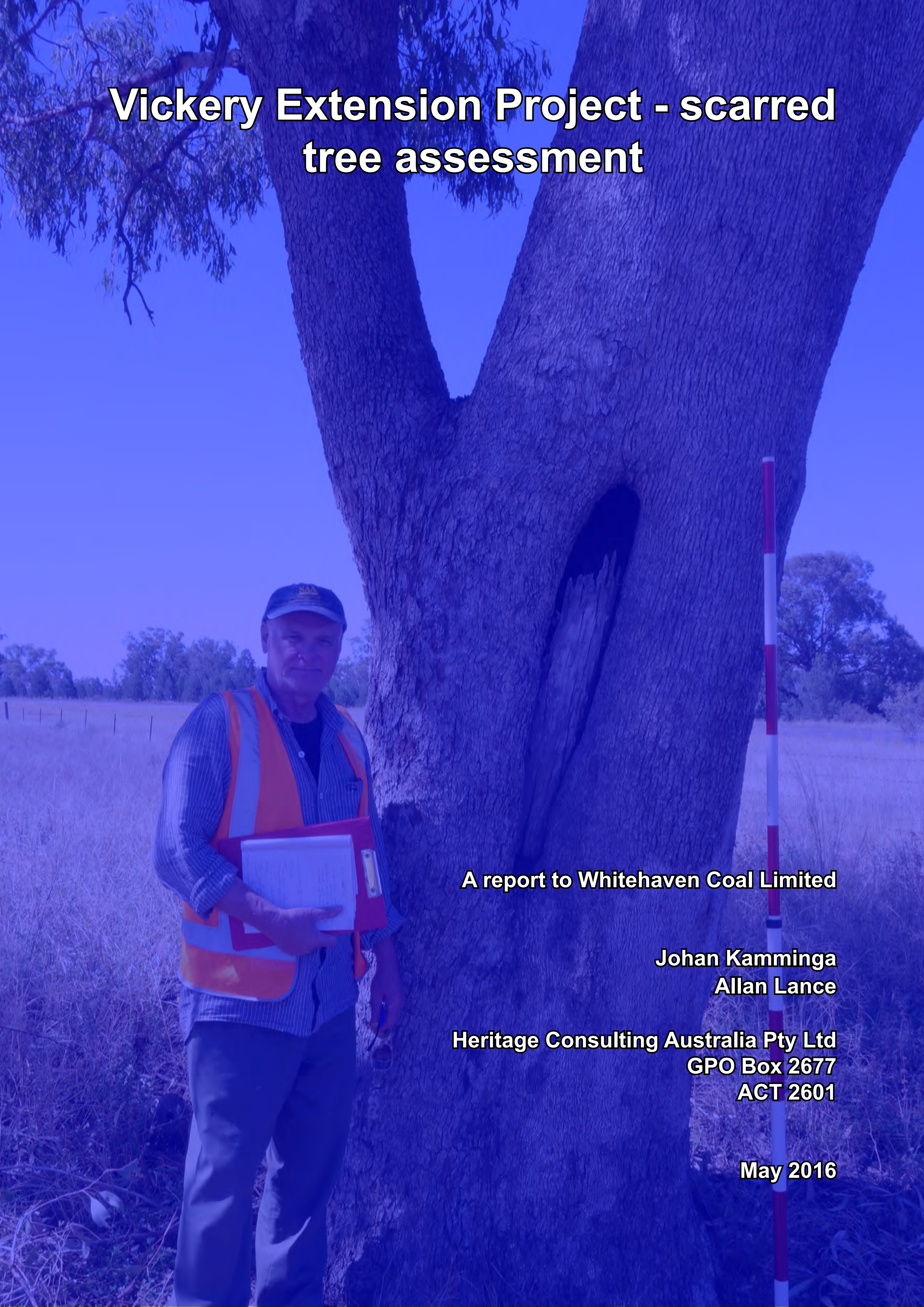
APPENDIX 6A: KAMMINGA AND LANCE 2016



Vickery Extension Project - scarred tree assessment

A report to Whitehaven Coal Limited

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1. Introduction

An Aboriginal Cultural Heritage Assessment (ACHA) is being prepared as part of the evaluation of environmental and cultural impacts of the Vickery Extension Project, an area for expansion of the previously approved Vickery Coal Mine located on the Liverpool Plains, approximately 25 km north of Gunnedah. As part of this process, a number of interested Aboriginal groups and individuals (Registered Aboriginal Parties - RAPs) were identified and they are assessing the project area for evidence of prior Aboriginal activity.

Additional to that process is the presently documented examination of trees bearing scars, originally recorded during a site investigation of an earlier but subsequently discontinued project (Vickery South Coal Project). This partially documented survey was undertaken by Suzan Hudson Consulting in 2012, with the assistance of representatives of local Aboriginal groups. This survey led to the incomplete recording of 26 trees bearing scars in the south of what is now the Vickery Extension project area. These trees have not been entered onto the Office of Environment and Heritage (AHIMS) database, so the criteria usually used to distinguish natural from cultural scars have yet to be applied.

As we explain below, reliable identification of culturally modified trees requires reliance on a number of criteria or attributes to distinguish commonly occurring natural wounds in bark and wood and scars in the bark of trees from ones that were caused by Aboriginal and non-Aboriginal human activity. Included in these criteria are the age of the tree and modification which requires trained forestry specialist knowledge about regional- and species-specific tree age and rates of tissue regrowth over modifications.

Subsequent to our submission of the review report on the scarred trees in late 2015, an independent assessment of the subject trees was carried out by a professional forester, Dr Mark Burns (2016). The Burns report corroborated our conclusion that none of the wounds or scars on the subject trees is demonstrably Aboriginal in origin (refer to Section 18 and Appendix 1; see also Burns 2016:101).

2. Study aims

The main aims of this investigation of trees with scars are to:

- Undertake an investigation of past land-use practices in the project area to identify potential sources of impacts to trees. These sources would include phases of initial exploration, settlement, land clearing, and establishment of property and paddock boundaries. This investigation will attempt to identify the earliest European activity in the area, likely to have led to the creation of non-

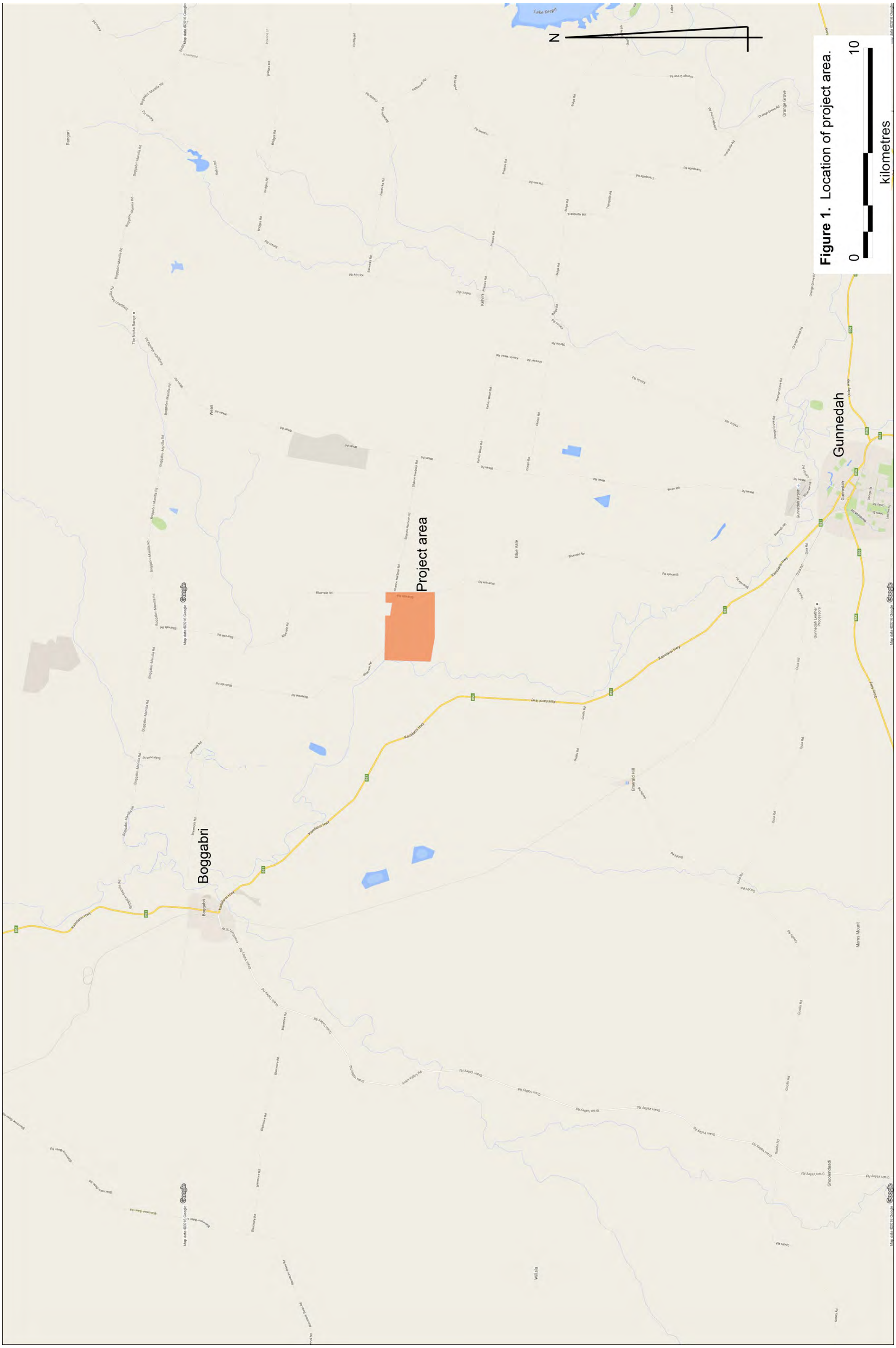

Figure 1. Location of project area.

Figure 2. Scarred trees (orange) and previously recorded sites in the project area.

Indigenous scarring on the trees.

- Investigate post-contact Aboriginal history for the region, to provide an approximate final date for traditional Aboriginal activity that would have seen the creation of traditionally scarred trees.
- Map previously identified scarred trees and other cultural features, to identify high sensitivity zones: the locations where deliberate tree modification would most likely have occurred.
- Refine criteria for the evaluation and recording of culturally modified trees. This would include and surpass those characteristics identified by Andrew Long (2002, 2003, 2005) in his pioneering studies on tree scarring.
- Evaluate forest age (possibly with the input of a forestry specialist) and establish the likelihood (or otherwise) of the oldest trees dating from a period when traditional Aboriginal practices were still extant.
- Conduct a field investigation that relocates and records in detail all the previously identified scarred trees. Further evaluate the field area to identify other trees with scars that might have been missed during earlier field reconnaissance. By cataloguing all trees with scars (including those trees previously assessed as bearing scars of a natural rather than a cultural origin), it will be possible to document the full range of scars and origin of clearly natural features.

3. Personnel

This investigation has been carried out by Dr Johan Kamminga and Mr Allan Lance. Dr Kamminga is co-author of the authoritative textbook *Prehistory of Australia*, has more than 45 years' experience in the investigation of Aboriginal archaeological sites and has conducted detailed studies of scarred trees (e.g. Kamminga and Grist 2000). During his field research and consultancies in different parts of the continent Dr Kamminga has documented Aboriginal sites of cultural significance including Indigenous culturally modified trees.

Mr Lance has more than 30 years' experience in the assessment of Aboriginal cultural heritage sites. His experience includes the documentation of numerous scarred trees in riverine settings, including along the Murray River, southern New South Wales and the Victorian Mallee, western and central Queensland. As part of these studies, Lance has worked with Traditional Owners to confirm the identity of culturally scarred trees and distinguish them from trees bearing natural scars.

4. Study methodology

The initial phase of the study was a preliminary review of literature for the region, with mapping of historical features from published sources. This phase was followed by a field investigation on 11 and 12 December 2015, in which each of the previously documented trees was examined by archaeologists Dr Johan Kamminga and Mr Allan Lance and relevant features were recorded. In this case, these features included the following attributes:

Location
Obtained with a handheld Garmin Oregon 650 GPS receiver.

Tree species
Identified using a range of attributes relating to tree form, foliage, bark, and fruit if present.

Tree height estimate
Obtained using a laser distance measuring device or triangulation when a target at the top of the tree could not be found.

Tree girth
Obtained at the standard chest height of 1.5 m from the ground using a fibreglass tape measure.

Scar length
Measured using a steel tape measure.

Scar width
Recorded at the mid-point of the scar using a steel tape measure.

Scar height above the ground
Recorded using a steel tape measure (and soil level estimated in those cases where erosion had exposed roots).

Overgrowth
Overgrowth (also termed ‘regrowth’ and ‘accelerated growth’) of sapwood and bark tissue inward from the margins of a scar surface is a common attribute of both natural and cultural scars. Under normal circumstances, the original wood surface, along with any cut marks on it, is preserved underneath this overgrowth. The rate of this growth depends on a number of variables, such as tree species, local environment, and shape and size of the bark that had been removed.

Thickness of the overgrowth was measured outward from the dry scar face. For those scars where the heartwood had decayed, the extent of growth into the wound cavity was measured, with an estimate of the original location of the dry face (four measurements were taken: top and bottom and left and right centre). The average of the number of recordings was taken to estimate scar age.

Whilst we recorded the extent of scar panel overgrowth we note that these measurements to some degree are subjective and prone to variation between recorders, sufficient to be termed ‘recorder error’ (for instance, see Kamminga and Grist 2000:Table 4). In our view, identification of bark regrowth extent on box species in general is not altogether reliable.

Scar orientation

Measured using both a mechanical and digital compass.

Scar symmetry

This attribute was assessed subjectively.

Scar shape

This was evaluated with reference to leaf shape (a useful comparative shape compendium.

Epicormic growth

The presence or otherwise of branch growth below the scar was noted.

Suspected origin

The suspected origin of the scar was decided based on conditions of the tree and scar.

As mentioned above, after the preparation of our preliminary review report, forester Dr Mark Burn was commissioned to undertake a separate study of the trees we examined (Burns 2016). In this study Burns has further refined his methodology for dating scars by including a larger number of reference trees of specific species and exhibiting scars of known age. Burns has also provided the maximum estimated age for scars by calculating from the maximum depth of regrowth tissue rather an average of depth readings (Burns 2016:15-33). In our preliminary report we relied on Burns’ previous methodology and reference tree data to estimate scar age (see Burns 2014a). In preparing this post-review report we have adopted the more conservative age estimates Burns has calculated. We have also in a number of instances also incorporated a number of his identification of natural causes of scarring (see Table 3 and Appendix 1, and Burns 2016).

5. Ethno-historical context

The Aboriginal people who occupied the Gunnedah Basin at the time the first European explorers reached the region belonged to the Kamilaroi (Gamilaraay) language group (Curr 1878 III:304-5, Tindale 1974:195, Austin 2008). People speaking this language, or variants of it, were widespread through central western New South Wales, in an area stretching from the upper reaches of the Hunter Valley westward to the Darling River near Brewarrina and northward to encompass the Macintyre River near Goondiwindi. The territorial extent of this language group can be gleaned from the travels of missionary William Ridley through the region in the winter of 1855 (*The Empire* 12 December 1855 p.2). As he could speak the language he was able to reliably identify Kamilaroi speakers and he noted the locations where he encountered them. At Western Creek near the Condamine River, Ridley encountered a family of Bigambul people who could speak Kamilaroi, the language of their southern neighbours. Further Kamilaroi speakers were found in Surat and south along the Balonne River, although traditionally this was the domain of the Mandandanji (Tindale 1974:181). Along the Moonie and Barwon Rivers to the junction with the Namoi River near Walgett, all the Aboriginal people Ridley encountered spoke Kamilaroi. Kamilaroi speakers also resided at settlements at Murrurundi and Warialda. Further north only Bigambul language was spoken.

