



ACT Heritage Council

BACKGROUND INFORMATION BARTON HIGHWAY ROAD CUT (Block 1 Section 125, Nicholls)

At its meeting of 16 November 2017 the ACT Heritage Council decided that the Barton Highway Road Cut was eligible for registration.

The information contained in this report was considered by the ACT Heritage Council in assessing the nomination for the Barton Highway Road Cut against the heritage significance criteria outlined in s10 of the *Heritage Act 2004*.

Note: a glossary is contained at the end of this document

HISTORY

The Barton Highway Road Cut (the Road Cut) is an exposure of the Black Mountain Sandstone, above which can be seen the Camp Hill Sandstone Member.

The road cut as we see it today originated in 1979 during reconstruction of the Barton Highway (see Figure 1) when the western end of Percival Hill was excavated. The roundabout was constructed about a decade later, opening 23 November 1987 (*The Canberra Times* 21 Nov. 1987p3).

The ACT division of the Geological Society of Australia (GSA) included the Road Cut in a 1987 report on geological monuments in the ACT.

The GSA is the peak body representing the earth sciences in Australia. In 1987 the ACT Division of the GSA prepared a report on the geological monuments of the ACT, i.e. places they considered to be of geological significance in the ACT. This was updated in 2012 with the publication of *Significant Geological Features in the Australian Capital Territory, 2012*, which now refers to geological monuments as 'Significant Geological Features'. The current nomination stems from these GSA reports and relies heavily on the updated 2012 report as well as the Australian Stratigraphic Units Database from Geoscience Australia (© Commonwealth of Australia (Geoscience Australia) 2016).

The GSA defines Significant Geological Features as, "...those features of special scientific or educational value which form the essential basis of geological education, research and reference" (Finlayson, 2012:5). However, the GSA ACT Division have not adopted specific criteria to determine significance, but instead rely on a statement on the geological value of each place.

The Barton Highway Road Cut is considered a significant geological feature by the GSA because they consider it to be "...a valuable outcrop of the Black Mountain Sandstone which helps to demonstrate the regional variation of that unit...[and] a very useful teaching locality to demonstrate some features of proximal flysch..."



Figure 1 The Barton Highway reconstruction in 1979 at the Gundaroo Drive intersection, facing south – the Barton Highway Road Cut can be seen circled in the lower left side of the image (*Canberra Times* Wednesday 9 May 1979, page 19).

This means that the significance that the GSA assign to the Barton Highway Road Cut relates to its ability to show variation in a regionally important geological formation (Black Mountain Sandstone) as well as being a useful example of a type of geological formation (a flysch)

Geological Formations

The Barton Highway Road Cut consists of the Black Mountain Sandstone on top of which the Camp Hill Sandstone can be seen. Both of these geological formations have an important relationship with the State Circle Shale (which is not exposed in the Barton Highway Road Cut) that helps to provide an understanding of the geological deposition processes which occurred within the region. Further detail on these geological features can be found in the Australian Stratigraphic Units Database Definition Cards included in the description section.

The formation of the stone, or stratigraphical deposition, started with the State Circle Shale being laid down (deposited), which then transitioned into the Black Mountain Sandstone. Following deposition of the Black Mountain Sandstone, a period of deformation (uplift, intense folding, volcanism and erosion) halted the deposition process. This deformation event (called the Quidongan deformation) left the Black Mountain Sandstone exposed and eroded down to the underlying State Circle Shale in some areas; over these exposed surfaces the Camp Hill Sandstone was deposited which is the lowest layer of what is referred to as the Canberra Formation (which consists of several other geological formations that are not referred to in this document).

Flysch (proximal)

The Barton Highway Road Cut is considered to be important to the GSA for its ability to demonstrate a flysch formation, which is an important concept for understanding geological formation processes in the region.

A flysch forms through the erosion of mountains being formed by the movement of the tectonic plates which make up the earth's surface. In this scenario, as tectonic plates run into each other mountains are pushed up on one side while the other side is pushed down forming a foreland basin – basically a fold in the earth's surface that dips at the base of the newly forming mountains that acts as a trap for the eroding material. The flysch then forms as a series of sedimentary rocks made up from the eroding material settling in one of these basins in a deep marine environment. The sedimentary rocks are found in thin layers which can be interbedded with shales; a combination that shows a cyclical nature to the depositional environment.

