AQUA2026 Field Trip

Wombeyan Karst Conservation Reserve

Saturday 4th July 2026

Hire cars will leave the pick-up locations at 7 am, and arrive Wombeyan around 10:30 am. We are booked in for a Wollondilly Cave tour at 11 am. Cars departs Wombeyan around 3 pm to return to Sydney by 7 pm.

The Wombeyan Caves are situated between Taralga and Mittagong. They became the first protected caves in Australia in 1865.

The field trip will include a guided cave tour (Woollondilly Cave; led by Andy Baker (UNSW) with NPWS staff) and a self-guided cave tour (Fig Tree Cave).

Attendees need to be physically fit as this field trip includes a strenuous bush-walk of a few km, including steep slopes, steps and vertical fixed ladders in Woollondilly Cave.

What to bring:

Water bottle, lunch and snacks for the day. There will be a driver-break / rest room stop on the journey to the caves where there will be a chance to buy more snacks / lunch provisions if needed. Appropriate clothing for bush-walking (hiking boots, backpack for water bottles and snacks). Expected maximum temperature is 13 °C, the caves will be slightly cooler. The caves are lit, but if you have a good torch, it could enhance your cave experience.

Communications:

Mobile coverage generally gets worse the further you travel from Sydney. Telstra is the best service provider. When we get to Wombeyan, there is a satellite link and good service again.

Facilities at Wombeyan:

Excellent potable groundwater is available on-site. Rest rooms. A kiosk with very limited stock of souvenirs.

The Journey (Sydney to Wombeyan)

Outer Sydney – Eora (first ~45 mins)

We will join the M31 Hume Highway, which is the main route to Melbourne and Canberra. Initially the highway passes outer Sydney suburbs, where you can see new housing developments near Campbelltown and Wilton.

Throughout the first half of the journey, you will be travelling through the Sydney Basin of Permian and Triassic sediments comprising mostly shallow marine and fluvial sandstones, with some coal. It is the same geology as in Sydney and at UNSW:

http://www.ga.gov.au/scientific-topics/energy/province-sedimentary-basin-geology/petroleum/offshore-eastern-australia/sydney

Upper Nepean Catchment – Tharawal Country (after ~1 hour)

After Campbelltown, the M31 passes through the upper Nepean catchment. This provides part of the drinking water for Sydney, and the catchment is highly protected and comprises pristine forest. The views can be spectacular in places:

https://www.waternsw.com.au/education/learning-about-water/catchments

Southern Highlands – Gundungurra and Dharawal Country (the second hour of the journey)

For most of the journey you will be travelling through Gundungarra Country, which extends from Campbelltown to Goulburn. Much of the landscape that you will see was cleared by Europeans in the nineteenth century.

After passing through the upper Nepean catchment, the Hume Highway bypasses the towns of the Southern Highlands, and continues towards Goulburn. Near Marulan, we eventually leave the Sydney Basin, crossing into a mixture of older rocks affected by the Lachlan Orogeny, and Miocene Basalts.

https://en.wikipedia.org/wiki/Lachlan_Fold_Belt

Taralga Road – Gundungurra and Dharawal Country (last hour)