Kamilaroi speakers inhabited a large area (75,400km^2), and they are thought to have prospered due to the rich food resources available from the rivers and grasslands of the region (Tindale 1974:194). Tindale (1974:110) identified a correlation between the production of seed food and large tribal areas. The reliability of grass seed food was argued to permit more regular aggregation of people and greater sedentism (albeit within the constraints imposed by the desire to move freely in search of game and to obtain dispersed resources such as stone for toolmaking or the need to perform ceremonies across their estates). Ceremonial gatherings included those associated with feasting on the seeds of Bunya pines in the Bunya Mountains. Tindale (1974:125) notes that some of the northern Kamilaroi people attended these ceremonies.

The first British explorers, the botanist Allan Cunningham and Surveyor General Thomas Mitchell, observed the camps of Kamilaroi people along the banks of the Namoi River. They described large camps, interpreted as indicative of semi-sedentary habitation. On 14 May 1825, Cunningham (cited in O'Rourke 1997) was travelling along Coxs Creek approximately 35 km west of the project area. He noted in his journal:

> … many trees had been barked by the Aborigines to construct their huts, which were strewed thro' the forest to the number of 14 in no [?] order or [?] village-like disposition.

Cunningham's observations suggest that huts were not grouped together, but were scattered amongst the trees and that their sturdy construction would have permitted lengthy periods of occupation. Some of the huts were large enough to shelter a family of six, with the larger ones having a square bark floor with forked stakes supporting a conical bark roof.

More huts were encountered on 17 May 1825, further to the north, near the junction of the Namoi River and Coxs Creek:

> The natives had been, in the last rains, housed under their bark gunyas near the spot – now perfectly dry and hard – on which we erected our tents, it appearing evident from the remains of their fire, and the effects of the heavy rain had left around it, that the season was exceedingly wet when these savages decamped from this ground.

Major Thomas Mitchell (1839, cited in O'Rourke 1997) reporting on similar huts near Moree described them as:

> … semi-circular, or circular, the roof conical, and from side a flat roof stood forward like a portico, supported by two sticks … [the] interior of each looked clean, and to us, passing in the rain, gave some idea, not only of shelter, but even of comfort and happiness.

Of particular relevance to the present study was the discovery by Cunningham on 18 May 1825 of cut marks from a steel hatchet on the trunks of trees near Coxs Creek. The tool that made these cut marks would have been traded northward from the Hunter Valley. Other cut marks observed by Cunningham on trees along Coxs Creek appeared to have been made with stone hatchets (called stone 'mogo').

A diverse range of animal foods was obtained through hunting, fishing and collecting. This included various species from the river (fish, eels, yabbies, tortoises and mussels) (Mitchell 1839; Mathews 1903; Parker 1905; O'Rourke 1997). Waterbirds were caught with nets and their eggs were also collected. Terrestrial animals hunted and trapped included: kangaroos, wallabies, koalas, possums, emus, echidnas, lizards, snakes and frogs (Mitchell 1839; Fison and Howitt 1867; Parker 1905; O'Rourke 1997). A diverse range of plant foods was also collected, including seeds, fruit and nectar from flowers of numerous plants (Lance 1982). A number of historical records also described canoes made from bark sheets.

Conflict between Aboriginal people and British settlers and the introduction of diseases such as smallpox, led to a dramatic decline in Aboriginal populations through the region. The extent of this population decline can only be speculated upon, but even

Cunningham (1825) was surprised by the few Aboriginal people he encountered. He attributed this to the actions of soldiers and settlers on punitive raids in the Mudgee district in 1824. However, O'Rourke (2009) argues that these raids encountered few Kamilaroi, and that disease is the more likely to be responsible for population decline at this early date (along with the dispersed nature of the Aboriginal population and their likely avoidance of contact with the early explorers).

Other historical sources lament the declining numbers of Kamilaroi people caused by dispossession of land and the consequent destruction of habitat and social networks (O'Rourke 1997). Within a decade of first contact, few Kamilaroi were living traditionally, with most settled on pastoral leases, many working as shepherds, stockmen or labourers (O'Rourke 1997). Traditions were abandoned reluctantly, but inevitably, in face of the loss of land and dramatic population decline. The last recorded traditional ceremony in Kamilaroi country is reported to have occurred in 1905 at Wee Waa, downstream 100 km from the project area (O'Rourke 1997).

Aboriginal reserves were established along the Namoi River in the early years of the 20th century, at Baan Baa and Borah Crossing. The 20 acre (8 hectare) Baan Baa Reserve operated from May 1901 until it was revoked in 1918 for Soldier Settlement allotments (Legislative Assembly 1919). There had been requests from the Farmers and Settlers' Association for the revocation of the reserve already in 1908, but these had been rejected. At the time, there had been on average only two Kamilaroi people receiving rations at the reserve (Legislative Assembly 1909:4, 20). There was a larger population at the Manilla Aboriginal Reserve at Borah Crossing, with 51 people reported on the reserve in 1907 and 12 receiving rations (Legislative Assembly 1908:17, 21). The Manilla Reserve operated until 1961 (Thompson 1981; Barber *et al*. 2007).

6. Contact history

6.1 Initial exploration

An earlier assessment of historical context for the adjacent and previously approved Vickery Coal Project, carried out by Pearson (2012), provides considerable information relevant to an understanding of the historical land use in the project area.

Initial exploration of the region commenced with Surveyor General John Oxley's expeditions in 1818 passing well to the south of Gunnedah and encountering the Peel River near Tamworth. His report on the expedition sparked interest in the pastoral potential of the region and prompted further expeditions that led in 1827 to the official discovery of the Namoi River by Allan Cunningham's party (Pearson 2012).

As this region was beyond the Limits of Location, the officially sanctioned lands made available for settlement by Governor's decree in 1829, no formal settlement took place at the time. Despite the goal of the colonial Government to contain and control British expansion, initially escaped convicts and then squatters moved into the district (Pearson 2012).

Escaped convict George Clarke (alias 'the Barber') had reached the district some time in 1826, having fled from the service of Hunter Valley pastoralist Banjamin Singleton, to whom he had been assigned (*The Sydney Gazette and New South Wales Advertiser* 8 February 1831). Clarke lived with the local Kamilaroi people and built a hut and yard on Barbers Lagoon, a distributary of the Namoi River, approximately 14 km to the northwest of the project area. When Cunningham's expedition passed through the area in 1827 they encountered Clarke's hut. From 1827, Clarke rustled cattle from the squatters further to the south until his capture in 1831. His fanciful accounts of the rivers and resources encouraged Acting Governor Richard Burke to send an expedition led by Surveyor General Thomas Mitchell into the region in 1831 (Pearson 2012).

Mitchell reached the Namoi River on 16 December 1831, in the vicinity of the present project area. He then travelled northward and had Clarke's stockyard and house pointed out by the district's Aboriginal people. At the time of Clarke's capture, the Kamilaroi people were living an almost entirely traditional life, with little disruption from the British settlers who were soon to arrive in the district (Pearson 2012).

6.2 Aboriginal post-contact history

A report by missionary William Ridley to the Moreton Bay Aborigines Friends Society and published in *The Empire* (12 December 1855, page 2 and then republished in *The Sydney Morning Herald* two days later) describes travels through eastern Australia with a particularly emphasis on meetings with Kamilaroi people. Ridley specifically mentioned the Aboriginal population he met along the Namoi River:

> The remainder of the month I spent on the Namoi, where I had many favourable opportunities of addressing both colonists and aborigines on the all-important topic of salvation.
>
> Though the number of aborigines is very much reduced since the occupation of this district by colonists, sixteen years ago, there are still a few at almost every station; and as there are two or three stations within every ten miles, the aggregate along 200 miles of river, is considerable.
>
> The Namoi blacks are useful, and even indispensable members of society: without their services in stock-keeping and shepherding, and especially at sheep-shearing time, the business of this district could hardly be carried on

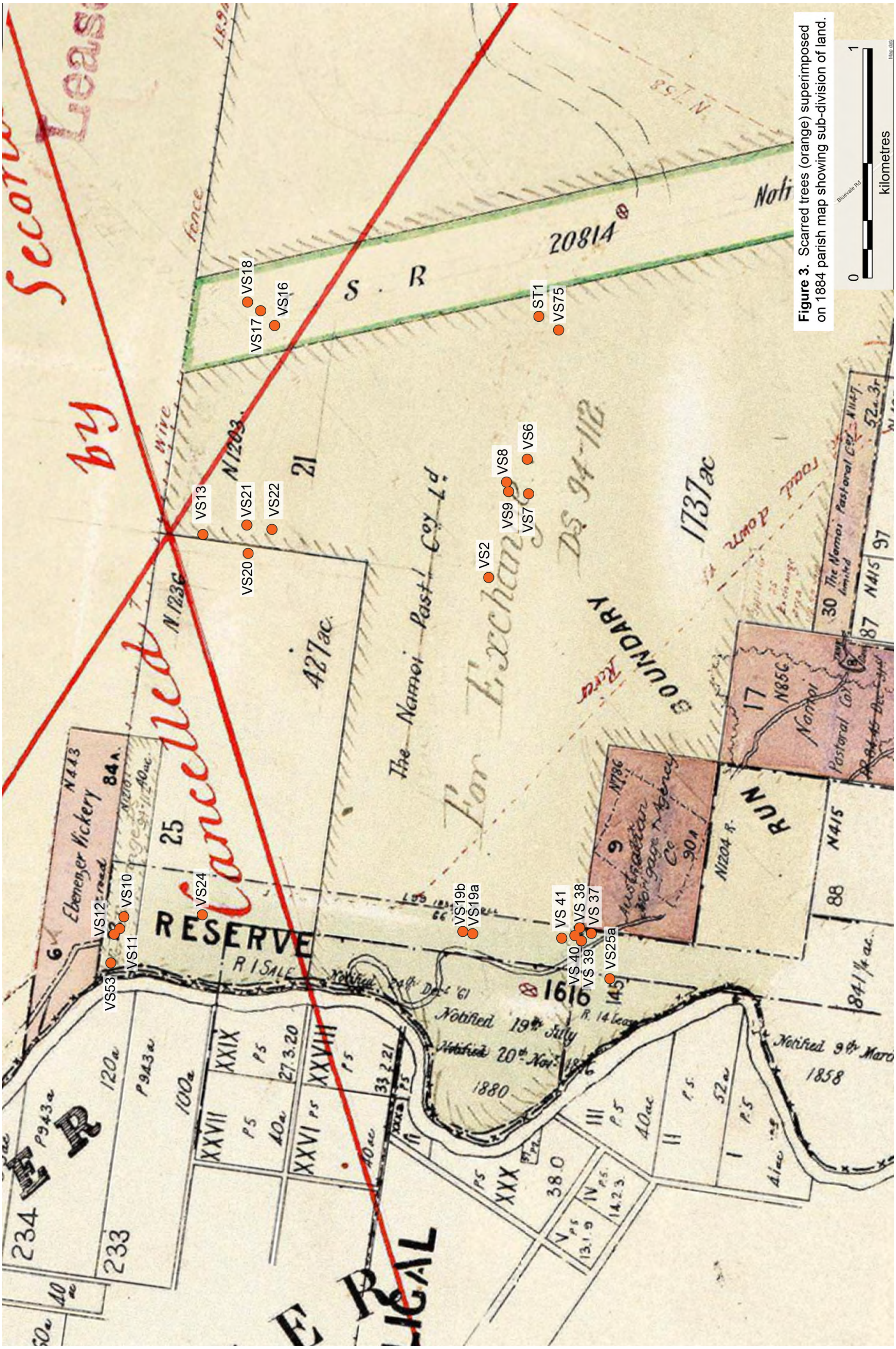

Figure 3. Scarred trees (orange) superimposed on 1884 parish map showing sub-division of land.

> Again, along the course of the Namoi, in 250 miles one would find over a hundred aborigines all speaking Kamilaroi, engaged in the service of the colonists …

After the arrival of British squatters there was a dramatic decline in the numbers of Aboriginal people living in the district. Although speaking about the Aboriginal inhabitants of the Balonne River district, Ridley's observations reported in *The Empire* (1855) are equally apposite to the situation along the Namoi River:

> On this river the effect upon the aborigines of the occupation by European of the country was vividly presented. Before the occupation of this district by colonists the aborigines could never have been at a loss for the necessaries of life. Except in the lowest part of the river there is water in the driest season; along the banks game abounded, water fowl, emus, parrot tribes, kangaroo, and other animals might always, or almost always, be found. And if at any time these failed to supply food for the human tribe, the fish furnished a sure resource.
>
> But when the country was taken up, and herds of cattle introduced, not only did the cattle drive away the kangaroos, but those who had charge of the cattle found it necessary to keep the aborigine away from the river, as their appearance frightened the cattle in all directions. In fact it is said that while troops of aborigines roam about the runs, and especially if they go near the cattle camps and watering places, it is impossible to keep a herd together.
>
> After some fatal conflicts, in which some colonists and many aborigines have been slain, the blacks have been awed into submission to the orders which forbid their access to the river. And what is the consequence? Blackfellows coming in from the west report that last summer very large numbers, afraid to visit the river, were crowded round a few scanty waterholes, within a day's walk of which it was impossible to get sufficient food; that during the hottest weather the great red ants in that dry locality were so formidable that neither men nor even opossums could rest night or day, except for an hour or so at noon; that owing to these combined hardships many died. This is only blackfellows' report; but when we know that people have been cut off from four-fifths of their usual supply of food, and reduced to a scanty supply of bad water, is it an incredible report that sickness and death have fallen upon them?
>
> As might be expected, partly from the pressure of real want, partly out of anger at the interference of the white man with their prosperity, they skulk about spearing cattle.
>
> How can such evils be prevented? The squatter has a license from the Crown to occupy the country with his cattle, and unless his cattle are secure from the visits of blacks they will not stay on the run. He argues thus: "The license entitles me to make sure of the benefit to be derived from depasturing the run; and the run is useless while blacks roam over it as they please, so that the license, if worth anything, includes the right to order them away from the river.

> The question then arises whether it is not the duty of the Government, on assuming the ownership of the land, by granting licenses to occupy it, to see that the human beings who have been wont to get their living off the land thus taken up, have at least a supply of food provided for them equal to that of which they are deprived.
>
> To those blacks who volunteer to become servants to the occupier of the station, liberal supplies of food and clothes are generally given. But where they are as numerous as they are on the Balun, it is impossible for more than a small proportion of them to be so employed; and whether they become servants to the colonists or not, surely the tribes who are deprived of their chief means of subsistence have a right to some compensation from the government which takes to itself the responsibility of owning the land, and lets it to others for purpose inconsistent with their accustomed free occupation of it.