Unconformity (angular)

The Barton Highway Road Cut is one of the few places in the ACT to interpret the unconformity between the Camp Hill Sandstone and the Black Mountain Sandstone, the only other place being a restricted-access area within Parliament House.

An unconformity is a change in the geology where the overlying and underlying geology do not form a continual sequence – it shows that there has been a significant gap in time between when the two rock layers were deposited and a change in how the geology was formed. An angular unconformity is an abrupt example of this where the underlying layer has been tilted and eroded before the overlying layer has been formed horizontally over the top so that the orientation of the structures of the two layers is clearly visible. It is then possible for further movement to alter the orientation of both layers together, although the relationship between them will stay the same.

Dating Of Geological Features

Dating of geological features uses intervals of geological time as they relate to each other into super-eons, eons, eras, periods, epochs and ages. These divisions of geological time are based on how the rocks that form the earth sit above or below each other with most divisions being based on major changes, such as extinctions or a change in formation

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processes. The actual age of these divisions is becoming better known as advances in research and direct dating refine the models of geological time.

The geological time period covered by the Barton Highway Road Cut is contained within the Phanerozoic Eon (~541 million years ago to current), more specifically within the Paleozoic Era (~541 million to ~254.14 million years ago) and more specifically again within the Silurian Period (~443.8 million to ~423 million years ago). The Silurian Period started at a time when roughly 60% of marine species went extinct, but then saw many jawed and bony fish evolve as well as more land-based life expanding. The three geological features referred to in this document, the Camp Hill Sandstone Member, the Black Mountain Sandstone, and the State Circle Shale, formed during different epochs within the Silurian.

Camp Hill Sandstone Member - Late Silurian, fitting in to the late Wenlock Epoch (~433.4 to ~427.4 million years ago).

The Black Mountain Sandstone - early Silurian, fitting into the Late Llandovery Epoch (~443.8 million to ~438.5 million years ago).

The State Circle Shale - upper part of the Llandovery Epoch, with a rubidium-strontium direct dating age of 435+/-7 million years ago.

Era	Period	Epoch	Age	Started, million years ago
Paleozoic	Silurian	Pridoli	n/a	423 ± 3.2
		Ludlow/ Cayugan	Ludfordian	425.6 ± 0.9
			Gorstian	427.4 ± 0.5
		Wenlock	Homerian/ Lockportian	430.5 ± 0.7
			Sheinwoodian/ Tonawandan	433.4 ± 0.8
		Llandovery/ Alexandrian	Telychian/ Ontarian	438.5 ± 1.1
			Aeronian	440.8 ± 1.2
			Rhuddanian	443.8 ± 1.5

Table 1 Table of geological time, focussed on the Silurian Period (Information extracted from the ICS *International Chronostratigraphic Chart v.2017/02*)

Variation in The Black Mountain Sandstone

The Barton Highway Road Cut demonstrates a regional variation of the Black Mountain Sandstone which has more shale than at the type locality. This is important as it reveals differences in the way that the geological feature was formed over time. The Barton Highway Road Cut exposes the top part of the Black Mountain Sandstone which is not visible at the type locality, so it helps to complete the sequence and show the relationship to the overlying Camp Hill Sandstone.

Description of The Barton Highway Road Cut

The Barton Highway Road Cut is the exposed vertical section at the southwest end of Percival Hill. It is ~130m long northwest-southeast and roughly 4m high, tapering down at the ends. The exposed rock is Black Mountain Sandstone with a small section of Camp Hill Sandstone sitting on top.

The following descriptions of the geological formations discussed above are the Australian Stratigraphic Units Database Definition Cards (© Commonwealth of Australia - Geoscience Australia 2016).

Definition card for: Black Mountain Sandstone

State(s): ACT, NSW,

Status of unit: Formal

Usage: Defined

Stratno: 24186

Replaces: Black Mountain sandstone

Reserved by: Abell, R.S. (after Opik 1958) **on:** 26-OCT-90

Approved: Y

Approved by: Brakel, A. **on:** 26-OCT-90

Name source: Named after Black Mountain, Canberra, ACT (Opik 1958).

Unit history: Synonymy: none.

