THE HORNSBY DIATREME: CENTREPIECE OF THE NEW HORNSBY PARK

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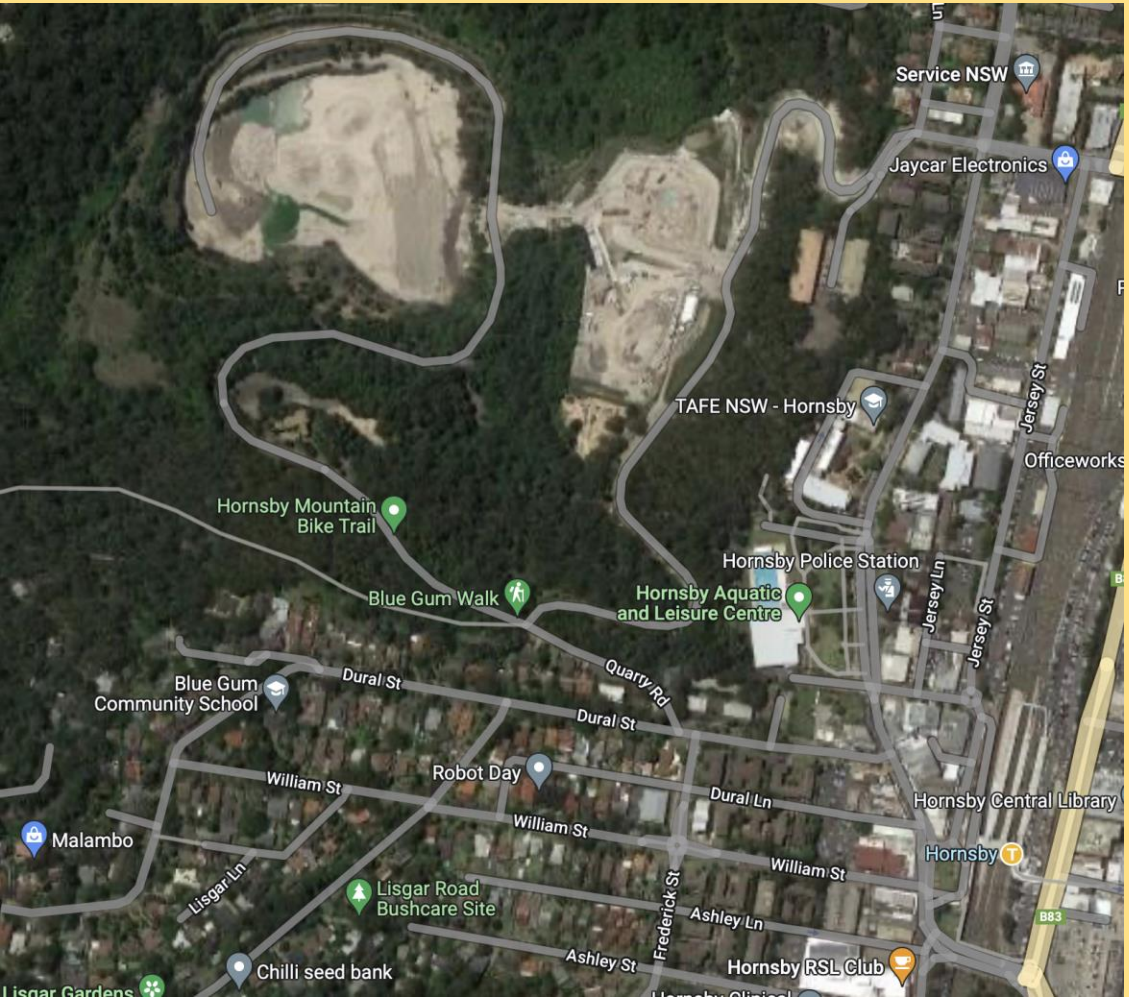
ACKNOWLEDGEMENTS

Many thanks to **John Martyn** for providing photographs of the quarry at various stages of its development, and for informative discussion which has revealed that there are far more questions than answers concerning the geological history of the formation of the diatreme

I am also very grateful to **Craig Clendinning** (Project Manager of Major Projects, Hornsby Shire Council) for providing access to the quarry site in 2020 and for allowing me to use some photographs of the diatreme face

Note that I am not speaking today on behalf of the Geological Survey of NSW

Where is the Hornsby Diatreme? It is (metaphorically-speaking) in our backyard



What is a diatreme (or maar–diatreme volcano)?