On an expedition down the Namoi River in the 1840s to inspect potential holdings along the Darling River, Oscar de Satgé (1901:122), traveling with his brother, commented on their Aboriginal stock hands building canoes using traditional techniques to allow them to cross stretches of river:

> If canoes were not handy at the usual crossing place, we had to construct them of bark, stripped from the big river gum, by the indefatigable arms of our black boys, who were splendid hands with the tomahawk. These canoes would be cleverly stripped, so as to allow one end to be stopped up with mud, and take in our saddles and packs, to be guided over the river by Billy and Jonathan …

7. Pastoral industry

Despite the Gunnedah region being outside the Nineteen Counties and therefore unavailable for selection, pastoralists in search of suitable pasture moved their stock into the district from the 1830s. The area to the south of the Namoi River was largely occupied by 1835 and the first run on the northern side of the River was claimed by Edward Cox's stockmen in 1835, with the property known as "Namoi Hut", named after a building erected near the site of present-day Boggabri. By 1849 the Namoi Hut run comprised 19,200 acres. Other runs were soon established, including that of Mr I. Robertson, who was the first holder of the *Burburgate* run, the land on which the project area is located (Pearson 2012).

Government recognition that squatters had occupied lands well beyond the "Limits of Location", for which the government was receiving no revenue and in areas which were outside its effective control, led in 1836 to the introduction of a licensing fee of £10 for each squatter per year for the right to depasture stock on Crown Land. Eight squatting districts were established outside the Nineteen Counties, including the Liverpool Plains

District, which encompassed the project area (Pearson 2012).

By 1840 more than 40 pastoral stations had already been established in the Liverpool Plains District. The 1846 *Waste Lands Occupation Act* made long-term leases available to land holders, recognizing the leasehold occupation of the lands, but also making freehold rights available to homestead blocks, providing some security of tenure to those who had made improvements to their properties. Large runs were held along the Namoi River. These included a number held by W.C. Wentworth taken up between 1837 and 1845. One of these was the *Burburgate* run. To the north, around Boggabri, John Panton held several leases, which included the Boggabri station which covered an area of 96 square miles. This property was acquired by Sydney merchant Thomas Mort in 1866 and was passed on to another Sydney merchant Ebenezer Vickery. Small landholdings around the project area still in Vickery's name remain on the Parish map dating from 1884 (Pearson 2012).

With closer settlement legislation, the Burburgate run became a series of smaller landholdings. In 1848 John Charles Lloyd had been appointed manager of the reduced holdings, which was listed as occupying 65,920 acres. Lloyd purchased Burburgate from Wentworth in 1853 and Lloyd's brother Edward Henry (who had joined John on the property five years earlier) became the new manager upon its acquisition. The following year, their brother Charles William Lloyd also moved to Burburgate. Charles was assistant manager until 1858, when a partnership was formed between the brothers, and Charles succeeded Edward as resident partner and general manager (Abbott 1974).

In 1856 Charles was responsible for erecting wire fences and installing steam driven pumps for sheep washing. In 1860 he installed a wool scour. In 1863 Charles introduced sheep dipping to protect the sheep from scab. Oscar de Satgé, Assistant Manager at Burburgate from 1859 to 1861, provides some valuable insights into the operations of the Lloyd properties in his 1901 publication: *Pages from the Journal of a Queensland Squatter (1901:93, 103-5):*

> We arrived at Burburgate towards sundown; it was evidently the centre of a large establishment, the working part away from the owner's and manager's residence, everything ship-shape, close to the bank of the Namoi, and possessing every reasonable comfort in a good house and the usual wide verandah which always accompanies an Australian house. Besides which there was a fine garden, sloping to the river, full of peaches, figs and grapes.
>
> Burburgate had a long stretch of both sides of the river, with Baanbah north and south below it, and, forty miles lower down, the splendid stations

> of Gurley and Edgeroi ... Edgeroi and Gurley consisted of rolling downs and thick soil plains, with sufficient shelter for sheep in clumps of mayall and emu bush… I have always considered Gurley and Edgeroi, and Gundamaine and Galatheral, the best properties for growing and fattening sheep and cattle that I ever saw under one holding ... They became partly the prey of selectors in after days, and are now held by several owners.
>
> Burburgate was the head station, and all these other out-stations had efficient overseers … The lambing arrangements were particularly successful, being chiefly carried on at Burburgate ... The run being well watered, it was especially adapted for lambing, and certainly results were obtained there that I have never seen equalled elsewhere. The Burburgate lambing was by hand, and a great many blacks were employed.

Burburgate was acquired by Mort, Cameron and Buchanan in 1865 and later by Ebenezer Vickery. Vickery (1827-1906) was a prominent landowner, industrialist and manufacturer. After a period, Burburgate was acquired by the Namoi Pastoral Company (Pearson 2012).

In the 1860s the township of Gulligal, located on the western bank of the Namoi River, was the most important town in the district and linked to Boggabri by twice-weekly coach service. Regular flooding of the Namoi led to Gulligal’s gradual abandonment, particularly after the 1864 flood (Pearson 2012).

By 1886, the Burburgate Run comprised 220,000 acres, having been subdivided in accordance with the 1884 *Subdivision of Runs Act*. It was further subdivided in 1894 for closer settlement. By 1905 Burburgate had been reduced to a holding of 47,000 acres and was sold to H.S. Rich and Sons for subdivision into 58 blocks of from 105 to 2,200 acres in area (Pearson 2012).

The pattern of land subdivision in the project area can be better appreciated upon examination of the parish maps prepared by the New South Wales Land’s Department. A number of maps are available, dating from 1884 until 1930, and these show a changing configuration of property and paddock boundaries, and have implications for the concentration of activities likely to have led to post-contact tree scarring. These maps reveal a correlation between property and paddock boundaries and infrastructure and trees with scars (Figure 3). This is particularly the case for the north western portion of the project area seen in the vicinity of a road running parallel with the Namoi River. Whilst it is possible that the correlation is coincidental, we suggest that it may well explain at least some of the tree scarring.

8. Archaeological context

While this investigation is concerned with the identification of Indigenous culturally modified trees, these cannot be assessed without reference to the known Aboriginal sites in the project area. Evidence of prior Aboriginal habitation is widespread throughout Australia, particularly in areas where there is abundant water, such as adjacent to the Namoi River. Historical accounts point to the value placed on this resource by the Kamilaroi people living there at the time of first British contact. Although no complete documentation of Indigenous sites in the project area has occurred at the time of writing, this area is being fully assessed for traces of prior Aboriginal habitation.

Prior to the present investigation, a small number of Indigenous sites had been reported and registered in and around the project area. These comprise a very small range of sites: stone artefacts and stone artefact scatters, a single scarred tree and hatchet grinding grooves. Within the project area there are two recordings of stone artefacts (AHIMS sites 20-4-290 and 20-4-548) and a campsite with a hatchet grinding groove (AHIMS site 20-4-9). These sites are all located in the north western corner of the project area, adjacent to the Namoi River. Other sites found in the general vicinity of the project area include: four stone artefact occurrences, a hatchet grinding groove site and a single scarred tree.

9. Aboriginal bark and timber use and associated tree scarring

Many trees (mostly eucalypts) in woodland and old growth forest throughout Australia exhibit scars from the deliberate removal of bark by Aboriginal people (see Table 1). Favoured trees included such river red gum, and species of box, stringybark and paperbark. Inevitably, because of natural tree death, bushfires and agricultural clearing, the overall number of Aboriginal scarred trees has diminished rapidly. Scarred trees tend to be more common in well-watered areas of NSW, in proximity to major water bodies such as watercourses, lakes and swamps, and within road easements. This reflects both the suitability of trees available for use, but also the greater use of well watered areas by Aboriginal people in traditional times and the persistence of old trees in reserves along watercourses.

In pre-contact times bark sheets were cut from the tree with a stone hatchet or hand-held stone chopper and then pried off with a lever, such as a pointed stick, hatchet handle or stone wedge. During British colonial and later times a steel hatchet was most commonly used.

Bark was removed from trees to obtain sheets or fibre strips for a range of artefacts and structures, to carve decorative and symbolic patterns into the wood of living trees, to wedge out wood to make artefacts, and to expose timber or enlarge existing holes during hunting and collecting animal and insect foods.

Despite the dramatic diminution in number due to natural tree death and other causes, trees identified as bearing Aboriginal scars are still being recorded during archaeological field surveys, sometimes in relatively large numbers. In some riverine areas of eastern Australia, the Aboriginal scarred tree may be the most common site type recorded.

Aboriginal scarred trees are a rapidly diminishing cultural heritage resource and are vulnerable to natural deterioration and developmental impacts. Many Aboriginal people regard these trees as highly significant because they are a visible symbol of ancestral occupation and ownership of the land and the use of its resources. Given the importance of protecting from avoidable impact the progressively diminishing resource of scarred trees, it is essential that developers, community stakeholders, and government agencies to understand the significance and management options relating to this site type, so that appropriate actions can be taken in planning, development and land management decision making.

In commissions from Aboriginal Affairs Victoria and subsequently the NSW Office of Environment and Heritage, Andrew Long (2002, 2003, 2005) provided a comprehensive review of Aboriginal scarred trees (culturally modified trees) in southeastern Australia; (see also Mulvaney and Kamminga 1999 for a brief summary of the site type). However, reliable identification of Aboriginal culturally modified trees remains highly problematic, with considerable implications for assessments of site significance and potential development impacts to heritage values.

Table 1. Tree species exploited for their bark by Aboriginal people in southeastern Australia. Most of the data in this table derives from historical records and field identifications of culturally scarred trees in Victoria, and it is based substantially on Long (2002, 2003, 2005) and Kamminga (1978:460-61, 2002).

Common Name	Botanical Name	Historical Reference or known Distribution of Scars
Gum Trees		
River red gum	*Eucalyptus camaldulensis*	Long 2005:57. Widespread along rivers and flood prone areas of inland NSW and Victoria.
Forest red gum	*Eucalyptus tereticornis*	Trees widespread in NSW and Victoria, though in Victoria scars are only recorded in Gippsland. Known to have been used to make still water canoe hulls.
Manna gum	*Eucalyptus viminalis*	Southwestern Victoria and Port Phillip.
Blue gum	*Eucalyptus globulus*	Historical recorded for Gippsland, but scars are yet to be identified.
Swamp gum	*Eucalyptus ovata*	Scars recorded in the Port Phillip area.
Yellow gum	*Eucalyptus leucoxylon*	Scars recorded in central and western Victoria.
Box Trees		
Black box	*Eucalyptus largiflorens*	Scars recorded in northwest Victoria.
Grey box Alternative common names: Gum-topped box, inland narrow-leaved box, and western grey box	*Eucalyptus microcarpa*	Southeastern Australia. Common in the wheat belt of Victoria, SNW and Queensland; in Victoria the main area is in the area immediately north of the Grampians, also Port Phillip area.
Grey box Alternative common name: gum topped grey box	*Eucalyptus moluccana* Roxb. Synonyms: *Eucalyptus hemiphloia F.Muell* Intergradation occurs with *E. albens* in the upper Hunter Valley. Synonyms*: Eucalyptus hemiphloia* F.Muell.	Long 2005:57. NSW & Queensland. Distributed in the relatively drier areas of central and northern coastal NSW and eastern Queensland, scattered as far north as the Atherton tableland.
Red box	*Eucalyptus polyanthemos*	Long 2005:57.
Poplar box	*Eucalyptus populnea*	Long 2005:57
Swamp box	*Tristania suaveolens*	Long 2005:57.
White box	*Eucalyptus albens*	Long 2005:57.
Yellow box	*Eucalyptus melliodora*	Long 2005:57. Scars recorded across Victoria.

Common Name	Botanical Name	Historical Reference or known Distribution of Scars
Stringybark Trees		
Thin-leaved stringybark	*Eucalyptus eugenioides Sieber ex Spreng.*	Long 2005:57
Messmate	*Eucalyptus obliqua*	Southwest Victoria and Port Phillip area, but scars have yet to be identified.
Yellow stringybark	*Eucalyptus muelleriana*	Scars recorded in Gippsland.
Brown stringybark	*Eucalyptus baxteri*	Scars widespread in Victoria.
Red stringybark	*Eucalyptus macrorhyncha*	Non-specific historical reference only.
Blue-leaved stringybark	*Eucalyptus agglomerata*	South and central coast of NSW, east of the Great Dividing Range (canoe hull, reported in Lampert & Sanders 1973:108).
Native pines		
White cypress pine	*Callitris glaucophylla*	Scars recorded in Gippsland.
Murray pine	*Callitris gracilis*	Scars recorded in Gippsland.
Other genera		
Moreton Bay chestnut	*Castanospermum australe*	Long 2005:57.
Moreton Bay fig	*Ficus macrophylla*	Long 2005:57.
Paperbark	*Melaleuca* spp.	Long 2005:57.
Brown barrell	*Eucalyptus fastigata*	Long 2005:57.
Blackbutt	*Eucalyptus pilularis*	Long 2005:57.
Budgeroo	*Lysicarpus angustifolius*	
Bangalay, southern mahogany	*Eucalyptus botryoides*	Narrow coastal belt from Newcastle to Canoe hull, reported Lampert & Sanders 1973:108; see also Smyth 1878/1:411).
Southern mahogany	*Eucalyptus acmenoides*	Long 2005:57.
Mountain ash	*Eucalyptus regnans*	Reported for Gippsland, but scars have yet to be identified.
White mallee and other mallee species	*Eucalyptus spp.* incl. *Eucalyptus dumosa*	Non-specific references only.
Red ironbark	*Eucalyptus sideroxylon*	Reported for Gippsland, but scars are yet to be identified.
Narrow-leaved Ironbark Alternative common name: narrowleaf red ironbark	*Eucalyptus crebra*	Long 2005:57; also other Ironbark species. Ironbarks do not appear to have been used extensively.
Black wattle	*Acacia mearnsii*	Reported for southwest Victoria, Port Phillip area and Gippsland, but scars are yet too be identified.
Moonah (species of tea tree)	*Melaleuca lanceolata*	Non-specific historical reference only.
Belah (species of she-oak)	*Casuarina cristata*	Scars occur in northwest Victoria.
Kurrajong	*Brachychiton populneus*	Historical reference for northeast Victoria, but scars have yet to be identified on trees.
Sandalwood, quandong	*Santalum* spp.	A non-specific historical reference only.
Northern sandalwood	*Santalum lanceolatum*	A non-specific historical reference only.
Bitter quandong	*Santalum murrayanum*	A non-specific historical reference only.

9.1 Carved trees

One of the rarest and most vulnerable Aboriginal site types is the carved tree, a variety of culturally modified tree (usually distinguished from ‘scarred trees’), which occurs in eastern and central NSW and southeastern Queensland and, particularly in the Darling River Basin (Mulvaney and Kamminga 1999:31-33). More than 1,000 carved trees have been documented, though less than about 300 now survive, most on public land where old growth trees have been preserved. Carved trees marked ceremonial grounds and burial places. Usually bark was first removed and cuttings made on the tree trunk in patterns of circles, spirals, concentric diamonds and lozenges. While a concentration of 120 carved trees has been reported to occur around one Bora ground (Bell 1979, Mulvaney and Kamminga 1999), carved trees usually occur in small numbers or as solitary trees. Many of those recorded were carved with steel hatchets in the nineteenth century.

Three examples of carved trees have been reported from the Gunnedah region (Etheridge 1918:50, State Library of New South Wales 2011). These include a carved tree marking the location of a grave near the main street of Gunnedah, and apparently dating to the time prior to the arrival of Europeans. The images of two boomerangs and a shield were carved into the bark, however, secondary regrowth was reported (Etheridge 1918:50). The second site containing scarred trees was reported from a bora ground on Burburgate station (Etheridge 1918:50). These trees originally associated with a bora ground are illustrated and one shows a cross-hatched pattern and the other has chevrons forming a pattern in the trunk. A third illustration of Burburgate carved trees is found in State Library of New South Wales (2011:15), which reproduces an 1894 illustration of six of the trees from the same bora ground. The description of the exact location where these carved trees occurred is ambiguous. Etheridge’s 1918 map shows two carved tree locations on the southern side of the Namoi River (one at Gunnedah, the other just to the north), while his description (1918:50) describes the second lot of carved tree occurring on Burburgate holding as being “a little north-west of Gunnedah, on the Namoi River”. Neither of these descriptions rules out the project area as the original site of the trees.