Type section locality: Black Mountain (Opik 1958). Reference section (Lat 35° 17'S Long 149° 06'E) in cuttings along access road to the summit of Black Mountain (Owen 1987). Here the formation is exposed as an upward facing sequence of grey fine- to medium-grained quartz sandstone with subordinate grey shale interbeds showing sedimentary structures typical of proximal turbidite deposit. Top and bottom of the formation not exposed.

Extent: Hills and ridges at Black Mountain, Jerrabomberra Hill, Ginninderra area and northwest Capital Hill.

Thickness range: Estimates are >800 m (Crook and others 1973) and >450 m (Henderson 1981).

Lithology: Thickly bedded, in places massive medium-grained sandstone in which siltstone and shale interbeds are more common lower in the sequence. Sedimentary structures include plane/cross/convolute laminations, load casts, flute moulds and slump units (Crook and other 1973).

Depositional environment: Marine - prograding turbidite fan complex deposited by eastward-flowing turbidity currents.

Relationships and boundaries: Base has gradational and conformable contact with State Circle Shale. Topmost beds are now an erosion surface except for unconformable contact with late Silurian Camp Hill Sandstone (Opik 1958) - now obscured by Parliament House.

Age reasons: Unfossiliferous. Early Silurian (Late Llandovery) by stratigraphic superposition with underlying State Circle Shale.

Correlations: On similarity of lithofacies probably co-eval with Tidbinbilla Quartzite, Murrumbidgee Sandstone and uppermost beds of the Ryrie Formation and Murrumbateman Creek Formation.

Definition card for: Camp Hill Sandstone Member

State(s): ACT, NSW,

Status of unit: Formal

Usage: Redefined

Stratno: 24208

Replaces: Camp Hill Sandstone

Reserved by: Abell, R.S. (after Opik 1958) **on:** 26-OCT-90

Approved: Y

Approved by: Brakel, A. **on:** 26-OCT-90

Parent: Canberra Formation

Name source: Named after Camp Hill, in Canberra, ACT (Opik 1958).

Unit history: None.

Type section locality: A deep road cutting on State Circle on the southwest side of Camp Hill (Lat 35° 18'5" S Long 149° 07' E) - the member rests with marked unconformity on early Silurian State Circle Shale. The sequence consists of a thin basal grit (approx. 10cm thick) overlain by thinly bedded multicoloured siltstone and sandstone. The top is not exposed.

Extent: Scattered outcrops in the central Canberra and Ginninderra areas; Murrumbateman Creek catchment and west of Queanbeyan.

Thickness range: Estimated thickness up to 60m (Hendersen 1981).

Lithology: Well-bedded sandstone and siltstone with thin shale partings.

Depositional environment: Shallow marine.

Relationships and boundaries: Overlies late Ordovician Pittman Formation and early Silurian State Circle Shale, Black Mountain Sandstone and Murrumbateman Creek Formation with major unconformity (Strusz and Henderson 1971, Crook and others 1973, Henderson 1978 and 1979). The Camp Hill Sandstone passes gradationally upwards to mudstone and siltstone of the Canberra Formation. The top of the member is arbitrarily taken where mudstone dominates over sandstone. It is the basal member of the Canberra Formation.

Age reasons: Late Silurian (late Wenlock) based on the brachiopod *Rhipidium* (Berry and Boucot 1970).

Correlations: None. Australian Units Database

Definition card for: State Circle Shale

State(s): ACT, NSW,

Status of unit: Formal

Usage: Defined

Stratno: 17298

Reserved by: Abell, R.S. (after Opik 1958) **on:** 26-OCT-90

Approved: Y

Approved by: Brakel, A. **on:** 26-OCT-90

Name source: Named after State Circle road cutting, Canberra, ACT (Opik 1958).

Unit history: Synonymy: None.

Type section locality: Northwestern road cutting on State Circle near the South African Embassy at Lat 35° 18' Long 149° 06' (Opik 1958; Strusz and Henderson 1971). Formation comprises about 60 m of non-calcareous sandy shale and dark grey shale with beds of fine-grained sandstone. Upper and lower boundary relationship not exposed (this locality is now partly obscured by a retaining wall and shrubs). REFERENCE LOCALITY: Cutting in northeastern part of State Circle between Commonwealth Avenue and Kings Avenue (Lat 35° 18' S Long 149° 07' E). Here the formation consists of buff-coloured laminated siltstone and shale with fine sandstone beds contorted by slumping. The age of the sequence is late Llandovery as indicated by the graptolite *Monograptus exiguus* (Strusz and Jenkins 1982). The upper boundary at this locality is unconformably overlain by the Camp Hill sandstone member, the basal unit of the Canberra Formation.