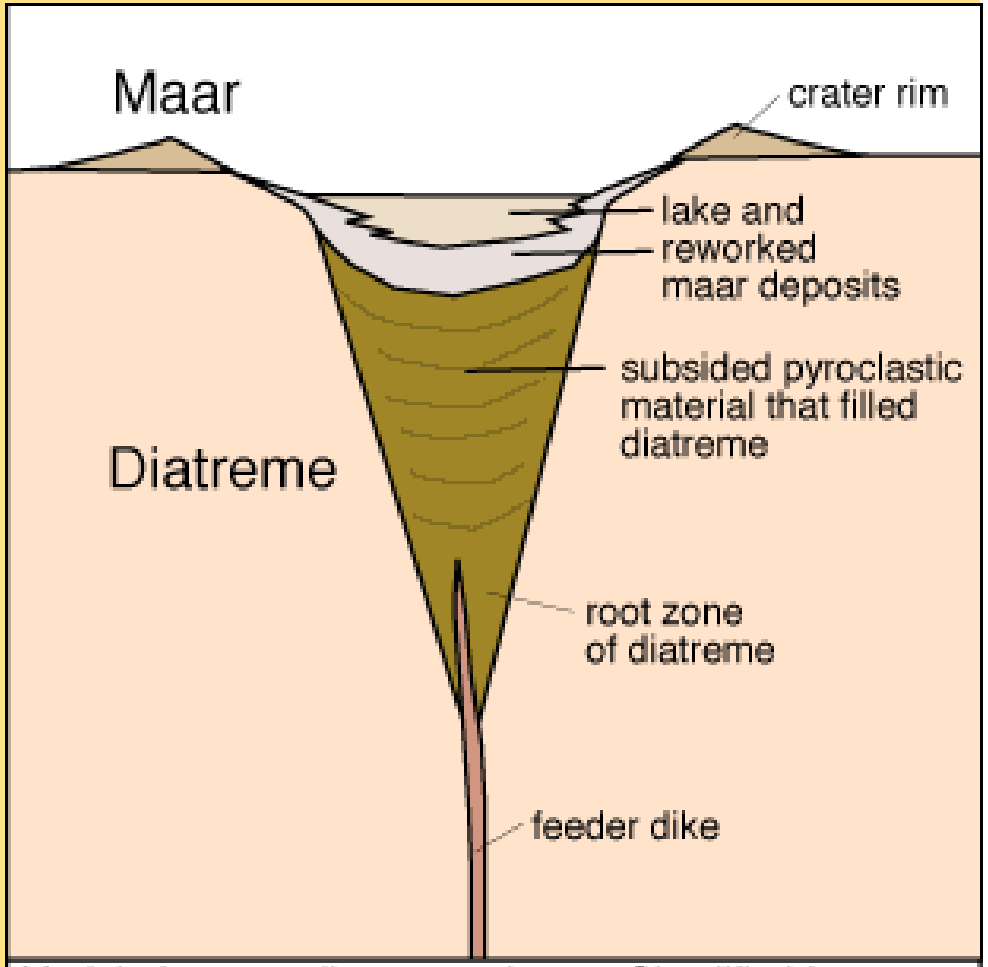
a weird sort of volcano that doesn’t erupt lava

produced when a column of steam or superheated gas blasts vertically through overlying rock, fracturing it into small fragments which are intermixed with clasts from deeper in the crust