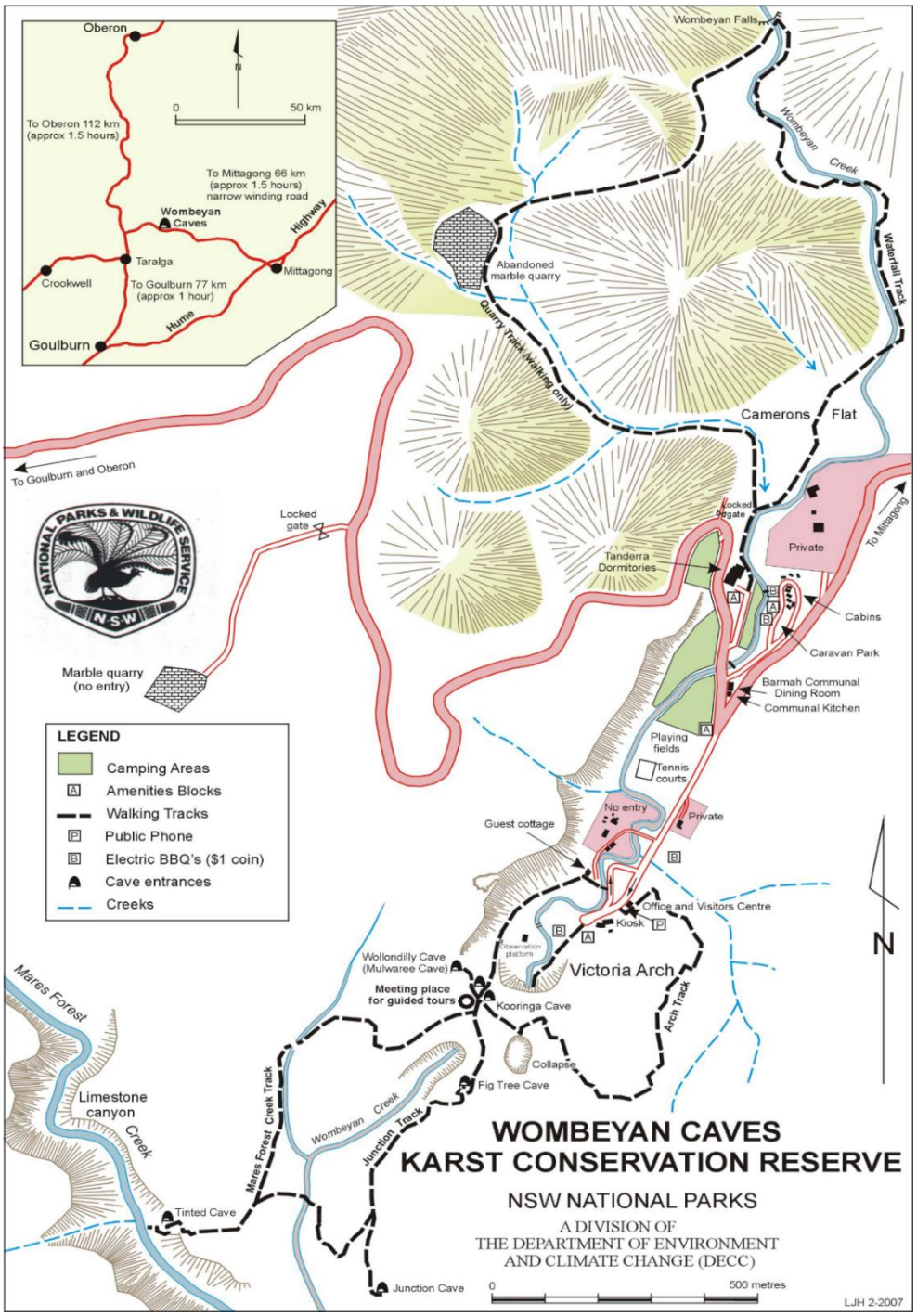
At Goulburn we leave the highway and head back on ourselves, north and then east, to reach the caves. You can follow the geology here (we enter from the south, through Taralga, turning east to the marble at Wombeyan.

https://gmaps.geoscience.nsw.gov.au/100K/Taralga/

Wombeyan Caves Overview

“Wombeyan” translates as "grassy valley between mountains”

Wombeyan Caves are situated in Upper Silurian (410Ma) marble. The original limestone has been folded and metamorphosed, buried by volcanics and re-exposed, probably several times. Today the marble forms a small-scale trough or basin, surrounded by volcanics. The caves are protected as part of Wombeyan Karst Conservation Reserve. Wildlife is abundant and the area has rich evidence of its use by Indigenous peoples.



Wollondilly Cave (11 am tour)

Wollondilly Cave is a multi-level cave. If could be considered to be two caves, joined at the lowest level at the ‘Fortifications’. The cave is well decorated with speleothems. The lower levels have erosional scalloping from past water flow. Cave passages are largely joint controlled.

Dr. Janece McDonald (University of Newcastle) monitored the hydrochemistry of cave drip waters in the caves, including Wollondilly Cave through the 2002-2003 El Niño event (McDonald, 2004; McDonald et al 2004, 2007; McDonald and Drysdale, 2007). Drip water hydrochemistry was responsive to climate variability. The original monitoring sites will be seen on the tour. Subsequently, stalagmites from the cave were sampled with permission and preliminary analyses made, identifying material that had formed over the last 133 ka. Most of that work remains unpublished (McDonald et al., 2009). The first paleoclimate paper was recently published by Matt Goodwin (University of Newcastle) with a last three-thousand-year record of effective infiltration from a stalagmite from ‘The Cathedral’ (Goodwin et al., 2025).