Extent: Crops out poorly around Black Mountain, Jerrabomberra Hill and northwest Belconnen.

Thickness range: Greatest known thickness of 113 m logged in BMR drillhole C5 (Henderson 1978). However, maximum thickness may be closer to 200 m (Strusz and Henderson 1971).

Depositional environment: Deepwater marine turbidite deposit (Crook and other 1973).

Relationships and boundaries: Basal contact not exposed but discordance in dip with underlying Pittman Formation suggests an unconformable relationship (Crook and others, 1973). The formation is overlain conformably by the Black Mountain Sandstone and unconformably by the late Silurian Camp Hill Sandstone member (Strusz and Henderson 1971).

Age reasons: Upper part of the Llandovery (Fronian stage) from monograptids (Opik 1958). Confirmatory evidence from Rb-Sr age of 435±7Ma (Bofinger and others 1970).

Correlations: Lower part of the Ryrie Formation (Gungoandra Siltstone) and lowermost beds of the Murrumbateman Creek Formation.

Physical condition and integrity

The Barton Highway Road Cut has some weed growth and erosion affecting the exposed surface, but the geology remains quite clear. It is possible that the cutting may be deepened in the future which would refresh the exposed surface and make the finer attributes of the geological feature more discernible.

Glossary

Conformable/ in sequence – geological formations are created by material being laid down and built up over time. When this happens in a steady flow of material creating successive layers then the progress of the formation can be seen in sequence and the connection between the layers is said to be conformable.

Erosion – a geological formation process where existing rock and other material is worn away and the worn material deposited elsewhere.

Folding – a geological formation process where existing rock that has been formed as a flat planar surface is bent or curved through certain pressures instead of breaking.

Deposition – geological features are created by various processes that lay down material that becomes rock. This can be by the deposition of eroding material, volcanic activity or other chemical and mechanical processes.

Fossils – are the remains or impressions of prehistoric plants and animals

Brachiopods – are a type of fossil that resemble clams or mussels, but have evolved differently so that the way they attach to their shells is internally different as well as the symmetrical nature of the shells being different.

Graptolites – a type of ancient marine worm fossil that existed during the Llandovery epoch, of which monograptids are a sub-type.

Geological Formations – are a distinct type of rock that has formed in such a way that it can be identified as having an origin or formation process that is different from other surrounding rocks.

Geological time and relative dating – Instead of using a specific age for geological time, it is arranged in a relative order based on major events and what formations came before or after others; within this order there are groupings of eons (covering many hundreds to thousands of million years), eras, periods, epochs and ages (covering a few million to 15 million years).

Unconformity / Unconformable– when a geological sequence has been interrupted during its formation, or a geological feature is eroded or broken up and a new layer or formation process starts over the top of this break an abrupt boundary can be seen between the geological features (representing a gap in time between the deposition of the two sequences) and the connection between these layers is said to be unconformable.

Rubidium-strontium direct dating – a method of determining how old a rock is by measuring the ratios of different types (i.e. different isotopes) of rubidium and strontium.

Sandstone – a type of sedimentary rock that has formed by the accumulation and cementing of sand-sized particles.

Shale – a type of sedimentary rock that has formed by the accumulation and cementing by compaction of fine silt or mud sized particles in laminated planes.

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Stratigraphic superposition – layers of rock represent material laid down in succession over time with the oldest layers at the bottom and the newest at the top.

Uplift – a geological formation process where rock and other material is pushed up, such as in the formation of mountains.

REFERENCES

Commonwealth of Australia (Geoscience Australia) 2016. *Australian Stratigraphic Units Database*.
http://dbforms.ga.gov.au/www/geodx.strat_units.int accessed 16 January 2017.

Finlayson, D. M. 2012. *Significant Geological Features in the Australian Capital Territory, 2012*. Geological Society of Australia (ACT Division), Canberra.