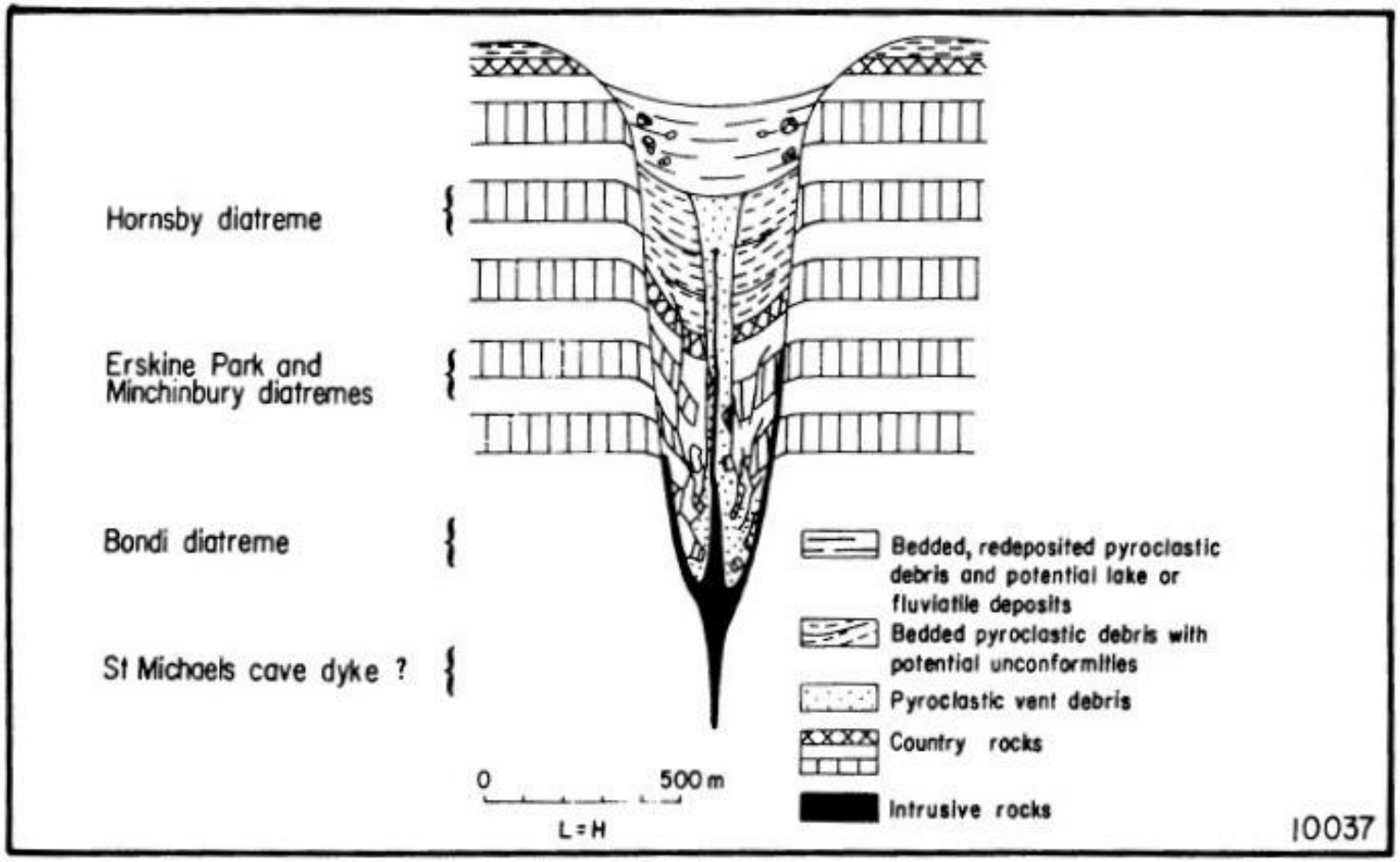
erupted material falls back into the vent to be deposited as characteristically dished bedding (concave up)

Cross sections of models of a typical maar-diatreme volcano

Eruptions are caused by interaction of ascending molten rock intersecting the water table, generating steam-driven (phreatic) explosions, with subsequent collapse of ejecta into conical or basin-like cavity



Model of a maar-diatreme volcano. Simplified from Lorenz (1986).



From Helby & Herbert (1980): *A Guide to the Sydney Basin*. Bulletin 26, Geological Survey of New South Wales, Sydney.


Strokkur Geyser
Iceland (approx. 40 m)


Old Faithful, Yellowstone
(32--56 m)


Waimangu Geyser New Zealand (460 m)