10. Natural tree scarring

While deliberate bark removal, notching of trees to allow climbing or chopping timber for various purposes was common in traditional times and in the post-contact era, there are also numerous examples of trunk damage that have occurred naturally. The vast majority of such wounds are the result of natural and not cultural agencies or causes (Long 2002, 2003, 2005:18-26; Burns 2014a). Such causes include:

- Lightning strike
- Fire damage
- Wind damage
- Branch and secondary stem tears
- Larval activity
- Termite activity
- Bird damage
- Abrasion (for instance from other tree limbs).

10.1 Lightning strikes

Lightning strike scars are the most common type of natural scar, and are often seen on river red gums, box and stringybarks. During a lightning strike the electrical current passes to ground via the moisture in and around the cambium layer. The heated sap may sufficiently scald and damage the cambium layer to cause the bark to peel off, usually from the tree's crown down the trunk. An associated feature of lightning strike is damage to the crown. Trees struck by lightning tend to die prematurely. Red gums survive lightning strikes better than other tree species such as box. Lightning-strike scars are usually long and thin, curve around the trunk and broaden towards the base.

10.2 Fire damage

Long (2002, 2003, 2005) has identified two main varieties of fire scars: a distinctive triangular scar with a wide base at ground level; and a linear succession of scars (continuous, elongated or discontinuous) down the trunk. Typically fire scars occur on the downwind side of the tree and therefore can be characterised by a number of trees all bearing scars facing the same direction. The surface of fire scars can be charred (sometimes with burnt hollows) or weathered, or appear unburnt (when the outer ring disintegrates). Commonly, with lightning scars and with fire scars in general there is damage to the branches as well, and complete branches may protrude from the scar.

10.3 Impact scars, limb abrasion and breakage

Impact scars may result from adjacent tree fall, floating debris during flood, and from modern human activities such as woodcutting and logging which was widespread in historic times. This damage is identifiable from contextual evidence and direct evidence of irregular outline, damage to heartwood, branch tear and the location of the scar on the tree. The swaying of an adjacent limb over time may abrade the bark on a trunk or thick lower branch and polish the exposed wood surface. The resultant scar usually is irregular in outline and associated with branch tears and impact marks on the trunk. Tearing of the bark on a trunk can also be caused by a limb breakage during strong wind, which is common with river red gums. This type of damage leaves a tear-shaped socket in the trunk at any height, but often higher up (Long 2002, 2003, 2005).

10.4 Termite and borer infestation

Termite infestation causing loss of bark is usually indicated by termite holes in the wood and by differences in weathering of wood surfaces. *Lyctus* borer grub infestation (of species such as river red gums) is easy to distinguish, as it usually creates scars of irregular shape at or near the base of the tree, with insect holes and 'channels' in the wood surface. River red gum is resistant to termite infestation.

10.5 Bird damage

A number of species of flocking birds strip bark from trunk and limbs of grey box and other tree species. The resultant scars usually are located in the middle and upper part of a tree, have a maximum dimension of less than 1.5 metres and a low length/width ratio, are distinctively irregular in shape, and often curve around the trunk.

10.6 Natural tree scarring - conclusions

As well as these natural causes there are numerous less common other agencies of wounding that result in of bark scarring and wood loss (Burns 2014a:1) such as stock damage, ring-barking and trauma damage.

The natural cause of a scar is often difficult to determine since a number of causes can act in combination. These processes of wounding are often sequential; for example, branch tear resulting from wind damage leading to subsequent fungal and termite damage over time (Burns 2014a:1).

A similar but even more extensive range of natural scarring forces and agencies is reported in the Canadian guidelines for identification of Culturally Modified Trees:

> Most of these scars are not cultural, that is, the result of traditional bark collection by aboriginal people. Instead, they are the result of a variety of natural forces and agents. For western red cedar and yellow cedars, the trees most often used by aboriginal people, these natural forces and agents include fire, lightning, falling trees, breaking branches, animals, fungi, sun scalding, nutrient deficiency, lack of soil, and falling or sliding rocks. Modern machine damage is another source of bark removal. Following damage, a tree attempts to heal itself by covering a wounded area with new layers of wood and bark." [Resources Inventory Committee 2001:144].

11. Identification of Aboriginal cultural scars

In general, reliable identification of Aboriginal culturally modified trees is highly problematic (see for instance Burns 2013, 2014a, 2014b, 2014c). This is particularly so for scars with extensive overgrowth of scar tissue or where subsequent wood and bark deterioration have altered the original appearance of the wound. This can happen within only a few decades (Burns 2014a:1).

Burns advises that:

> Based on a failure by most people to understand both the rate of tree and wound growth and also the many natural causes that can lead to scarring, the age and cause of scarring are often frequently misinterpreted. As a result, both trees and scars present in live trees today are most likely much younger than most people consider. This makes the likelihood of scarring being Aboriginal related unlikely.
>
> In addition, it should be noted that a tree would initially have had to have been of a reasonable size to have been used (scarred) for Aboriginal purpose. Hence, scar age is normally much younger than tree age which makes the probability of scarring being of Aboriginal origin even lower. [Burns 2014a:1-2].

11.1 Degree of confidence in Aboriginal scarred tree identificatio

The significant difficulty in reliably and consistently identifying this site type is indicated in NSW National Parks & Wildlife guidelines (Long 2005; see also Kamminga and Grist 2000). There can be no doubt that there is also a significant degree of error in discrimination between natural, non-Aboriginal cultural and Aboriginal cultural scars for scarred trees registered on the AHIMS Aboriginal site database. Anecdotal evidence provided to us by colleagues over a number of decades suggests that the majority of Aboriginal scarred trees registered on the AHIMS database and the Victorian AAV site register may well bear natural or European scars, rather than scars resulting from Aboriginal activities. After considering the concerns raised by Kamminga and Grist (2000) in the Yarriambiack Creek Aboriginal Heritage Study, commissioned by Aboriginal Affairs Victoria, this department advised consultants operating in Victoria to submit scarred tree registration requests only for definite identifications (Mark Grist personal communication). Prior to this, identifications of Aboriginal scarred trees were mostly qualified by the degree of confidence expressed in the following terms:

Definite Aboriginal scar – With few exceptions, a scar that conforms to a sufficient number of identification criteria, or is identified as an Aboriginal scarred tree by historical evidence (oral or documentary). In meeting the guidelines/criteria, all conceivable natural causes of the scar are discounted.

Probable Aboriginal scar – A scar consistent with all of the criteria for Aboriginal origin but for which natural or other human origin cannot be ruled out.

Possible Aboriginal scar – A scar which conforms to all or most of the criteria and where an Aboriginal origin cannot be reliably considered as more likely than alternative natural or human causes. The characteristics of this scar will also be consistent with a natural cause. Thus this definition for uncertain identification indicated by minimal attributes such as evidence of wound or scar of unknown cause on a tree.

These categories have also been applied in Aboriginal cultural heritage surveys in NSW (e.g. Officer and Kamminga 1998).

11.2 History of guidelines for scarred tree identificatio

The following documents the history of the development of scarred tree recording methodologies employed by archaeologists in eastern Australia over the last four decades.

Coutts and Witter 1977

The original set of criteria for identifying Aboriginal scars was formulated by the Victoria Archaeological Survey (Coutts and Witter 1977:53):

1. The scar should end above the ground.
2. The sides of the scar should be parallel and the ends should be rounded or squared off.
3. The scar should have general symmetry.
4. Often there are hatchet or axe marks on the scar face (best preserved at the top of the scar).

Irish 2004

For a re-assessment of previously recorded Aboriginal scarred trees, which were determined, with a high degree of confidence, not to be of Aboriginal origin, archaeologist Paul Irish formulated a more comprehensive set of 14 identification criteria (Irish 2004:Table 1):

1. Scars do not usually reach the ground.
2. If a scar reaches the ground its sides should be roughly parallel.
3. Scars are usually symmetrical, with parallel sides or concave in form.
4. Scar outlines should be fairly regular in outline and regrowth.

5. Scar ends are usually squared off or tapered.

6. Scars with axe or adze marks on the original scar surface are likely to be of human origin.

7. Scars should possess a similar shape to those types of artefacts known to have been locally made from tree bark.

8. Scar age must be appropriate for the area (e.g. in Sydney at least 100 years old).

9. The tree species bearing the scar must be endemic to the area.

10. Heartwood (xylem) is usually exposed (but older scars can be totally overgrown by outer bark growth) and is usually flat.

11. Xylem grain pattern is usually parallel to the trunk or branch on which the scar is located.

12. The presence of Aboriginal cultural remains (e.g. stone artefacts, hearths) in close proximity increases the likelihood of cultural origin.

13. Inspection of scar forms on surrounding trees may clarify the likelihood of a natural scar origin.

14. Knowledge of local Europeans tree marking types (e.g. surveyors' marks) can exclude these scars as Aboriginal.

Kamminga and Grist 2000

In 2000 Kamminga and Grist formulated a set of guidelines based in part on the research of Andrew Long, and also on their own observations during an archaeological survey of Yarriambiack Creek in the Wimmera-Mallee region of Victoria (Kamminga and Grist 2000:59-60). These guidelines were as follows:

1. Cultural scarring occurs on certain tree species indigenous to the region (excluding plantings during historic times), and known to have been exploited for their bark.

2. Aboriginal bark procurement scars occur on trees that were living before the cessation of traditional Aboriginal exploitation and on younger trees around historic-era camps (until early in the 20th Century). Aboriginal bark procurement of rectangular sheets to supply pastoralists continued until the late nineteenth century.

3. Cut marks (scarfs) from a stone or steel hatchet or a steel axe are often seen on the wood surface within a cultural scar, especially near its top and/or base. These marks are usually exposed by dieback around the scar margin, and/or covered by subsequent overgrowth. At times such marks can be used to infer an Aboriginal origin, but usually the marks are from steel tools.

4. Cultural scars tend to occur on the lower part of the tree trunk, though they do **not** commonly extend right to ground level. Scars caused by bushfire, lightning strike or fungal attack usually **do** extend to the ground level. Cultural scars that do extend to the ground (for instance some canoe scars) usually were straight-sided before overgrowth reduced the area of wood exposure or distorted the plan shape.

5. Cultural scars are generally symmetrical in shape and roughly parallel or concave sided. While some fire scars also are symmetrical they tend to be wider at their base.

6. The margin of a cultural scar and overgrowth are usually reasonably uniform, with regrowth advancing over the scar surface at a uniform rate.

7. The top and bottom of a cultural scar is either squared-off or pointed in shape (normally as a result of overgrowth; a 'keyhole' profile with a 'tail' is typically the result of branch loss).

8. Presence of 'dieback' around the scar. Often when bark is taken from a tree subsequent contraction of living the cambium layer from the margin of the fresh scar occurs, resulting in dieback (death) of bark from the margin of the scar. Dieback of bark is very common around scars resulting from the removal of square or large rectangular bark sheets. Long proposes that over time bark dieback and subsequent callous tissue overgrowth on the margins of the scar face transform it into an elongated ovate shape. Insect infestation may also be a cause of dieback but usually there is other evidence to identify a natural cause on a living tree.

9. An epicormic stem (a subsidiary shoot or limb) growing just below a cultural scar is a common feature on box trees and much less commonly on river red gums. Growth of an epicormic stem indicates that the process was traumatic (e.g. by removing of a bark sheet, or by fire or ringbarking) and not progressive (e.g. rubbing of bark by stock or tree limbs, or bird or insect attack). It is a response by the tree to the sudden reduction of the canopy after removal of bark.

It was emphasized that, in practical terms, the presence and patterning of hatchet or axe cut marks (Guideline 3) often constituted the most persuasive indicator of human origin of a scar.

Long (2002, 2003, 2005)

In the years 2002-2005, Andrew Long (2002, 2003:11-12, 2005) published guidelines he originally formulated in 1999 in a report to the Victoria Archaeological Survey. We compile below these widely used guidelines:

1. Aboriginal scars reflect a wide range of bark removal, wood removal and toe hold scar forms.

2. Aboriginal scars may occur on a wide range of tree species, including various

gum, box, pine, fig, paperbark and stringybark species.

3. Aboriginal bark removal scars have a wide range of sizes and shapes, reflecting the numerous purposes for which bark was used.

4. Traditional Aboriginal scars will not display marks made by a full size woodsman's axe (blade length 10-15 cm). While small steel axes or 'hatchets' (blade length 5-10 cm) were rapidly adopted into the Aboriginal toolkit for a range of purposes given their lightness and flexibility, larger types of axe were not commonly used other than for cutting timber.

5. Scarred trees with three or more scars are generally Aboriginal in origin.

6. Scars with stone tool marks will be Aboriginal in origin.

7. All scars dating to 170 years or more will be Aboriginal in origin, though some Aboriginal scars are much more recent. This may only be determined through scientific dating.

11.3 Relevant diagnostic criteria for Indigenous scarred tree identificatio

We elaborate below on a number of previously applied criteria.

11.3.1 Tree species

In inland south eastern Australia, box tree species were favoured. Along rivers the river red gum was commonly used for bark canoes (Carver 2001; Long 2002, 2003, 2005).

11.3.2 Date of scarring or wounding event

In south eastern Australia generally, definite Aboriginal scars are at least 140 years in age (from about 1870 and older). At the time of scarring, the tree probably would have been reasonably mature. The age of a suitable tree would have varied according to species, but at least 30 years was not uncommon. Settler scars will be less than about 170 years old (Long 2002:8, 11).

11.3.3 Scar size and shape

The size range of Aboriginal scars reflects the wide range of traditional uses to which bark was put. Originally, some decades ago, archaeologists hoped that by faithfully recording the dimensions, orientation and preservation of the scar it would eventually be possible to identify the function of the bark taken from the tree (Coutts and Witter 1977:53). We believe that, since the 1970s, at best, very little progress has been made. Other than for canoe trees the VAS, and its successor AAV, has effectively ceased encouraging recorders to consider the purpose of the removed bark from general scar shape. However, Long (2002, 2003, 2005) has proposed, as did Coutts and Witter, that an appraisal of scar attributes can in many instances reveal its original scar shape and size, thereby identifying the reason for bark removal.

The range of scar types identified by Long (2002, 2003, 2005) include rectangular or square sheet or ‘slab’, for shelter construction, and circular, oval or elongated panel, curved in cross-section, for canoes and containers which require curvature. However, Long states that because of the considerable overlap in the size and shape of bark used for different artefacts it is often difficult to ascribe a particular function to a cultural scar. It remains the case that canoe-hull scars are more distinctive than other types because of their considerable length. As Long has pointed out, post-scarring processes will often distort the shape of the original scar, confounding interpretation of scars many decades later.

11.3.3.1 Huts and shelters

Rectangular bark sheets from large mature trees with straight trunks were used by Aboriginal people for roofs and walls of huts and shelters. Commonly, the sheet width was 50-75% of the tree’s circumference. Sometimes the bark was removed as a sleeve around the entire trunk, effectively killing the tree. Rectangular sheets of different sizes were fitted together to make a hut or shelter.

