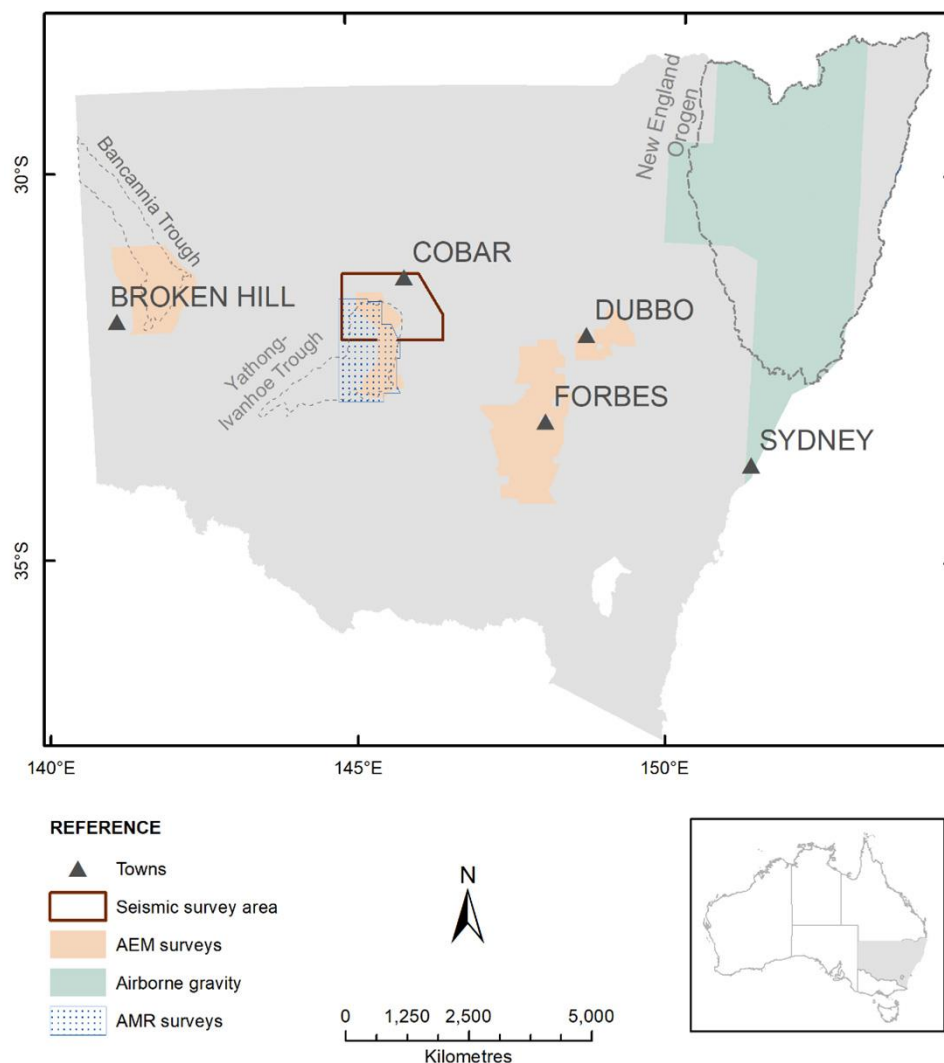


Figure 1. Map of proposed survey areas. Survey areas are subject to change.

<i>Survey name</i>	<i>Line spacing (km)</i>	<i>Line direction (degrees)</i>	<i>Height above ground (m)</i>	<i>Area (km²)</i>	<i>Release date</i>
Forbes–Dubbo AEM	2.5	090–270	TBC	21,500	2023
Bancannia Trough AEM	2.5	090–270	60	10,900	2022
Cobar–Yathong Seismic Survey	N/A	Approx. E–W	0	N/A	2023
Yathong AEM	2.5	090–270	TBC	6,000	2023
Yathong AMR	0.2	090–270	60	11,400	2023
NSW Airborne Gravity	2.5	021–202	150	805,000	2023
New England Airborne Gravity	1.25	021–202	150	96,600	2023

Table 1. Survey specifications and data release dates.**Forbes–Dubbo AEM**

The Forbes–Dubbo AEM survey supports MinEx CRC, FFR and the Critical Minerals Strategy. The survey area targets:

- Groundwater in:
 - Devonian sandstone basins
 - Cenozoic river sediments and
 - the Great Artesian Basin
- Mineralisation in:
 - Macquarie Arc and Parkes Thrust (gold and copper)
 - the northern end of the Hill End Trough (gold, copper, lead and zinc)
 - Cenozoic–Mesozoic igneous rocks around Dubbo for Rare Earth Elements (REE) such as niobium, zirconium, hafnium and yttrium, and
 - peralkaline granites, the Ganantagi Granite and Narraburra intrusive complex for zirconium, yttrium, tantalum, hafnium, lithium, gallium and REEs.