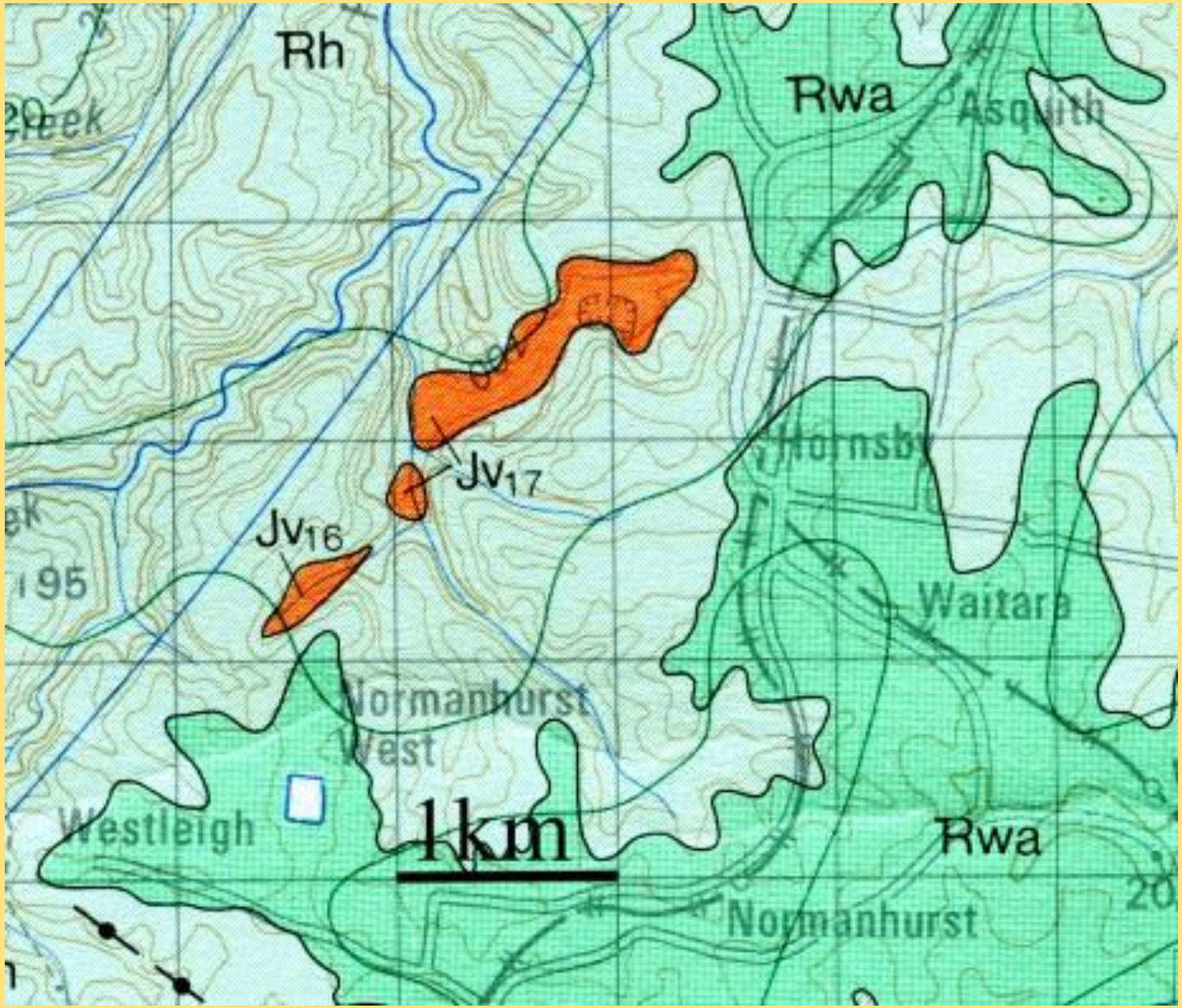
Local Geology

How do we know the age of the diatreme?

It exploded through a lake, around which plants were growing. Microscopic spores and pollen that were preserved in the vent deposits were analysed to give an approximate age of 163-200 million years ago.

How common are diatremes?

Generally uncommon to rare, but 95 are known from the Sydney Basin, mostly eroded to form depressions.