11.3.3.2 Canoe hull scars

Canoe hull scars are the largest of all the different categories of scars. Trees from which bark was selected for canoes were mature with a larger circumference, as these provided larger, flatter sheets. As with huts and shelter bark sheets, the main trunk characteristics required were a straight stem with no surface defects. ‘Canoe trees’ occur along rivers and around other major water bodies in those areas where canoes were used. Cultural scars more than three metres in length are most likely to be canoe hulls (Long 2002:8). The largest ‘canoe tree’ scars are up to six metres long and two metres wide.

11.3.3.3 Containers

Smaller sheets cut from a curved trunk, thick limb or burl were made into coolamon dishes and into bowls. The bark for these are termed ‘curved preforms’ (Long 2002:8).

11.3.3.4 Weapons

In some parts of southeastern Australia small sheets were also cut for bark shields.

11.3.3.5 Incidental uses of bark

At least in northern Victoria and the Hunter Valley in NSW small flat sheets were used as stretchers for drying and dressing animal skins (mostly possum). Bark sheets were also used to line grave pits, and for carved bark corroboree sculptures. Bark was stripped from the trunks of mostly fibrous barked trees for making fishing lines, nets, string, climbing rope, etc.

Grub procurement scars with a ‘mutilated appearance’, resulting from the extraction of insect larvae underneath the bark also are known but their identification is problematical (Long 1999).

Finally, bark was also stripped from trees for their tannin, which was used for curing animal skin used as waterbags.

11.3.3.6 Toeholds

Toeholds were cut into the trunk or branches for climbing in pursuit of possums and other small arboreal game or for collecting eggs, nuts, fruit and honey. Toeholds are more commonly preserved on dead trees (Mulvaney and Kamminga 1999) as the small scars would be quickly covered by regrowth.

11.3.3.7 Resource extraction holes and other wounds

Resource extraction holes (also called ‘possum holes’) were cut into a hollow trunk or limb to locate, smoke out or directly extract small game such as possums, or to collect birds eggs or honey from stingless *Trigona* bees’ nests. This type of wound is often associated with cultural scars and sometimes occurs within bark-removal scars. Long (2002) reports that all such holes he examined in a study area in central Victoria had been cut with a steel axe and occasionally by chainsaw. Long concluded that extraction of these food resources continued throughout historical times in rural Australia, particularly during the Great Depression and for some years afterwards. They were made by both Aboriginal and non-Aboriginal people. A site containing a cluster of more than 30 trees with resource extraction holes has been recorded in the Wimmera Mallee region in western Victoria (Pardoe *et al*. 2008). The holes cut in the trees had been covered by some regrowth, but the steel axe cut marks were still clearly visible. It is inferred that these extraction holes dated from the Depression years in the 1930s, when the unemployed sought an income from selling possum skins.

Aboriginal cut marks into solid wood are normally from removal of limbs or roots or splitting wood from a trunk or limb to make into artefacts such as hunting and fighting weapons. Such scars on trees have not often been identified by archaeologists in Victoria (or in Australia generally). Lance (1992) investigating a sand extraction quarry site near Cooper Creek in south western Queensland encountered a small number of trees scarred by the removal of curved pieces of timber from trunk and exposed roots. During a subsequent site inspection a knowledgeable Traditional Owner identified these scars as indicating wood procurement for boomerangs. The timber had been cut with a steel axe, indicating that the activity had occurred in the district after European steel tools had become available at the end of the 19th century

11.3.3.8 Tool cut marks

Many scars are the result of the activity of non-Aboriginal people (Europeans, Chinese, Afghan etc) such as pastoralists and farmers, prospectors and miners, surveyors and even non-Indigenous town dwellers. Bark sheets were used in constructing roofs and doors on houses, shepherds' and shearers' huts, and all kinds of sheds (e.g. for the Wimmera-Mallee region of Victoria see Priestley 1967; Robertson 1992:34-37; Stainthorpe 1925:8, Pardoe *et al*. 2008). We have also encountered instances where it can be inferred that bark sheets were used to construct a platform for vehicles such as carts and wagons to cross a sandy creek bed (Kamminga and Grist 2000), and also in constructing a rural railway line in the 1920s (Officer and Navin 1998).

Cutting the outline of a bark sheet (slab or panel) with a stone or steel hatchet or axe normally leaves marks in the wood surface. Such cut marks usually are evident within a few centimetres from the top and bottom edges of the scar, and define the length of the bark sheet removed. The reason these marks are so visible on an aged scar is that the cambium layer was damaged by the removal of bark, and dieback of bark around the scar's margin subsequently occurred.

Cut marks on the heartwood beneath scars can sometimes total more than half the scars on recorded probable or definite Aboriginal scarred trees (e.g., Edmonds 1998:48; Kamminga and Grist 2000:2, 97; Story 1993:14-15). The presence of cut marks made by a stone hatchet is convincing evidence that a tree is an Aboriginal scarred tree. While it has long been recognised that both stone and steel cut marks occur, there has been some confusion in distinguishing the two. The identification of stone marks is particularly problematic since it depends substantially on a subjective inference that a relatively 'blunt' cutting edge caused the preserved cut marks which are often in aged and weathered wood. We believe that the such identifications are prone to error.

An early interpretation by Sams (1988) of narrow marks as stone hatchet marks is unreliable because a stone edge used for chopping wood is necessarily broad, with acceptable edge angles ranging from 65° to 95° and most effective angles between 85° and 95° (Kamminga 1982:63). The narrow marks noted by Sams are therefore likely to be indicative of a metal cutting edge such as on a steel axe.

Long (2002) suggested that stone hatchets cut marks are very shallow (less than 5 mm) and that steel axe marks "may be deeper'". Long proposes that steel tools result in a straight, narrow incision marks. He also noted that it is very difficult to identify stone tool marks with certainty, as they are easily confused with steel marks that have enlarged by wood decay. He inferred that the use of a stone hatchet tended to leave broad, asymmetrical 'bludgeon' marks, having the appearance of crushing or gouging of underlying sapwood against the wood grain. He further noted that all tool marks which penetrate the sapwood increase the rate of subsequent dryface decay.

We propose that stone hatchet marks and blunted steel hatchet or axe marks often cannot be distinguished, especially if the cut marks are weathered. Probably the only certainty is that relatively deep, sharply defined cut marks are from a steel implement (see Kamminga and Grist 2000:63). Notably, there is no available baseline replicative stone-tool-use experimental data to adequately corroborate identifications of stone hatchet cut marks (Kamminga 1978). In our view, less distinct cut marks do not necessarily indicate use of a stone hatchet.

In most cases, there is little problem in identifying cut marks from a steel hatchet or axe (Carver 2001:87; Long 2003:11, 2005:11); simply the wood fibre is more evenly and sharply cut. With steel axe marks the length of the car mark ranges from 10 to 15 cm. We note that archaeologists have been able to distinguish a wider range of metal tool marks on culturally scarred trees in Canada; for instance, at least five different types of iron or steel tools have been identified from their characteristic cut marks (Resources Inventory Committee 2001:8, 16).

Whilst in pre-contact times all Aboriginal hatchet heads were made of stone, steel hatchets (and less commonly steel axes) were so remarkably superior to stone that they were eagerly acquired from British settlers. Aborigines carrying steel hatchets were seen by explorers even well beyond the colonial frontier. Therefore, a scar showing evidence of steel hatchet use may be an Indigenous cultural scar.

Non-Aboriginal cultural scars are often rectangular, approximately one to three metres long, and have a line of steel axe cut marks in the wood along where the sheet has been cut (Long 2002:10). According to Long (2002:8) a ‘zig-zag’ arrangement of cut marks, especially at the top of the scar, is always non-Aboriginal, whether from a steel axe or hatchet. The cut marks are often obscured by regrowth of bark tissue over the margin of the original scar. For purposes of cultural resource management, trees with steel axe or steel hatchet cut marks or saw marks (which could have been made by non-Aboriginal people) may require other intrinsic and extrinsic supporting evidence to identify as definite or probably Aboriginal. This range of further attributes to be considered includes historical references, age of the tree, and the kind, context, and date of modification to the tree.

12. Post-contact cultural scarring

In addition to natural scarring and Indigenous bark and timber use activities, many examples of tree scarring and timber use can be dated to the post-contact period.

These continue to this day. The causes of early colonial era scarring can be attributed to a range of agencies dating from the earliest period of European settlement (and is often difficult to distinguish from Aboriginal scarring and timber use). These include:

- Survey and blaze marks (e.g. Kamminga and Grist 2000, Kamminga *et al*. 2008; see further details below).
- Bark sheet procurement for use in building structures and other artefacts.
- Abrasion by introduced stock animals, primarily cattle.
- Fencing (such as trees used as strainer and other fence posts).
- Damage associated with vegetation clearing activities.
- Impacts from vehicles and machinery such as farm vehicles (Burns 2014a; Long 2005).

Native forest areas were subject to land clearances commencing in early colonial times and continuing during subsequent, more intensive agricultural land use. Activities such as surveying, road and track construction, and provision of other rural infrastructure, have impacted trees during this period through to the present day. In describing the range of impacts in the Gunnedah-Boggabri region, Burns (2013, 2014a, 2014b, 2014c) has emphasised that:

> ... these activities, combined with natural processes such as wind, fire and termite damage, have resulted in considerable scarring of tree trunks.

As with natural scarring and wounding, the specific causes of cultural impacts are often difficult to determine because of subsequent impacts from agencies such as fire, fungus and termites (Burns 2014a:1).

13. Polythetic classification of scarred tree

Polythetic classification is the framework used in classifying scarred trees and in discriminating and classifying those that are culturally modified trees. This type of classification is commonly recognised as a practical way of dealing with a wide range of Aboriginal archaeological artefacts and features and discriminating those from natural features (e.g. see Hayden 1980:3, Kamminga 1985:10, Kamminga and Grist 2000, Kamminga *et al.* 2008).

A polythetic category or type, such as an Aboriginal stone tool or scared tree, is defined by a constellation of attributes for which no single attribute is essential or sufficient for membership (Clarke 1968:36; Read 2007; Sneath and Sokal 1973; Sokal and Sneath 1963:13). Thus polythetic categories are not rigidly bounded but need only be identified or classified by more than one of the diagnostic attributes in the set, and none of the attributes has to occur for each member of the category. This method of defining classes is consistent with Wittgenstein's concept of 'family resemblances' and contrasts to monothetic or ‘Aristotelian’ classification in which a specific set of characteristics are both necessary and sufficient in order to identify members of that class (van Rijsbergen 1979).

The attributes within the polythetic set for Aboriginal scarred tree are both intrinsic and extrinsic (external or contextual). Needless to say, an essential defining attribute of an Aboriginal scarred tree is the existence of a scar or more invasive wound to trunk or limb. However, the presence of a wound alone is not sufficient for an identification of probable or definite scar/scarred tree. Other attributes are required, such as scar of particular size or shape, cut marks on the dryface, a particular tree species, extensive weathering of the dry face or even location of the scar on the tree.

14. Australian Aboriginal scarred tree identification in the wider contex

Culturally modified trees (CMTs) in North America include a diverse range of categories, such as: logged tree, felled tree, planked tree, tested tree, undercut scar tree, kindling collection tree, sap and pitch collection trees and arborgraph tree (drawing or painting on tree): none of which are recorded in an Indigenous Australian context. The Australian Aboriginal ‘carved tree’ has its equivalent in North America in an equally rare CMT category called arborglyph tree.

In Canada the attribute categories used to distinguish natural from cultural scars are similar to those used in Australia. These include: scar shapes, presence and character of tool cut marks, location of scar on the trunk, number of and types of scars on a tree, character of the tree trunk or limb, maturity of the tree (mature young trees being preferred), age of the tree and the scar, correlation between the tree species and scar attributes, along with extrinsic attributes such as proximity to known forest trails and village sites.

The range of specific diagnostic or identifying attributes in the North American context is, however, more sophisticated and the classification of scars more discriminatory than generally possible in the Australian context. For instance, in Canada scarring and scar shape and type is often specific to particular tree species. In all, 21 tree species were exploited, of utmost importance Western red cedar (*Thuja plicata*), but also yellow cedar (*Chamaecyparis nootkatensis*), spruces (*Picea glauca*), hemlock (*Tsuga heterophylla*), pines (*Pinus contorta*, *Pinus ponderosa*) (Gottesfeld 1992; Resources Inventory Committee 2001; Swetnam 1984). As an example of this refinement in identification by species and scar type association, long narrow tapered bark-strip scars (called triangular or tapered scars) occur only on two tree species, Western red cedar and yellow cedar, and indicate bark procurement to make items such as clothing, mats, blankets, baskets, ropes, nappies and towels.

Other important differences between Canadian and Australian culturally modified tree classification is the relatively large variety of identifiable cut marks represented on Canadian scarred trees, which often signature a specific type of stone or steel tool. Canadian scarred trees often have multiple scars of the same type. Just one example of the relative sophistication of identification and classification in Canada is the rectangular bark-strip scar on lodgepole pine (*Pinus contorta*) for which there are twelve defining attributes (Resources Inventory Committee 2001:69, 85).

15. Dating scarred trees

One problem encountered when trying to assess the origin of a tree scar, comes from estimating the age of the tree, and establishing whether it would have been alive at a time Aboriginal people were frequenting the district. A further question is whether the tree would have been sufficiently large to have provided bark suitable for traditional Aboriginal people.

Direct dating of trees is problematic in an Australian setting and previous attempts to employ dendrochronology (tree ring dating) have been largely unsuccessful (e.g. Cheal *et al*. 2012:8). In those countries where tree ring dating has been successful, annual tree rings can be counted. These rings are visible because seasonal variations in the density of wood grown onto the outer edge of the tree provide a visible banding of annual growth rings. The reason that dendrochronology has not proven to be useful is that in Australia eucalypts tend to grow opportunistically and therefore may have poorly defined ring boundaries, a high frequency of intra-annual (latewood) bands, known as false rings, and an almost total absence of preserved dead wood (Williams and Brooker 1997:5).

15.1 Chronometric dating

It has been suggested that radiocarbon (^{14}C) dating of trees with scars can establish with certainty the age of the tree and the scar. While Beesley (1989) proposed that radiocarbon dating the surface wood of scars may prove valuable, Long argued that a scarred tree should be at least 150 years old to obtain a reasonably accurate date. Very few scarred trees have been dated chronometrically in Australia. One instance is the Mildara Winery Tree, a river red gum on the Murray River near Mildura (AAV 7329-12). The uncalibrated age determination of this scar was 280±70 years BP (Godfrey *et al*. 1996:41).

Another example of the application of this methodology comes from Central Queensland, where a tree removed from a development area was dated by one of the current investigators (Lance). The tree bore a scar that met the criteria of Indigenous cultural use (shape, size and position of scar on the trunk), and the tree was very large

(2.5 metres diameter and 20 metres high). It was hoped to date the centre of the tree using radiocarbon dating of the inner timber. Unfortunately, the centre of the tree had decayed and been attacked by termites. It was necessary to date the innermost piece of timber remaining, and to then extrapolate to give an approximate tree age. This gave an estimate of approximately 410 years old and one of the larger branches was dated, giving an age of approximately 240 years old. The scar itself was exposed at the surface, had abundant regrowth concealing the edges of the scar, although it was not possible to establish the age of the scar directly. It is likely this was formed by Aboriginal people at or shortly after the time Europeans arrived in the district.

Dr Michael Barbetti, former Director or the NWG Macintosh Centre for Quaternary Dating at the University of Sydney, advised that it may be difficult to obtain meaningful radiocarbon dates for wood samples taken from scarred trees younger than 350 years (Michael Barbetti, personal communication). The reason is that atmospheric ^{14}C levels have (generally) decreased since the eighteenth century, so that most samples from recent centuries appear to have similar ^{14}C ages. However, if the tree was still growing in the late 1950s, then the distinctive high ^{14}C contents (due to atmospheric nuclear tests) should show up in the *outermost* wood tissue. While it is possible that a reliable age for an important scar may be inferred from a series of ^{14}C determinations obtained from the heartwood to the outermost rings, in normal circumstances this would not occur.