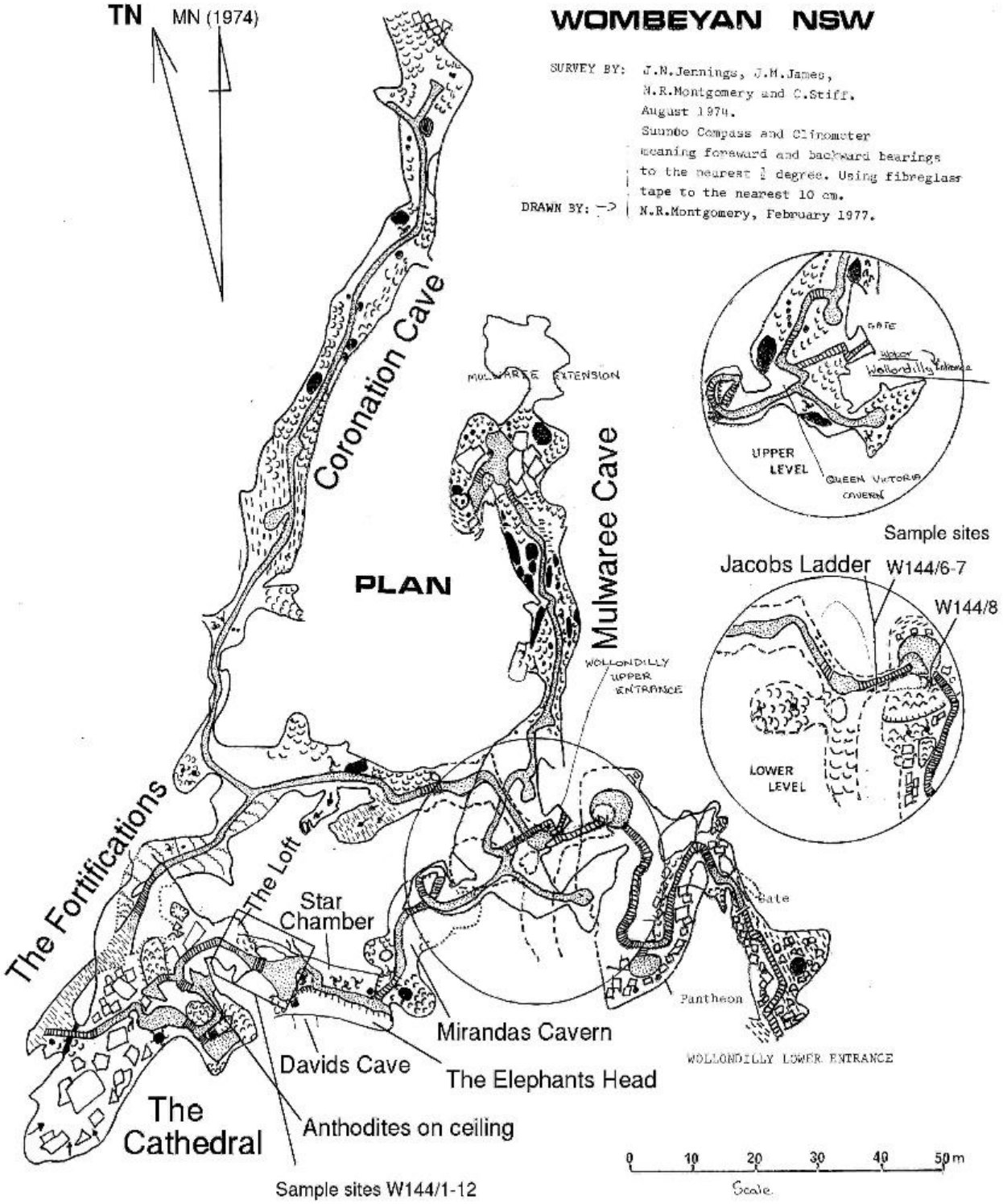
UNSW has recently recommenced research in Wollondilly cave, thanks to ARC LIEF and Laureate Fellowship funding. Danyang Sun has restarted cave hydrology monitoring and drip water tracing in Wollondilly Cave since 2023 for her PhD research, and some of her monitoring sites will be seen from the tour. Initial results are available in a preprint (Sun et al. 2025). UNSW PhD researcher Jocelyn McGrade is analysing modern stalagmites from the cave to obtain records of past groundwater recharge. Jocelyn is presenting her results in the AQUA meeting on Thursday.