Cobar–Yathong Seismic Survey

The Cobar–Yathong Seismic Survey supports all projects listed above. Approximately 350 km of hybrid reflection seismic will be acquired to image:

- 600–800 m below the ground in high-resolution and
- deep crustal features down to the Moho in less resolution.

The survey will traverse the eastern side of the Yathong Trough and the Cobar Basin along existing roads, tracks and fire trails. Cobar township is situated west of the Rookery Fault in the Cobar Basin (NSW Seamless Geology, 2022). Structures within the basin are recognised as an important control on mineralisation (Fitzherbert and Downes, 2021), especially the Rookery Fault and associated fault system. Despite this, there is little to no evidence on the dip of these structures or the role that they may have had during basin deposition (Burton, 2016). Imaging the faults and structures across the basin with seismic data aims to resolve these issues.

Cobar township began as a copper mining centre in the 1870s (NSW DPI, 2007) and the region continues to produce copper. However, the region also has a history of water security issues (Cobar Shire Council, 2022). The Yathong Trough overlies the Cobar Basin, is under explored and has few waterbores. Most bores are too shallow to locate water and deeper bores locate water that is too saline for stock (Mulholland, 1940). The Yathong Trough was the depositional site of Devonian sandstones that may host:

- deep groundwater for use in times of drought by agriculture, towns and industry, and
- rocks suitable for storing groundwater in times of surplus.

The initial drilling into the trough was began in November 2022. Results were not available at the time this paper was written. Drilling results will be used to inform mapping of the Yathong Trough.

Yathong AEM Survey

To compliment the seismic survey AEM data will be acquired to aid mapping of the eastern Yathong Trough. The survey will overlap with the 2019 Cobar AEM to allow comparison of the datasets.

Yathong AMR Survey

To assist with mapping the Yathong Trough, AMR will be acquired to improve the magnetic and radiometric coverage in the area. This will make it easier to map weak magnetic units that are dominantly sandstone.

NSW Airborne Gravity

The NSW Department of Customer Service (DCS) is undertaking an airborne gravity survey over the state for geodesy purposes. DCS has optimised the survey design for speedy and cost-effective acquisition. GSNSW is working collaboratively with DCS to deliver the airborne gravity data through [MinView](#). Preliminary and final data will be released in stages as the survey progresses.

New England Airborne Gravity

GSNSW's gravity data over the New England Orogen consists of 11 km spaced ground stations acquired pre-GPS. This data is useful for geological mapping at a tectonic scale, but is less useful for mapping at regional scale. Recent regional government-acquired gravity stations are generally 2–4 km apart (areas of geological interest may be 1 km). New gravity data is required to improve our coverage to support critical mineral exploration. GSNSW is working collaboratively with DCS to acquire infill airborne gravity data over the New England Orogen in NSW.

CONCLUSIONS

The GSNSW geophysical campaign will significantly increase the amount of publicly available geophysical data by the end of 2023, with approximately one fifth to a sixth of the state covered with new geophysical data. The areas covered are prospective for critical minerals and potential deep groundwater resources. All data will be made available through [MinView](#). For instructions on how to use MinView and how to download geophysical data visit [Vimeo](#).

REFERENCES

- Baarda F.D., 1968a, Planet Bancannia South No. 1 Completion Report. Planet Exploration Company Pty. Ltd: Geological Survey of New South Wales, File WCR129.
- Baarda F.D., 1968b, Planet Bancannia North No. 1 Completion Report. Planet Exploration Company Pty. Ltd: Geological Survey of New South Wales, File WCR130.
- Burton G.R., 2016, Geological observations from the Mount Drysdale area, central western NSW, with a reinterpretation of stratigraphic and structural relationships for Cobar Supergroup rocks north and east of Cobar: Geological Survey of NSW, Geological Survey Report No: GS 2016/0947.
- Cobar Water Board, 2022, History: Cobar Shire Council, <https://www.cobar.nsw.gov.au/services/water-and-sewer/cobar-water-board>.
- Deyessing L. and Carlton A., MinEx CRC audit and gaps report: North Cobar: Geological Survey of New South Wales, Geological Survey Report No: 2020/0184.
- Fitzherbert J. and Downes P., A mineral system model for DU-Au-Pb-Zn-Ag systems of the Cobar Basin, central Lachlan Orogen, New South Wales 2020: Geological Survey of New South Wales, Geological Survey Report No: GS2021/0042.
- Mulholland C., 1940, Geology and Underground Water Resources of the East Darling District: Department of Mines, Geological Survey.
- NSW DPI, 2007, Cobar's mining history: NSW Department of Primary Industries, primefacts 555.
- NSW Seamless Geology, 2022, [MinView](#): Department of Regional NSW, minview.geoscience.nsw.gov.au
- Wiltshire, M.J., 1969, Planet Jupiter No. 1 Well, Completion Report. Planet Exploration Company Pty. Ltd: Geological Survey of New South Wales, File WCR131.