One of the reasons for uncertainty in radiocarbon dating of scarred trees is the ambiguity inherent in ^{14}C dates that fall within the last three hundred years. A single determination from a two-metre diameter stump of 'king jarrah' (*E. marginata*) has provided a ^{14}C age of 230±50 years BP for the pith. After calibration, this date provides three possible calendar-year age bands:

1. AD 1500-1675
2. AD 1750-1805
3. AD 1930-1950

While the first band can be safely ruled out, the latter two provide a large degree of uncertainty in the absence of other evidence indicating a more precise age (Michael Barbetti personal communication).

15.2 Age of tree stands

An indirect method of establishing an approximate maximum date for a scarred tree is to date similar unmodified trees in the same stand as the scarred tree. Though individual trees within a stand will vary in age, if the overall age of the stand can be established, then the cultural modification is younger in age than the stand. Care should be taken to ensure that the scarred tree is not a veteran (Resources Inventory Committee 2001:84, 122).

15.3 Age of comparative reference trees

In order to calculate the increase in a trees diameter its growth needs to be compared with a tree possessing a scar of known age (Burns 2004a; Ngugi *et al*. 2015).

In a series of studies investigating potential cultural scarring of trees in the district, Burns (2013, 2014a, 2014b, 2014c) was able to estimate rates of tree growth based on the increase in trunk diameter following known age damage to the trunk. A number of survey scars of known age were used as reference trees in each of his studies. He measured the diameter of the trunk at the scar and outside the scar and was therefore able to calculate the amount of trunk growth since the bark was removed and the scar formed.

As these reference trees occur in the region where the present study was conducted, and as all reference trees, irrespective of setting or tree species, revealed similar rates of growth, we can be confident that Burns' estimates of tree age (and age of scars) are broadly applicable to the trees we investigated in the project area.

15.4 Age estimates from tree diameter

The relationship between tree age and tree diameter has been examined for a large number of tree species including box, karri, jarrah, marri, salmon gum and wandoo. Growth rates fluctuate widely over the life of a tree and can vary greatly between and within sites. Consequently, when tree age is estimated from tree diameter, the size of the error associated with this estimate increases with the size of the tree (Whitford 2006).

According to Burns (2014a:1-2) while the ratio of growth rate to tree age may vary due to a range of genetic, edaphic and climatic factors, the matching of tree diameter with age is consistent with many of his earlier field observations. Importantly, Burns' age assessments were also supported by locally occurring reference trees that exhibited scars of known ages. Burns therefore proposed that his conservative estimates of tree and scar ages are reasonable average approximations. This research has provided significant benchmark data and methodology for our own age assessment described in this report.

15.5 Estimating maximum lifespan of a tree

As described in the reports by Burns, tree lifespan is determined by the innate genetic potential of the species, the environment in which it grows as well as the propensity of the tree to suffer from damage caused by natural and cultural agencies. As such, many natural and other non-Aboriginal factors can interact to reduce the lifespan of a tree and to cause scars.

There is no doubt that some Australian eucalypt species such as river red gum (*Eucalyptus camaldulensis*) can live up to 500 years and longer (Williams and Brooker 1997:Table 1.1). There is even an uncorroborated claim based on tree diameter of *Eucalyptus marginata* for more than 1,000 years (Mawson and Long 1994). Hickey *et al*. (1999) suggested that, based on ring counts from adjacent celery-top pine (*Phyllocladus aspleniifolius*), old-growth *Eucalyptus delegatensis* in southern Tasmania may be at least 460 years old. It is unlikely that the ages of the very large trees in the southwest forests of WA are much greater than about 450 years. Species in the colder southeastern highlands of Australia such as *Eucalyptus regnans* can live for 200-400 years (Jacobs 1955). In general, eucalypt trees rarely exceed 400 years in age (Helms 1945; Rayner 1992).

According to Burns, the maximum lifespan of most dominant forest species in the region (including species we have inspected in the lease area) such as white box (*Eucalyptus albens*), Blakely’s red gum (*Eucalyptus blakelyi*), narrow leaf ironbark (*Eucalyptus crebra*), poplar box (*Eucalyptus populnea*) and other box, ironbark, red gum and cypress species in the Boggabri-Gunnedah district, are much shorter, often not exceeding 170 years, with average maximum lifespans commonly in the range 100-140 years. Burns reports that in open woodland and in single tree environments created by European clearing, lifespans are often even shorter due to a higher propensity for lightning strike, fire damage, wind damage, mechanical damage associated with clearing and agriculture, and many other factors. These primary causes of wounding can quickly lead to secondary effects, which result in further impacts to tree health. Secondary effects include die-back and enhanced fungal and insect attack. In terms of dieback, once a tree becomes subject to regular crown dieback due to leaf-eating insects, it then becomes more prone to borers and termites resulting in more rapid senescence (declining health) of the tree leading to its ultimate death. The decline of trees is further enhanced by drought and the application of broad acre fertilizer (Burns 2014a:3).

15.6 Age of fallen trees

Burns (2014a:7) observes that whilst it is easier to estimate the age of living trees using growth rates established through comparison with regional reference trees, estimating the age of dead and fallen trees is more difficult, with the period elapsed since the death of the tree needing to be considered. After death, a mature scarred tree may stand for 100 years or more before falling to the ground (Beesley 1989:12), where it may remain for many years before succumbing to fire, termite attack or decay.

Clues to the time since the death of a dead tree can come from the presence or absence of small branches and bark on the trunk. The smaller branches will be the first to fall off and decay upon the death of a tree. Larger branches will persist for longer periods (Burns 2014a:7). The size of the branches and twigs remaining on the trunk will hint at the relative age of the tree. The presence of bark will also give an indication of time since the tree's death. Bark will persist for some time after the tree has died, with much having fallen off within 10 years of the death of a tree.

If there are signs of chainsaw cuts on tree trunks, this can give an absolute earliest date for death of a tree as chainsaw use only became common in New South Wales in the late 1950s and early 1960s (Burns 2014a:7).

16. European impacts on forest and woodland in the Gunnedah region

The date of diminution and cessation of Aboriginal related scarring is one criterion in identifying culturally modified trees. For Victoria, and subsequently for NSW, Long (2002, 2003, 2005) has proposed that Aboriginal bark procurement (and tree scarring) generally ceased after about 1870, despite records of traditional ceremonies persisting until the turn of the century. Recently Burns has argued that the history of British colonial settlement in the Gunnedah-Boggabri region is consistent with Long's conclusion (Burns 2014a:5).

Forest and woodland in the region was extensively disturbed and modified after the arrival of British settlers more than 150 years ago. It can be reasonably inferred that the cumulative effects of agricultural land clearance and natural tree senescence and death have removed most of the mature trees scarred by Aboriginal people in pre-contact and early contact times. As reported by Burns (2014a:5) and previously Long (2003:30; 2005), these trees have been replaced by younger trees.

Many of the younger trees exhibit bark scars and other wounds associated with the agricultural and forestry use of the land after about 1870-1880, when traditional Aboriginal lifestyle had been substantially impacted by colonial appropriation of the land, decline in Aboriginal population numbers and cultural dislocation (Burns 2014a:2; see also Long 2002, 2003:30, 2005). This is not to say that Aboriginal procurement of tree bark and wood ceased completely at that time, since Aboriginal people continued to live on pastoral leases, reserves and in camps around settlements in rural areas, though admittedly their numbers were relatively small and traditional lifestyle had been severely disrupted.

In early colonial times in the Gunnedah area, Aboriginal people would have continued to procure bark for at least some traditional uses. They may also have procured bark sheets for settlers, as occurred in other regions in southeastern Australia. For instance, during a period of labour shortage Aboriginal people living around Warracknabeal in the Wimmera were paid up to a shilling by settlers for a standard sheet of box tree bark used for roofing farm buildings (Story 1993:24).

It has been suggested by Burns (2014a:5) that tree scarring by Aboriginal people in the Gunnedah-Boggabri region would have almost entirely ceased no later than about 1880. British settlement began by the mid 1850s and by the early 1880s were linked by railway to coastal towns. Burns infers that by 1880 much of the traditional Aboriginal material culture made from bark would have been replaced with European equivalents (e.g. corrugated iron sheets, metal buckets, tarpaulins and sawn timber) and dropped from the artefact inventory (e.g. bark shields would no longer have been formed on trees).

In any event, at least by the end of the nineteenth century most of the Aboriginal people living in the region are likely to have worked as station hands , or resided in Aboriginal reserves.

17. Assessment of scarred trees in the project area

Our aim in this study was to investigate each of the trees previously recorded in the list provided, to determine whether on the basis of physical inspection of the trees and recording of intrinsic and extrinsic attributes, we could identify with a reasonable degree of confidence any of the wounds (scars) as the consequence of Aboriginal cultural activity.

We observed evidence of both old and very recent natural scarring of the trunks of trees throughout the lease area. We infer that, to some extent, this high incidence of wounding is due to previous land clearance, either directly through ring barking and tree felling, and indirectly from exposing the remaining trees to storm damage, lightning strike, stock scuffage and abrasion and bird and insect activity.

The findings of the investigation have been detailed in Table 3 and Appendix 1. Table 3 provides a summary of the demonstrable or likely causes of the scars and their estimated maximum ages, Appendix 1 describes and illustrates each of the inspected trees and wounds.

Field Code	Scar Number	Appropriate Tree Species	Epicormic Stem Present (Y/N)	Base of Scar Above Ground (Y/N)	Mature tree of age consistent with known Aboriginal occupation (Y/N)	Symmetrical Shape (Y/N)	Scar Ends Squared Off or Tapered (Y/N)	Stone or Steel Hatchet Cut Marks (Y/N)	Shape Consistent with Traditional Artefact Type (Y/N)	Toeholds Present *Y/)N	Identifiable Indigenous Resource Procurement Hole or Wood Removal (Y/N)
VS2	1	Yes	No	No	No	No	No	No	No	No	No
	2	Yes	No	Yes	No	No	Yes	No	No	No	No
	3	Yes	No	Yes	No	No	Yes	No	No	No	No
VS6		Yes	No	No	No	No	No	No	No	No	No
VS7		Yes	No	Yes	No	Yes	Yes	No	Yes	No	No
VS8		Yes	Yes	Yes	No	Yes	No	No	No	No	No
VS9		Yes	No	Yes	No	Yes	No	No	Yes	No	No
VS10	1	Yes	No	No	Unknown	No	Yes	No	No	No	No
	2	Yes	No	No	Unknown	Yes	Yes	No	Yes	No	No
	3	Yes	No	Yes	Unknown	Yes	Yes	No	Yes	No	No
	4	Yes	No	Yes	Unknown	Yes	Yes	No	No	No	No
	5	Yes	No	Yes	Unknown	Yes	Yes	No	No	No	No
VS11	1	Yes	No	Yes	No	Yes	Yes	No	No	No	No
	2	Yes	No	Yes	No	No	No	No	No	No	No
	3	Yes	No	Yes	No	Yes	Yes	No	No	No	No
VS12		Yes	No	Yes	No	No	No	No	No	No	No
VS13	1	No	No	Yes	No	Yes	Yes	Yes	No	No	No
	2	No	No	No	No	No	No	No	No	No	No
VS16		Yes	No	Yes	No	No	No	No	No	No	No
VS17		Yes	Yes	Yes	No	Yes	Yes	No	No	No	No

Table 2. Listing of polythetic attributes for scars on trees in the project area.

Field Code	Scar Number	Appropriate Tree Species	Epicormic Stem Present (Y/N)	Base of Scar Above Ground (Y/N)	Mature tree of age consistent with known Aboriginal occupation (Y/N)	Symmetrical Shape (Y/N)	Scar Ends Squared Off or Tapered (Y/N)	Stone or Steel Hatchet Cut Marks (Y/N)	Shape Consistent with Traditional Artefact Type (Y/N)	Toeholds Present *Y/)N	Identifiable Indigenous Resource Procurement Hole or Wood Removal (Y/N)
VS18		Yes	No	Yes	No	Yes	Yes	No	No	No	No
VS19a	1	Yes	No	Yes	No	Yes	Yes	No	No	No	No
	2	Yes	No	Yes	No	Yes	Yes	No	No	No	No
VS19b		Yes	No	Yes	No	No	Yes	No	No	No	No
VS20		Yes	Yes	Yes	No	No	No	No	No	No	No
VS21		No	No	Yes	No	No	Yes	No	No	No	No
VS22		Yes	No	Yes	No	No	No	No	No	No	No
VS24		Yes	No	Yes	No	No	No	No	No	No	No
VS25a (VS33)	1	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No
	2	Yes	No	No	No	No	No	No	No	No	No
	3	Yes	No	No	No	No	No	No	No	No	No
VS37		Yes	No	Yes	No	No	No	No	No	No	No
VS38		Yes	No	Yes	No	No	Yes	Chainsaw	No	No	No
VS39		Yes	No	No	No	No	Yes	No	No	No	No
VS40		Yes	No	Yes	No	Yes	No	No	No	No	No
VS41		Yes	No	Yes	No	No	No	No	No	No	No
VS53		Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	No
VS75		Yes	Yes	No	No	No	No	No	No	No	No
ST1	1	Yes	No	Yes	No	No	No	No	No	No	No
	2	Yes	No	Yes	No	No	Yes	No	No	No	No

Table 2. continued. Listing of polythetic attributes for scars on trees in the project area.

18. Conclusions

There are many reasons why trees sustain wounds to their trunk or limbs. The causes of such damage are both natural and cultural, and after initial wounding, the resultant wound can change shape and size over time. It is often not possible with reasonable certainty to identify the initial or principal cause of a wound, even only a few years after the initial wounding event.

Many trees within the project area exhibit one or multiple wounds. A number of these wounds are relatively fresh in appearance, and some of even exhibit active bark displacement and detachment. Consistent with the general pattern in the region as a whole, the wounds (or scars) we have examined result from a range of natural and cultural causes.

Identification of Indigenous culturally scarred trees is problematical for a number of reasons (as discussed in this report). The identification and classification of scarred trees, whether natural or cultural, or Indigenous or non-Indigenous, is based on a polythetic set of attributes. The most diagnostic attributes for identifying Indigenous culturally modified trees are: appropriate age of tree and of wound, and stone hatchet cut marks. Tool cut marks may be fully exposed by bark dieback or obscured by bark regrowth, or else destroyed by deterioration of the wood tissue in the area of the original wound.

There are also contraindicative intrinsic or extrinsic attributes relevant to identification of Indigenous culturally modified trees, including fresh appearance of a wound (scar), inappropriate age of the tree relative to the cessation of Aboriginal cultural activity at that particular location, irregular or otherwise inappropriate original scar-shape, and the location of a wound too high on the trunk or a branch of the tree. Often a single contraindicative attribute is sufficient to eliminate Indigenous cultural activity as a potential cause of a particular wound (such as a bark scar).

In particular, the inferred or estimated age of a tree and the wound is often the most important criterion in assessing the cause of a wounding or scarring event. Around the time of first British settlement the Aboriginal population of the Gunnedah region had diminished, especially along the river where the British settlers were particularly prone to using violence to protect their cattle herds. Privatisation and alienation of the land commenced in the 1830 and one can infer that Aboriginal bark procurement and other cultural modifications began to dramatically decline in the project area even in this earliest phase of British ‘squatter’ settlement. Notably, the project area is located within the area of the former Burburgate run which was taken up in the 1830s. Prior to the 1860s the then pastoral lease, somewhat reduced in size from the original run, was wire-fenced. The process or subdivision of the original run continued into the 1880s and the early twentieth century by which time the largest farm allotment was only about 2,200 acres in area.