LOWER JURASSIC

Jv: diatremes (orange)

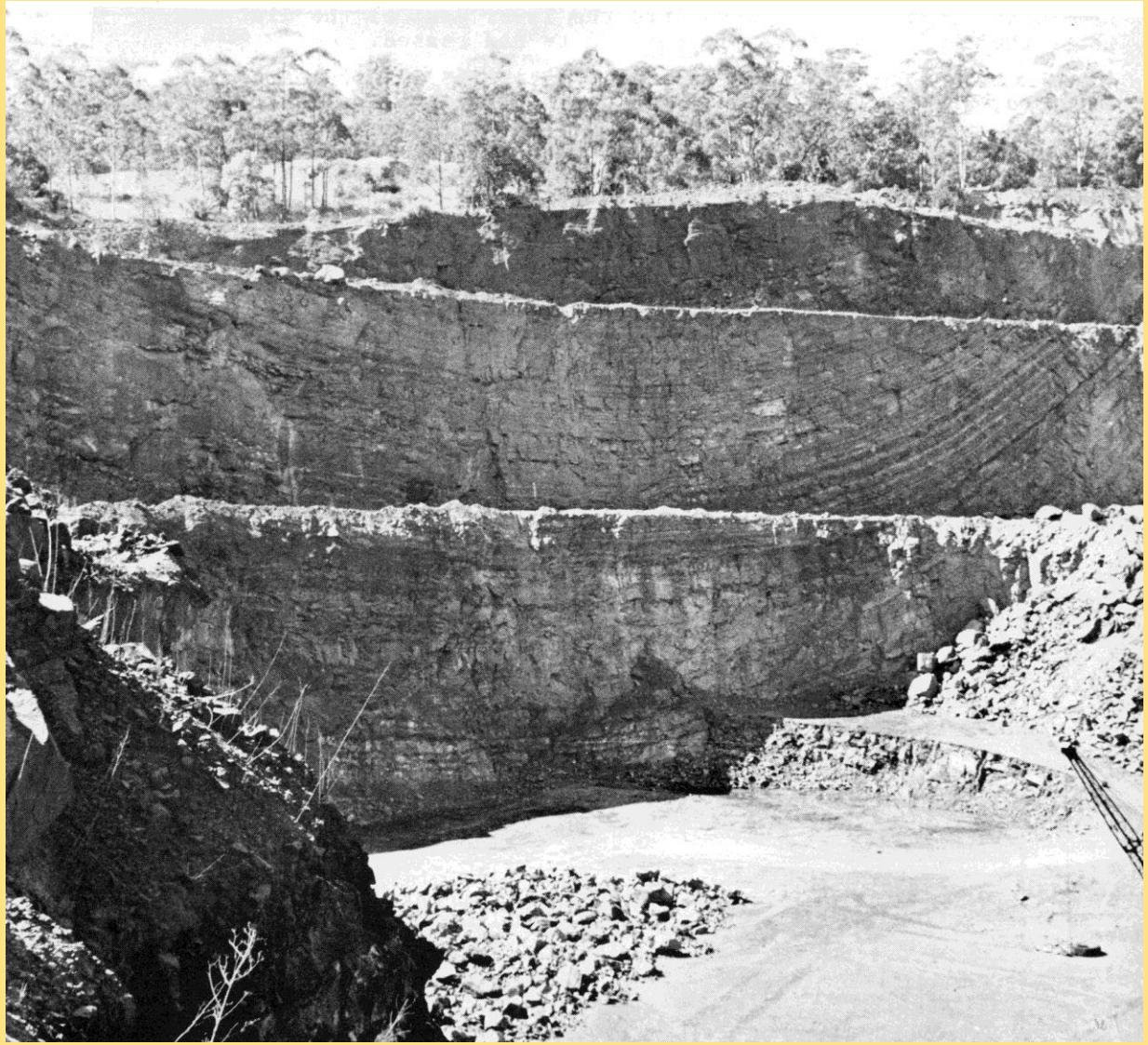
>40 Myrs gap

LOWER to MIDDLE TRIASSIC

Rwa: Wianamatta Group Ashfield Shale

Rh: Hawkesbury Sandstone

Why is the Hornsby Diatreme so scientifically significant?



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Perfect cross-section exposed in the east face of the quarry

Largest known & best preserved diatreme of about 95 exposed in the Sydney Basin

Contains fragments of exotic rock types brought up from the lower crust

Could be made easily accessible for students and researchers to study

Geotourism potential – internationally famous among geoscientists

A brief history of Hornsby Quarry

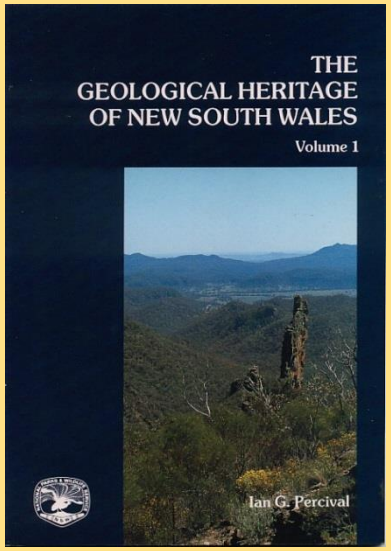
Hornsby diatreme exposed while the quarry was in operation (1979)