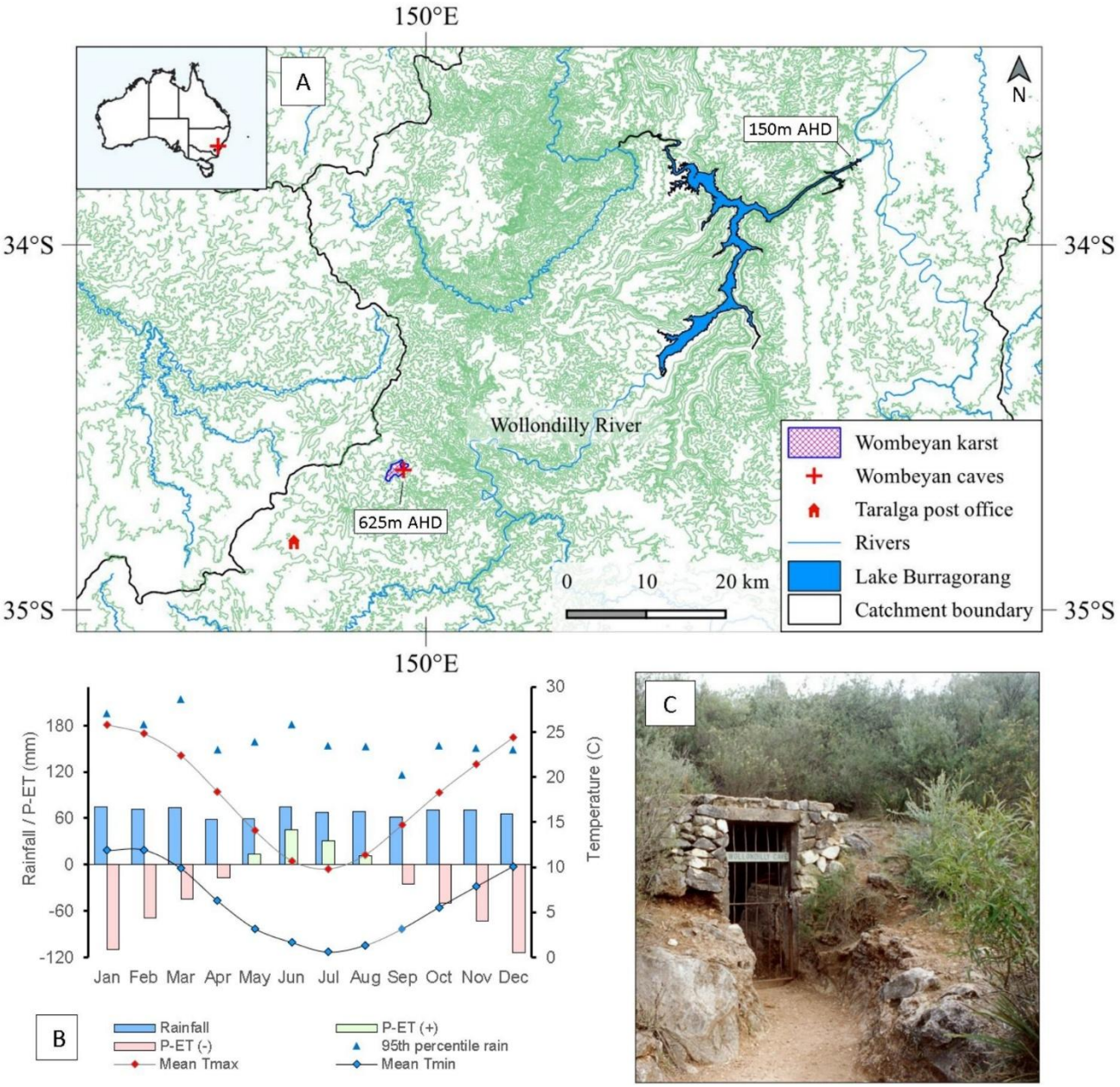
WOLLONDILLY CAVE

WOMBEYAN NSW

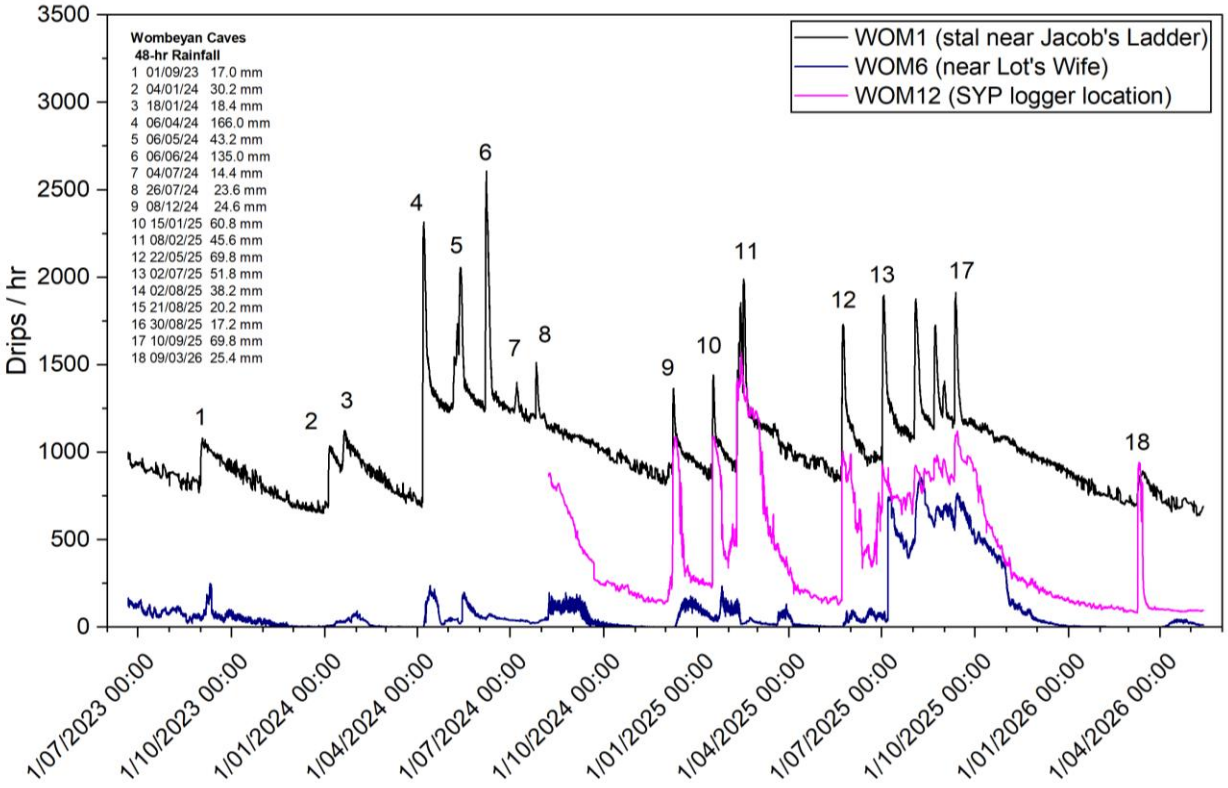
SURVEY BY: J.N.Jennings, J.M.James, N.R.Montgomery and C.Stiff. August 1974. Sunnbo Compass and Clinometer reading foreward and backward bearings to the nearest 1 degree. Using fibreglass tape to the nearest 10 cm.

DRAWN BY: —> N.R.Montgomery, February 1977.