The historical records do not indicate any Aboriginal settlement or presence within the larger areas of leasehold land or subsequently fenced within the former Burburgate run, including the current project area land. By the early twentieth century the numbers of Aboriginal people living on government reserves in the region generally were exceedingly small.

This historical evidence suggests that Aboriginal modification of trees within the project area may have virtually ceased as early as the 1830s (about 180 years ago), and increasingly more likely as early as the 1860s (150 years ago) when the land around the project area was fenced.

Summarising our conclusions, none of the wounds (scars) on the trees we inspected within the project area could be identified as Aboriginal cultural modifications, that is, trees with wounds caused by Indigenous people procured bark, wood or food resources, or carving into wood.

Aboriginal access to this privatised agricultural allotment appears to have ceased, or at the very least very substantially diminished, prior to the date estimated for any of the scars. In the independent forester's report age estimates for individual scars tended towards the maximum possible ages, and it is very likely that many of the scars are considerably younger than these estimates (Burns 2016:101). The estimated maximum age of the oldest scar (VS10) is 119 years. All the other scars inspected have maximum estimated ages within the twentieth century, and one was even a maximum of 17 years.

A number of subject trees exhibited evidence of cut marks from axe or chainsaw and are inferred to relate to agricultural activities. One of these trees (V10) probably relates to the construction of a former stockyard, another (VS53) was a fence post still with steel spikes embedded in the weathered cavity.

None of the scars we examined exhibited diagnostic attributes indicating an Aboriginal cultural association. Some of the scars were clearly too high on the tree trunk to be the result of Aboriginal cultural activity. The large majority of the scars were interpreted as wounds resulting from branch or secondary stem tear, which is common on trees (particularly box trees) in the region.

Kamminga & Lance Field Code	Burns Field Code	Common Name	Species Name	Inferred Approx. Age of Scar(s) in Years (Burns 2016)	Probable Cause of Scar	mE_GDA94 one 56	mN_ GDA94Z one 56
VS2	1	Yellow box	*Eucalyptus melliodora*	53-86	Branch tear and insect damage	230694	6589561
VS6	2	Grey box	*Eucalyptus microcarpa*	53	secondary stem or branch tear	231214	6589411
VS7	3	Grey box	*Eucalyptus microcarpa*	80	secondary stem tear at the base of the trunk followed by decay	231065	6589394
VS8	4	White box	*Eucalyptus albens*	100	branch fall/fire/insect attack	231114	6589483
VS9	5	Inland grey box	*Eucalyptus macrocarpa*	87	branch tear	231077	6589488
VS10	6	White box	*Eucalyptus albens*	66-119 (5 scars)	1-4 scars, branch or secondary stem tear; scar 5 caused by European tool and may relate to a mortised hole for a wood-en railing in a former stockyard	229168	6591109
VS11	7	White box	*Eucalyptus albens*	63-83	low branch or secondary stem tear	229113	6591126
VS12	8	White box	*Eucalyptus albens*	77	branch fall and secondary stem tear	229097	6591151
VS13	9	Cypress pine	*Callitris sp.*	48	Indeterminate, steel axe marks on dead wood	230844	6590808
VS16	10	Grey box	*Eucalyptus microcarpa*	50	secondary stem tear near base of trunk	231767	6590518
VS17	11	Grey box	*Eucalyptus microcarpa*	47	secondary stem tear near base of trunk	231828	6590581
VS18	12	Grey box	*Eucalyptus microcarpa*	67	decay caused by a branch/sec-ondary stem dying. branch fall/ damage	231865	6590633
VS19a	13	Poplar box	*Eucalyptus populnea*	80	secondary stem tear, probably caused by farming activity	229138	6589594

Table 3. Summary of assessment tree details (Data from Kamminga and Lance 2016, Burns 2016)

Kamminga & Lance Field Code	Burns Field Code	Common Name	Species Name	Inferred Approx. Age of Scar(s) in Years (Burns 2016)	Probable Cause of Scar	mE_GDA94 one 56	mN_ GDA94Z one 56
VS19b	14	Grey box	*Eucalyptus microcarpa*	53	secondary stem tear or branch fall possible associated with tree clearing or other pastoral activities	229146	6589629
VS20	15	Grey box	*Eucalyptus microcarpa*	27	secondary stem tear due to epicormic branch fall	230778	6590607
VS21	16	Narrow-leaf ironbark	*Eucalyptus crebra*	57	branch or secondary stem tear near base of the trunk	230894	6590618
VS22	17	Grey box	*Eucalyptus microcarpa*	67	low branch or stem tear, with subsequent insect damage; metal axe marks within the scar; apparently long history of wounding from both natural and European causes	230880	6590511
VS24	18	Poplar box	*Eucalyptus populnea*	20	too high on the trunk to an Aboriginal cultural scar (accessible only with a ladder)	229191	6590768
VS25a	19	Grey box	*Eucalyptus microcarpa*	10-57 (3 scars)	Repeated low branch or secondary stem tear over a period of decades, also evidence of damage from wire fencing on the tree (Burns (2016:79) agrees with Kamminga and Lance in this report that VS 25a is the same tree as VS 33)	228953	6588990
VS33	20	Grey box	*Eucalyptus microcarpa)*	10-57 (3 scars)	Repeated low branch or secondary stem tear, also evidence of damage from wire fencing on the tree (Burns (2016:79) agrees with Kamminga and Lance in this report that VS 33 is the same tree as VS 25a)	228953	6588990

Table 3 continued. Summary of assessment tree details (Data from Kamminga and Lance 2016, Burns 2016)

Kamminga & Lance Field Code	Burns Field Code	Common Name	Species Name	Inferred Approx. Age of Scar(s) in Years (Burns 2016)	Probable Cause of Scar	mE_GDA94 one 56	mN_ GDA94Z one 56
VS37	21	Poplar box	*Eucalyptus populnea*	100 (maximum, probably much younger)	low branch tear	229150	6589075
VS38	22	Poplar box	*Eucalyptus populnea*	30	low branch or secondary stem tear; chainsaw cut to timber at side, top and base of preexist-ing scare	229171	6589130
VS39	23	Poplar box	*Eucalyptus populnea*	50 (maximum, probably much younger)	Low branch or secondary stem tear early in life of tree	229125	6589121
VS40	24	Poplar box	*Eucalyptus populnea*	67	early secondary stem tear with subsequent decay of wood	229136	6589136
VS41	25	Poplar box	*Eucalyptus populnea*	17	branch tear; tree is relatively young with scar high up on trunk	229127	6589205
VS53	26	River red gum	*Eucalyptus camaldulensis*	50	European scar; tree is a corner post in fence with fence wire and metal spikes driven into trunk	228966	6591159
VS75	27	Inland grey box	*Eucalyptus macrocarpa*	87	secondary stem tear; most like-ly a combination of more than one wounding events event and decay processes such as termites and fungal attack	231828	6589288

Table 3 continued. Summary of assessment tree details (Data from Kamminga and Lance 2016, Burns 2016)

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20. Glossary of technical terms

(Compiled and modified from Resources Inventory Committee 2001:23, 131-138 and Long 2003, 2005).

Alcove
A term used by some as a synonym for test hole through bark and wood.

Archaeology
The understanding of the human past, including the recent past, through the examination of material remains.

Archaeological site
An area containing physical evidence of past human use or occupation.

Blazed tree
A tree with bark removal and chop marks modified to identify a trail or boundary.

Callus lobe
Same as bark overgrowth or lobe.

Cambium
The thin layer of living cells found between the bark and sapwood that generates new inner bark and wood cells.

Canoe tree
A tree from which bark has been removed to make a bark canoe.

Carved tree
A tree carved by Aboriginal people as part of a traditional activity (also called Arborglyph).

CMT
Culturally modified tree.

Culture
That complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities acquired by humans as a member of society.

Culturally modified tre
A tree that has been intentionally altered by Aboriginal people as part of their traditional use of the forest.

Cultural scar (or wound)
A bark or wood scar that is the result of human action.

Cut marks (also called as tool marks)
The cuts and other marks left on a tree as a result of stone, iron or steel tool use.

Cutting date
The year during which the most recent annual ring (the outside ring) of a tree was formed.

Dendrochronology
The dating of living and dead wood by the study of tree rings. Very useful in areas with distinct seasons, where pairs of rings denoting winter and summer growth periods can be discerned and counted to give an accurate age for a tree. In Australia, however, this distinct seasonality does not exist and dendrochronology is of little use.

Dieback
The progressive lateral death of cambium and bark, resulting in a bark scar or extension to a pre-existing bark scar. Typically, this will occur where a large bark removal scar has interrupted the free flow of water and nutrients, which are forced to divert widely around the damaged area, thus killing off a larger part of the tree than originally affected.

Direct ring count
A dendrochronological method in which the number of annual rings are added or subtracted from a known ring-year.

Disc
A “cookie-like” transverse cross-section through a tree stem used for dendrochronology.

Dryface
The dead, exposed timber that forms the scar surface. As the scar ages the dry face becomes increasingly cracked and weathered. Tool marks where the bark was cut and prised away are often preserved towards the top, bottom and occasionally across the centre of the scar. Tool marks will only be preserved on the sapwood (xylem).

Epicormic stem
A subsidiary limb which can often develop at the base of a scar. This is also part of the tree’s natural response to damage, by providing a way for the root system to re-connect with the leaf system, thus ensuring a two-way flow of starches from photosynthesis, water and plant nutrients from the soil. Without epicormic development, the root system below a large scar may die, seriously weakening the tree.

Ethnography
The study of the culture of a particular social group through participatory observation and interviews with the members of that group.

Ethnohistory
The study of past and contemporary indigenous cultures and customs by examining historical records as well as other sources of information about their lives and history.

Face-boring
A procedure for collecting tree core samples, where two cores are extracted, one through the area of modification, and the second through the unmodified side of the tree.

Felled tree
Usually large diameter, these trees were completely felled using traditional felling techniques, and not felled by the wind.

Hatchet
A short-handled implement held on one hand during use (an axe is held with two hands). The Aboriginal hatchet comprised a short handle made of splt sapling or branch wood folded over a stone head bound into place with resin, wax and string. Nearly all Aboriginal hatchet heads have cutting edges shaped by grinding; other surfaces of the head may also be smoothed by grinding, either partially or completely. Some hatchet heads are shaped and smoothed only along their cutting edge. This tool was used in a wide range of subsistence activities, including cutting bark from trees. It was not normally used to fell trees.

Healing lobe
See bark overgrowth (scar lobe).

Heartwood
As a tree grows, the annual rings produced are sapwood which turns into heartwood as the tree matures.

Increment core
Usually 5 mm-diameter cylindrical tree-ring samples extracted from living trees with a special borer.

Internal scar
A scar concealed within the bark of a tree. As bark overgrowth invades the surface of the exposes wood it can eventually cover the entire scar, thereby closing the scar window, creating an internal scar. These scars appear as narrow vertical creases. Also called hidden scar.

Overgrowth
The bark tissue or 'accelerated growth callus' that forms along the margins of a dry face of the wood. This is a natural response from the tree to cover the damaged area rapidly and protect the wound from decay and infestation. Overgrowth generally develops at a much faster rate than the tree's normal growth, and is often distinctive from the surrounding bark. Eventually the wound may be completely absorbed into the trunk and hidden from view by overgrowth.

Ring-year
The year during which a particular annual ring was laid down.

Ring-year of injury
The year during which the annual ring associated with the modification of the tree was laid down.

Sapwood
As a tree grows, the annual rings produced are sapwood. This turns into heartwood as the tree matures. Sapwood has some living cells and persists between the heartwood and cambium.

Scar
An area on a tree trunk or major limb from which bark has been removed and has exposed the underlying wood. The scar can be the result of either cultural (human) or natural bark removal.

Scar-boring
A procedure for collecting tree core samples in which a number of cores (probably 4 or more) need to be taken per cultural modification. All cores are taken through the healing overgrowth (lobe), some from in front of the modification and the others from behind the modification.

Scar crust
A hard black or dark brown layer formed on the inner side of a healthy scar tissue (lobe) where it grows against the smooth surface of an uneroded scar face.

Scar face
See Dryface.

Scar face/scar lobe interface
Area of contact between post-injury annual growth rings (scar lobe) and the original scar face, whether present or decayed.

Scar window
The opening created by the bark overgrowth along the margins of a scar. As bark tissue invades the sides of the scar it joins together above a scar, as well as below the scar if the scar does not extend to the ground, thereby obscuring the original edges of the scar and forming a lenticular (lens-like) or triangular opening (the scar window) over the scar.

Skeleton plot
The recommended minimum tree-ring analysis.

Survey marker tree
A tree with an area of bark removed by a surveyor, showing symbols or numbers cut with a steel tool into the wood within the scar panel.

Tool marks
See cut marks.

Tree-ring dating
Synonym for dendrochronology.

Veteran
Older trees in a younger stand; often survivors of a fire, disease or other event that killed most trees.

Wedge
A tapering tool made of bone, antler, wood or stone used to split wood.

Wedge sample

A partial disc removed from one side of a tree for dendrochronological study (and radiocarbon dating).

Appendix 1

Description of each subject tree

Tree Number	VS2
Location (GDA94 - Zone 56)	230694 6589561
Species	Yellow box (*Eucalyptus melliodora*)
Condition of tree	Mature tree with some crown damage
Estimated height (m)	12
Tree girth at 1.5 m (m)	4.25
Diameter of tree (cm)	135
Scar dimensions (m)	Scar 1 – 2.103x0.18 Scar 2 – 1.66x0.25 Scar 3 – 0.36x0.09
Scar height above ground level (m)	Scar 1 - 0 Scar 2 – 0.36 Scar 3 – 1.09
Overgrowth (cm)	Scar 1 - 16 (top), 35 (mid left), 27 (mid right), 0 (bottom) Scar 2 - 2 (top), 7 (mid left), 6 (mid right), 16 (bottom) Scar 3 - 17 (top), 12 (mid left), 14 (mid right), 13 (bottom)
Average overgrowth (cm)	Scar 1 - 26.0 Scar 2 – 16.0 Scar 3 – 13.0
Scar orientation (°)	Scar 1 - 240 Scar 2 – 180 Scar 3 – 40
Scar symmetry	Scar 1 - N Scar 2 – Y Scar 3 – Y
Scar shape	Scar 1 - Deltoid (triangular) Scar 2 – Deltoid (triangular) Scar 3 – Linear
Epicormic growth	N
Heartwood weathering	Scar 1 – moderate Scar 2 – little Scar 3 - none
Suspected origin	Scar 1 – Secondary stem tear (Burns 2016:38) Scar 2 – Secondary stem tear (Burns 2016:38) Scar 3 – branch tear
Notes	Termite damage to heartwood
Estimated tree age (years)	193
Estimated scar age (years)	Scar 1 – 83 (Burns 2016) Scar 2 – 86 (Burns 2016) Scar 3 - 53 (Burns 2016)

Plate 1. Tree VS2 showing Scar 1. Scale in 20 cm units.