Quarrying commenced in the early 20th Century after recognition of a volcanic neck. Interpretation of the structure as a diatreme in 1961, as cross section on east face exposed

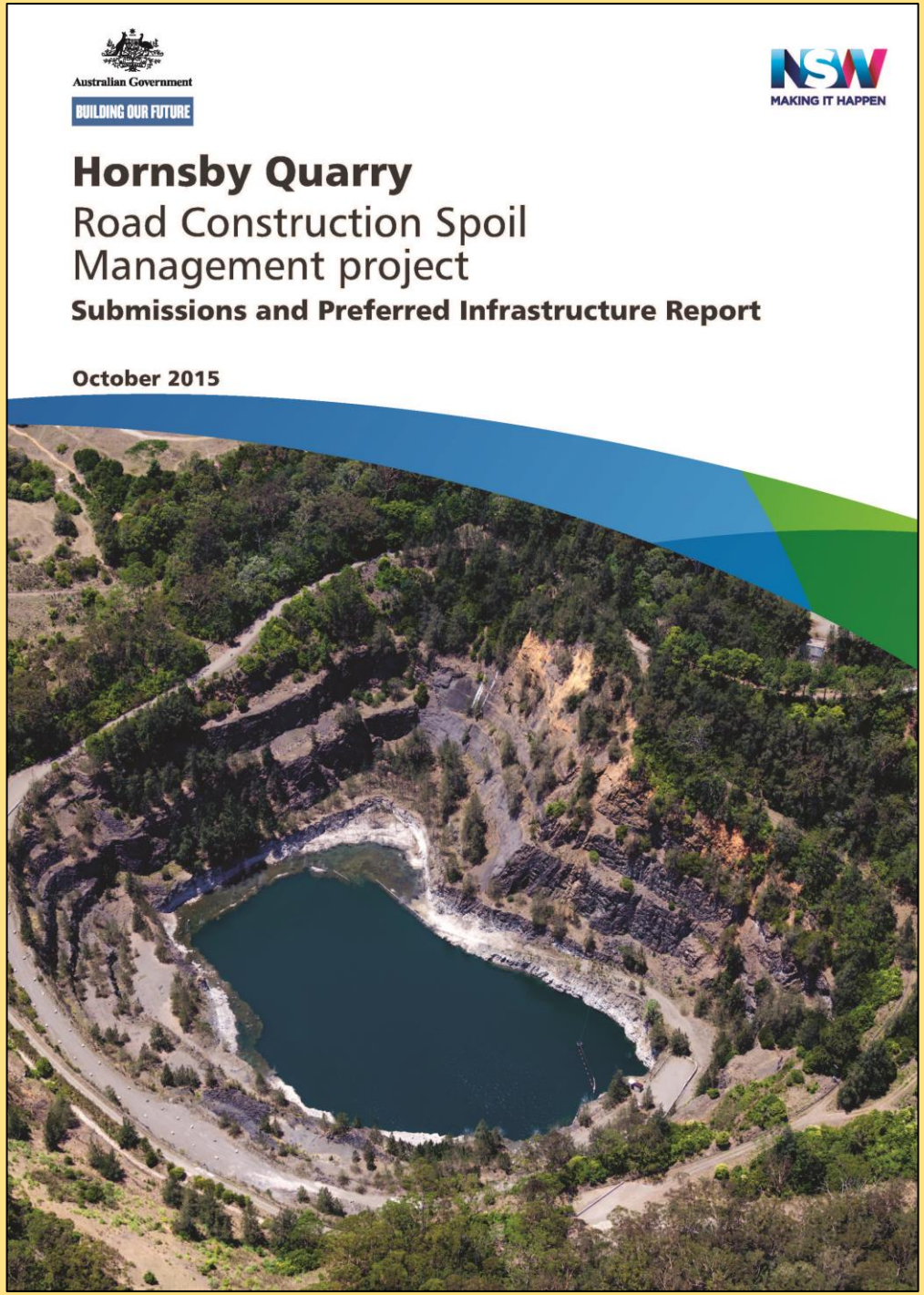
Quarried as a source of 'blue metal' aggregate for concrete, most recently by Farley & Lewers (ceased operations 2002)