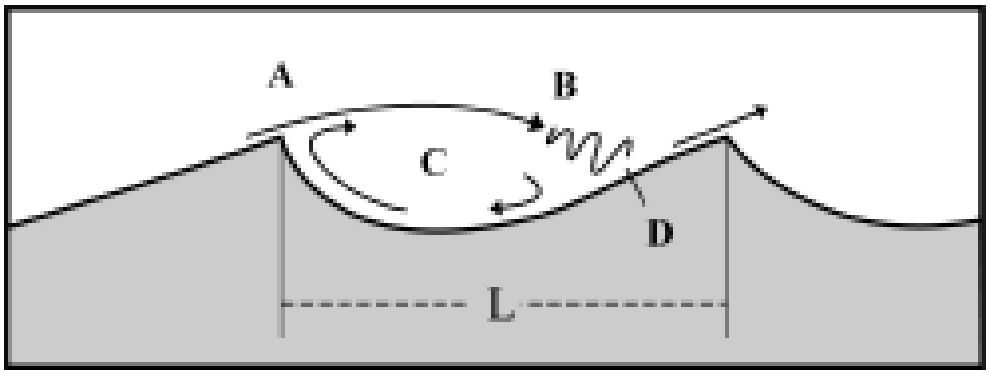




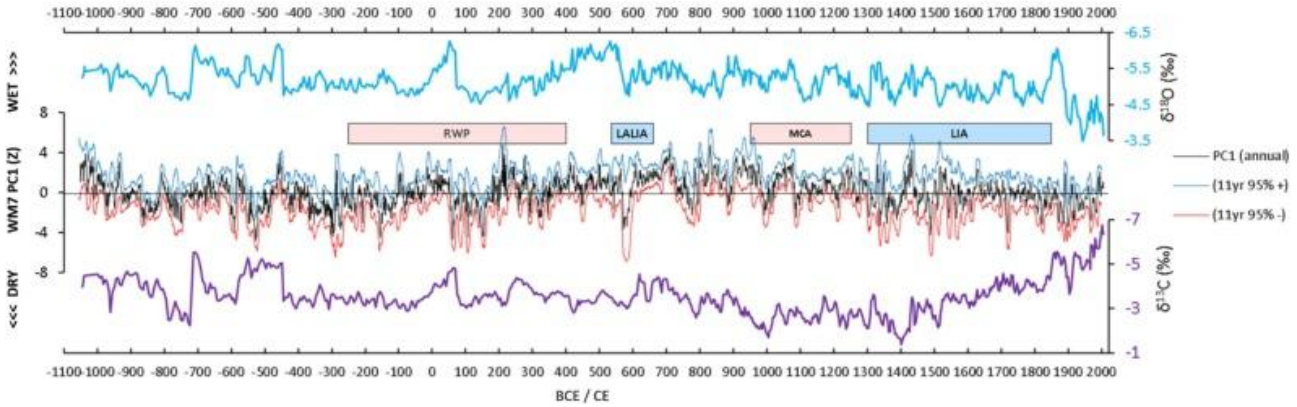
Location map (A), regional climatology (B), and photo of the upper entrance of Wollondilly Cave at 625 m (AHD) elevation (C). Wombeyan Karst drains into Wollondilly River and Warragamba Dam, a potable water reservoir for Sydney (A). Wombeyan caves mean monthly rainfall sum, water balance (P-ET), 95th percentile rainfall, and mean maximum and minimum temperatures are shown for the Wombeyan caves grid point (34.31°S, 149.97°E) calculated using data from 1889 to 2022 (Jeffrey et al., 2001) (B). The upper entrance to Wollondilly Cave was originally a small hole that was progressively enlarged to its current form as an iron gate (C). From Goodwin et al. 2025.



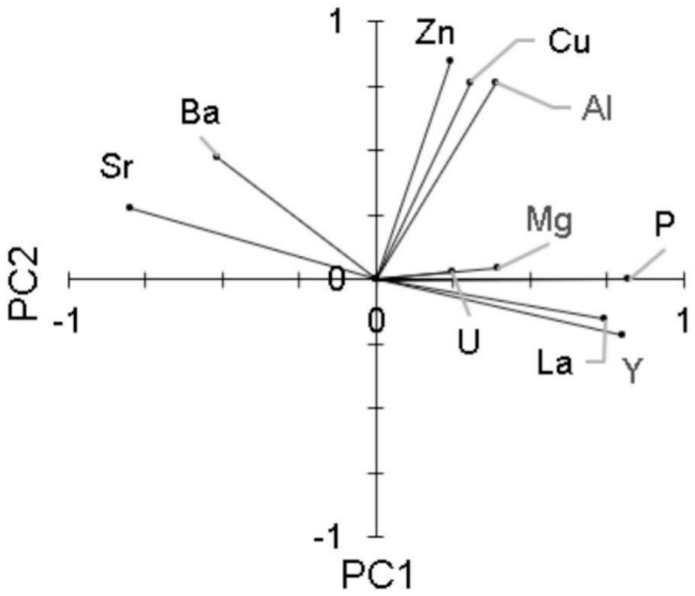
Unpublished cave drip hydrology data from Wollondilly Cave. Only 18 rainfall events in three years have generated recharge to the cave. It is these geochemical record from these recharge events that will be preserved in the stalagmites.



Profile of a scallop. Mainstream flow is to the right. A sublaminar jet detaches at A, becomes unstable at B, and reattaches to the wall at D. Upon impacting the wall, some water flows upstream and recirculates within the vortex labeled C, while the remainder continues in the downstream direction. Scallop lengths are defined as the distance, L, between scallop crests. Springer and Hall (2020), modified from Curl (1974).



WM7 $\delta^{18}O$ (top), trace element PC1 series with 11-year 95 % measurement uncertainty range (middle, note that there is some uncertainty in the scaling post – 1888 CE), and $\delta^{13}C$ series (bottom) from 1045 BCE to 2006 CE. The axes for $\delta^{18}O$ and $\delta^{13}C$ are inverted. Also shown for reference are the Roman Warm Period (RWP), Late Antiquity Little Ice Age (LALIA), Medieval Climate Anomaly (MCA) and Little Ice Age (LIA). From Goodwin et al (2025)