International Commission on Stratigraphy (ICS). 2017. *International Chronostratigraphic Chart v.2017/02*
<http://www.stratigraphy.org/index.php/ics-chart-timescale>

SITE PLAN

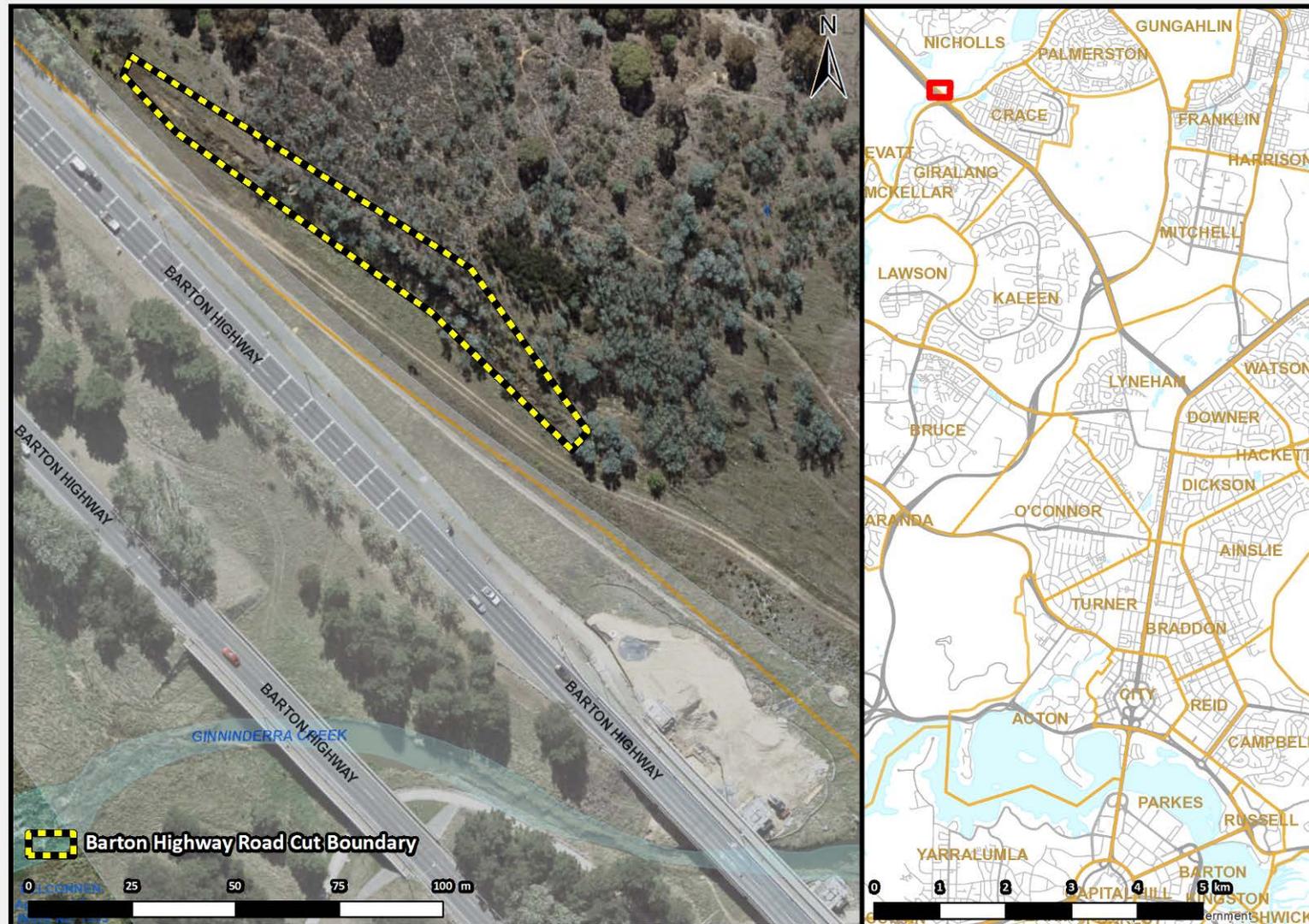


Image 1 Barton Highway Road Cut Site Boundary.

IMAGES



Figure 2 Barton Highway Road Cut, facing east towards Percival Hill. (ACT Heritage, 2017)



Figure 3 Barton Highway Road Cut, facing south with Percival Hill on the left and the Barton Highway on the right. (ACT Heritage, 2017)