Ownership of the site then reverted to Hornsby Shire Council

Several investigations were conducted by Council over many years into options for use and future public access



Hornsby Quarry circa 2010: dangerous (part-filled with water), inaccessible to the public, and overgrown



RMS planned to use the quarry void to hold spoil from tunnelling operations through Hawkesbury Sandstone during construction of NorthConnex road tunnel

Figure 1.3 Indicative Site layout

Diagram from RMS study into disposal of spoil from NorthConnex

Geological Society of Australia response to

2015 EIS Hornsby Quarry Road Construction Spoil Management project

Despite having commissioned the initial report in which the geoheritage aspects of the Hornsby Diatreme were first documented, the **Geological Society of Australia was not regarded as a stakeholder during the preparation of the EIS** and therefore was not consulted

- **The significance of the diatreme cross section exposed in the quarry** wall at the eastern end of the site **has been overlooked and disregarded** – the plan for infilling the quarry would largely obliterate this feature
- **Importance to the course of NSW's cultural or natural history (Criterion a)** no reference made to its natural history
- **Research Potential (Criterion e)** The EIS failed to identify any research potential for the Hornsby Diatreme; although the most recent scientific study was in 2000, since 2002 the site has been off-limits to researchers
- **Rarity (Criterion f)** Hornsby Diatreme is now the only unfilled diatreme or intrusive site in the Sydney Basin, and exposes dish-shaped bedding
- **In summary, the concept needs to be substantially modified** by retaining access to the eastern face of the quarry where the cross section through the diatreme is exposed, down to the 40m level (64m fill height proposed in EIS), with removal of any excess spillage of spoil that would cover this face.

Alternative fill levels – Original EIS Report (64m) in red; GSA submission (40m) in bright green; Preferred Infrastructure Report (54m) in white

64m

54m

40m

SUBSEQUENT DEVELOPMENTS AND CURRENT STATUS

- The diatreme cross section was listed on the Register of The National Trust in September 2016.
- It is not currently listed in the NSW State Heritage Inventory.
- A second opportunity for geological input came up in late 2019 when Hornsby Council sought public input into plans for the future development of the quarry void (after the infilling of the void was completed).
- The GSA argued that Council must incorporate the diatreme cross-section as a focal point of the new park and also urged Council to maintain access to the quarry face for close scientific examination by researchers and students.
- The Sydney North Planning Panel held a public hearing in May 2020, ruling that planning approval for the proposed redevelopment of the former Hornsby Quarry was deferred pending satisfactory resolution of several issues broadly including access to and visibility of the diatreme exposed in the eastern face of the quarry.
- These matters were addressed during a subsequent site visit (June 2020) facilitated by Hornsby Council, leading to planning consent being granted with redevelopment of the site now well underway.
- The compacted spoil material infilling the quarry void has been redistributed to create, at RL48, a lower level adjacent to the eastern face that will be the site of a lake as a central feature of the redevelopment.

THE DIATREME TODAY – SALIENT FEATURES

The dished beds of the diatreme infill are segregated by grainsize, shown by distinct banding. Is this indicative of multiple explosive events, or some other phenomenon during fallout from the ash clouds?

Lithological features of the Hornsby Diatreme

Lapilli are pebble sized (4-32 mm) ejecta interpreted to have formed in an ash cloud when hot ash particles cool to form nuclei around which layers of ash and mud coalesce as they descend (Byrnes 1982).

Small dark xenolith, in front of boot, embedded in larger rock fragment. The xenoliths include peridotite, sourced from the lower crust. Coal fragments come from depths of 1300-1500 m.

Banded layers are characterised by different lithologies and grainsizes

THE MOST ENIGMATIC PART OF THE DIATREME-RELATED EXPOSURE – THE SOUTHERN FACE OF THE QUARRY

Dish-beds of the diatreme infill are off to the left

Very steep dipping to near vertical beds

Possible slumped bedding

These steeply dipping beds on the periphery of the diatreme infill appear to defy gravity – they seem to be depositional rather than structural features. Certainly worthy of further investigation.

HORNSBY'S OWN JURASSIC PARK

Thank you for your attention