	Loadings	
	PC1	PC2
P	**0.82**	0.00
Mg	0.39	0.04
Sr	**-0.80**	0.28
Ba	-0.52	0.48
Al	0.39	**0.76**
Zn	0.24	**0.85**
Cu	0.31	**0.76**
U	0.25	0.03
Y	**0.80**	-0.22
La	**0.75**	-0.16

PCA results for normalised, concatenated track A and B LA-ICP-MS trace element data for the entire measured transect. Trace elements with loadings >0.75 are shown underlined in bold. From Goodwin et al (2025)

Fig Tree Cave (~2 pm)

Self-Guided Tour – collect token from kiosk on payment

This cave is claimed to be Australia's premier self-guided cave. Well decorated, it features several huge chambers and towering formations in the first section of the tour, fascinating views of the underground creek in the central section, and finally the magnificent Victorian Arch, where you can see actively forming stromatolitic stalagmites ('craybacks')

Infrared sensors at certain points of the tour control lighting and commentary; while at other point's backlit signs are positioned. Highlights of the tour include the Galleries, the Opera House featuring the Grand Stalagmites, the Colonnades, and the Creek Section with its Marble Way.

A recent paper (Rowling, 2026) studies broken speleothems in the cave, and argues for ice-build up in glacial conditions that led to freeze-thaw action and speleothem breakage. You can see these features on the tour.

Look out also for a possible charcoal layer in sediments in the cave.

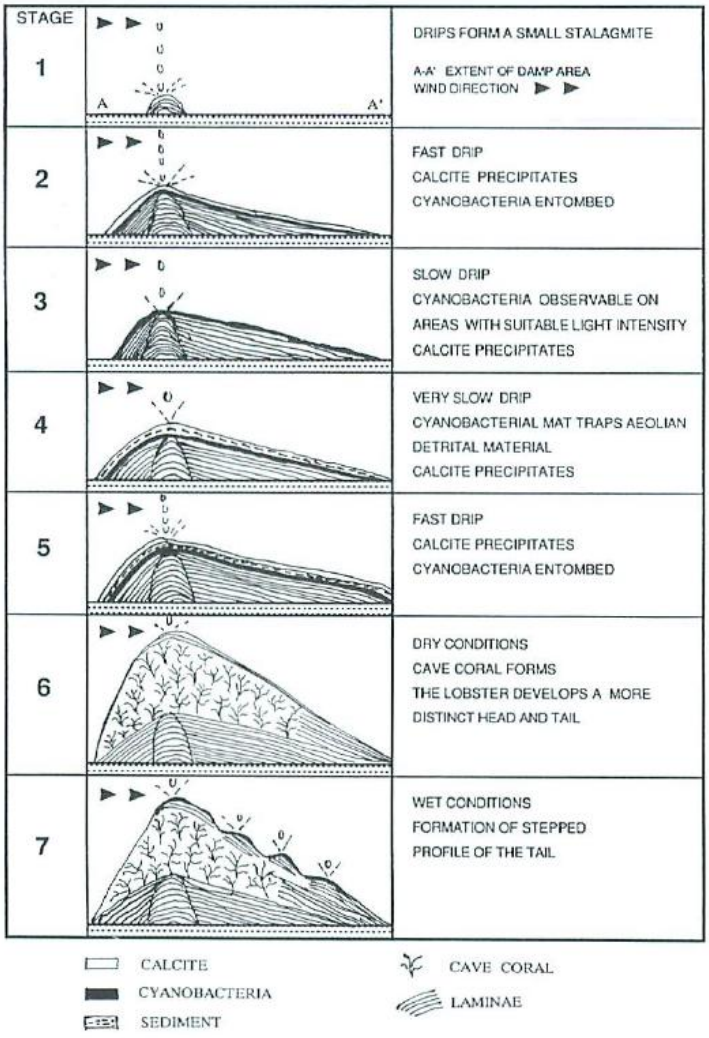


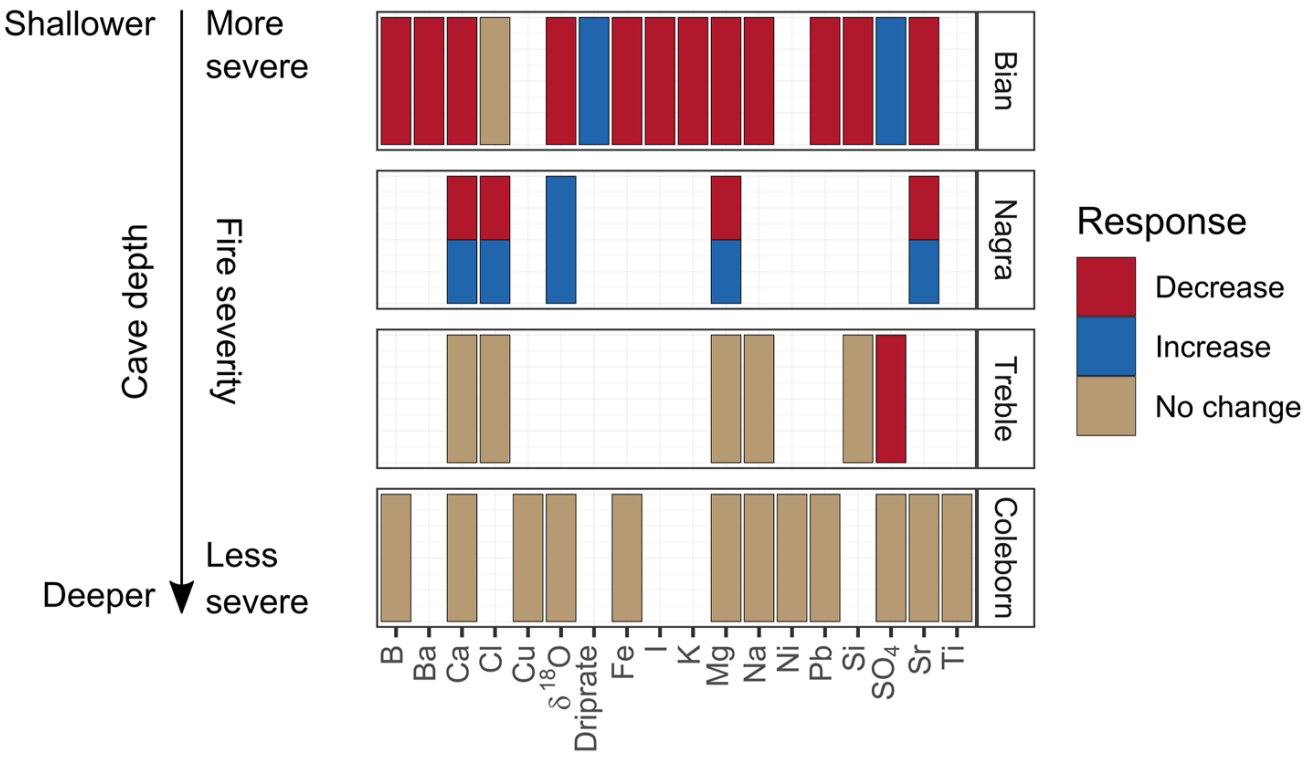
FIG. 11—PROPOSED MODEL FOR THE FORMATION OF A CRAYFISH-LIKE STALAGMITE

From Cox et al (1989)

Other Paleoclimate related research at Wombeyan

In 2015-2017, an UNSW / ANSTO / NSW Office of Environment and Heritage team monitored the caves to investigate the influence of fire on caves and karst processes. An experimental fire took place over Wildman's Cave, a wild cave remote from the tourist precinct. Bian et al., 2019 and Song et al., 2025 identified a post-fire response in cave drip waters and geochemistry, and a flashier hydrological regime that required less rainfall for water to reach the cave. This research has helped inform fire management policy, and foreshadowed a new approach to use cave stalagmites as a paleofire proxy (Campbell et al. 2023).

Orientated, angular gravel deposits in the entrance to Basin Cave were interpreted as solifluction deposits (Gillieson et al., 1985). A radiocarbon date of 27,850 years places this in the last glacial.



Published proxy responses to fire events in dripwater (Bian et al., 2019; Coleborn et al., 2018, 2019; Nagra et al., 2016; Treble et al., 2016). Red indicates a post-fire decrease in a proxy, blue indicates a post-fire increase in a proxy, and beige shows that no change was recorded. Results are presented in order of cave depth and fire severity, with the shallowest cave and most severe fire at the top of the figure, and the deepest cave and least severe fire at the bottom of the figure. From Campbell et al 2023.

Wombeyan References

Bian, Fang. et al. 2019. Hydrological and Geochemical Responses of Fire in a Shallow Cave System. Science of the Total Environment, 662, 180-191 https://doi.org/10.1016/j.scitotenv.2019.01.102

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Wombeyan books

Want to read more on Wombeyan Caves? Two books have been published by Sydney University Speleological Society (*Wombeyan Caves*, 1982; and, *Caves and Karst of Wombeyan*, 2004) and are available for purchase from the kiosk and make fine souvenirs.

Other cited references

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