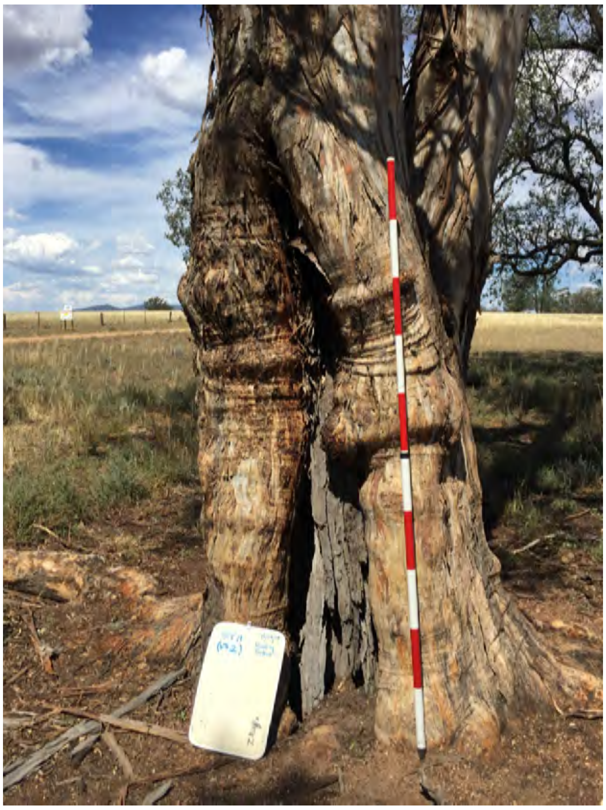

Plate 2. Tree VS2 Scar 1

Plate 3. Tree VS2 Scar 2

Plate 4. Tree VS2 Scar 3

Tree Number	VS6
Location (GDA94 - Zone 56)	231214 6589411
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Mature with broken upper trunk (wind damage)
Estimated height (m)	9.5
Tree girth at 1.5 m (m)	2.5
Diameter of tree (cm)	80
Scar dimensions (m)	2.3x0.33
Scar height above ground level (m)	0
Overgrowth (cm)	10 (top), 15 (mid left), 11 (mid right), 0 (bottom)
Average overgrowth (cm)	12.0
Scar orientation (°)	10
Scar symmetry	N
Scar shape	Acuminate (triangular and tapering to a point)
Epicormic growth	N
Heartwood weathering	Moderate
Suspected origin	Secondary stem or branch tear
Notes	Termite damage to wood in trunk, but little to scar surface
Estimated tree age (years)	114
Estimated scar age (years)	53 (Burns 2016)

Plate 5. Tree VS6 showing scar.

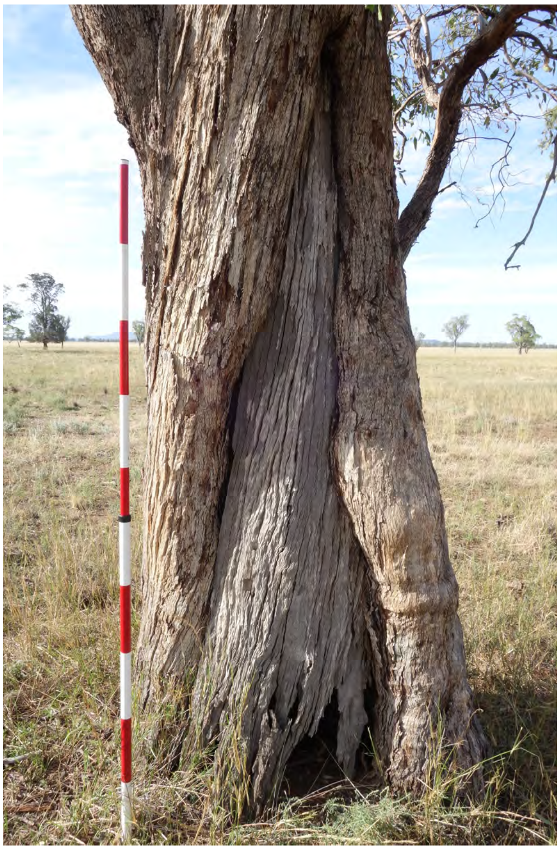

Plate 6. Scar on Tree VS6.

Tree Number	VS7
Location (GDA94 - Zone 56)	231065 6589394
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Living tree of moderate age with trunk damage but crown intact
Estimated height (m)	12.5
Tree girth at 1.5 m (m)	2.99
Diameter of tree (cm)	95
Scar dimensions (m)	1.53x0.4
Scar height above ground level (m)	0
Overgrowth (cm)	15 (top), 14 (mid left), 23 (mid right), 0 (bottom)
Average overgrowth (cm)	17.33
Scar orientation (°)	95
Scar symmetry	Y
Scar shape	Elliptic
Epicormic growth	Y
Heartwood weathering	Moderate to severe
Suspected origin	Secondary stem tear at the base of the trunk followed by decay
Notes	Termite damage to core of tree and weathered scar surface
Estimated tree age (years)	136
Estimated scar age (years)	80 (Burns 2016)

Plate 7. Tree VS7.

Plate 8. Scar on tree VS7 showing eroded heart-wood.

Tree Number	VS8
Location (GDA94 - Zone 56)	231114 6589483
Species	White box (*Eucalyptus albens*)
Condition of tree	Mature tree with wind damage to crown
Estimated height (m)	15
Tree girth at 1.5 m (m)	3.8
Diameter of tree (cm)	121
Scar dimensions (m)	1.5x0.26
Scar height above ground level (m)	0.3
Overgrowth (cm)	20 (top), 30 (mid left), 25 (mid right), 0 (bottom)
Average overgrowth (cm)	25.0
Scar orientation (°)	50
Scar symmetry	Y
Scar shape	Ovate
Epicormic growth	Y
Heartwood weathering	Moderate to severe
Suspected origin	Natural scarring due to branch tear/ fire/ insect attack
Notes	Termite damage to core of tree and weathered scar surface
Estimated tree age (years)	173
Estimated scar age (years)	100 (Burns 2016)

Plate 9. Tree VS8.

Plate 10. Scar on tree VS8 showing eroded heart-wood.

Tree Number	VS9
Location (GDA94 - Zone 56)	231077 6589488
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Middle age with some dieback of smaller branches
Estimated height (m)	20.5
Tree girth at 1.5 m (m)	2.65
Diameter of tree (cm)	84
Scar dimensions (m)	1.74x0.2
Scar height above ground level (m)	0.02
Overgrowth (cm)	12 (top), 28 (mid left), 23 (mid right), 15 (bottom)
Average overgrowth (cm)	19.5
Scar orientation (°)	90
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Moderate to severe
Suspected origin	Branch tear
Notes	Termite damage to core of tree and heavily weathered scar
surface	
Estimated tree age (years)	120
Estimated scar age (years)	87 (Burns 2016)

Plate 11. Tree VS9.

Plate 12. Scar on tree VS9 showing decayed heartwood.

Plate 13. Recording scar on Tree VS9.

Plate 14. Scar on tree VS9 showing decayed heartwood.

Plate 15. Upper edge of scar on Tree VS9 showing erosion of heartwood and extent of regrowth.

Plate 16. Base of scar on tree VS9 showing decayed and displaced heartwood and termite residue.

Tree Number	VS10
Location (GDA94 - Zone 56)	229168 6591109
Species	White box (*Eucalyptus albens*)
Condition of tree	Dead lower trunk only survives
Estimated height (m)	4.5
Tree girth at 1.5 m (m)	3.35
Diameter of tree (cm)	107
Scar dimensions (m)	Scar 1 – 1.178x0.54 Scar 2 – 3.1x0.56 Scar 3 – 0.77x0.36 Scar 4 – 0.84x0.32 Scar 5 – 0.09x0.04
Scar height above ground level (m)	Scar 1 - 0 Scar 2 – 0 Scar 3 – 0.94 Scar 4 – 1.68 Scar 5 – 0.93
Overgrowth (cm)	Scar 1 - 4 (top), 9 (mid left), 10 (mid right), 0 (bottom) Scar 2 - 0 (top), 17 (mid left), 15 (mid right), 0 (bottom) Scar 3 - 6 (top), 8 (mid left), 6 (mid right), 6 (bottom) Scar 4 - 0 (top), 6 (mid left), 10 (mid right), 13 (bottom) Scar 5 - 5 (top), 6 (mid left), 5 (mid right), 4 (bottom)
Average overgrowth (cm)	Scar 1 – 7.67 Scar 2 – 16.0 Scar 3 – 6.5 Scar 4 – 9.67 Scar 5 – 6.67
Scar orientation (°)	Scar 1 - 220 Scar 2 – 130 Scar 3 – 350 Scar 4 – 280 Scar 5 – 250
Scar symmetry	Scar 1 - N Scar 2 – Y Scar 3 – Y Scar 4 – N
Scar shape	Scar 1 – Spear shaped Scar 2 – Linear Scar 3 – Ovate Scar 4 – Aristate (rounded with a spine-like top) Scar 5 – Rectangular
Epicormic growth	N
Heartwood weathering	Scar 1 – moderate/ severe Scar 2 – moderate Scar 3 – moderate/ severe Scar 4 – severe Scar 5 – little/ moderate
Suspected origin	Scar 1 – low branch or secondary stem tear Scar 2 – low branch or secondary stem tear Scar 3 – low branch or secondary stem tear Scar 4 – low branch or secondary stem tear Scar 5 – European cultural scar (may relate to a mortised hole created to insert a wooden railing for stockyard)

Notes	Located 220m from Namoi River
Estimated tree age (years)	152
Estimated scar age (years)	Scar 1 – 79 (Burns 2016)
	Scar 2 – 119 (Burns 2016)
	Scar 3 - 83 (Burns 2016)
	Scar 4 - 76 (Burns 2016)
	Scar 5 - 66 (Burns 2016)

Plate 17. Tree VS10 showing Scar 1.

Plate 18. Scar 1 on Tree VS10 showing weathered heartwood of scar.

Plate 19. Tree VS10 showing Scar 2.

Plate 20. Scar 3 on Tree VS10 showing weathered scar heartwood.

Plate 21. Tree VS10 showing Scar 3.

Plate 22. Scars 4 and 5 on Tree VS10.

Plate 23. Tree VS10 showing close-up of Scar 4 revealing weathered and decayed heartwood beneath scar. Scale in cm.

Plate 24. Scar 5 on Tree VS10.

Plate 25. Tree VS11 showing Scar 1.

Tree Number	VS11
Location (GDA94 - Zone 56)	229113 6591126
Species	White box (*Eucalyptus albens*)
Condition of tree	Mature tree with some crown damage
Estimated height (m)	15
Tree girth at 1.5 m (m)	4.04
Diameter of tree (cm)	129
Scar dimensions (m)	Scar 1 – 1.0x0.23 Scar 2 – 0.126x0.08 Scar 3 – 0.32x0.07
Scar height above ground level (m)	Scar 1 – 0.86 Scar 2 – 0.94 Scar 3 – 0.33
Overgrowth (cm)	Scar 1 - 18 (top), 30 (mid left), 25 (mid right), 20 (bottom) Scar 2 - 14 (top), 25 (mid left), 18 (mid right), 16 (bottom) Scar 3 - 0 (top), 0 (mid left), 0 (mid right), 0 (bottom)
Average overgrowth (cm)	Scar 1 – 23.25 Scar 2 – 18.25 Scar 3 – 0.0
Scar orientation (°)	Scar 1 - 200 Scar 2 – 295 Scar 3 – 5
Scar symmetry	Scar 1 - N Scar 2 – N Scar 3 – N
Scar shape	Scar 1 – Truncate (linear with a squared off apex) Scar 2 – Ovate Scar 3 – Linear
Epicormic growth	N
Heartwood weathering	Scar 1 – severe Scar 2 – little Scar 3 – obscured by regrowth
Suspected origin	Scar 1 – low branch or secondary stem tear Scar 2 – low branch or secondary stem tear Scar 3 – low branch or secondary stem tear
Notes	Termite damage to heartwood of Scar 1
Estimated tree age (years)	184
Estimated scar age (years)	Scar 1 – 63 (Burns 2016) Scar 2 – 83 (Burns 2016) Scar 3 – similar in age to Scar 2 but obscured by overgrowth (Burns 2016)

Plate 26. Scar 1 on Tree VS11.

Plate 27. Tree VS11 showing Scar 2 in centre of photo and Scar 3 to left of ranging pole.

Plate 28. Close up of Scar 2 on Tree VS11.

Plate 29. Close up of Scar 2 on Tree VS11.

Tree Number	VS12
Location (GDA94 - Zone 56)	229097 6591151
Species	White box (*Eucalyptus albens*)
Condition of tree	Mature tree with extensive branch fall from crown
Estimated height (m)	16.5
Tree girth at 1.5 m (m)	3.23
Diameter of tree (cm)	103
Scar dimensions (m)	1.98x0.33
Scar height above ground level (m)	0.58
Overgrowth (cm)	15 (top), 20 (mid left), 25 (mid right), 16 (bottom)
Average overgrowth (cm)	19.0
Scar orientation (°)	195
Scar symmetry	N
Scar shape	Lanceolate
Epicormic growth	N
Heartwood weathering	Moderate to severe with buckling of heartwood by regrowth
Suspected origin	Branch fall and secondary stem tear
Notes	Termite damage to core of tree
Estimated tree age (years)	147
Estimated scar age (years)	77 (Burns 2016)

Plate 30. Tree VS12.

Plate 31. Scar on Tree VS12 showing irregular regrowth and buckled heartwood under scar.

Tree Number	VS13
Location (GDA94 - Zone 56)	230844 6590808
Species	Cypress pine (*Callitris sp.*)
Condition of tree	Dead tree with some remaining branches
Estimated height (m)	8
Tree girth at 1.5 m (m)	1.17
Diameter of tree (cm)	37
Scar dimensions (m)	Scar 1 – 0.49x0.11 Scar 2 – 1.4x0.32
Scar height above ground level (m)	Scar 1 – 1.59 Scar 2 – 0
Overgrowth (cm)	Scar 1 - 4 (top), 4 (mid left), 6 (mid right), 4 (bottom) Scar 2 - 1 (top), 4 (mid left), 3 (mid right), 0 (bottom)
Average overgrowth (cm)	Scar 1 – 4.50 Scar 2 – 2.67
Scar orientation (°)	Scar 1 - 210 Scar 2 – 350
Scar symmetry	Scar 1 - Y Scar 2 – N
Scar shape	Scar 1 – Lanceolate Scar 2 – Squat linear
Epicormic growth	N
Heartwood weathering	Scar 1 – Moderate Scar 2 – Moderate/ severe
Suspected origin	Scar 1 – European cultural with steel axe marks Scar 2 – Indeterminate natural

Notes

Steel axe marks across the heartwood of Scar 1

Estimated tree age (years) 53

(samples from Victorian plantations of *C. endlicheri* reveal similar growth rates. See Zimmer *et al*. 2012)

Estimated scar age (years)

Scar 1 – 48 (Burns 2016)

Scar 2 – 48 (Burns 2016)

Plate 32. Tree VS13.

Plate 33. Scar 1 on Tree VS13 showing axe marks on heartwood.

Plate 34. Scar 2 on Tree VS13.

Plate 35. Close-up of axe marks across heartwood of Scar 1 on Tree VS13.

Tree Number	VS16
Location (GDA94 - Zone 56)	231767 6590518
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Mature tree with some minor dieback and branch fall
Estimated height (m)	16.5
Tree girth at 1.5 m (m)	2.72
Diameter of tree (cm)	87
Scar dimensions (m)	2.5x0.41
Scar height above ground level (m)	0.15
Overgrowth (cm)	4 (top), 10 (mid left), 10 (mid right), 10 (bottom)
Average overgrowth (cm)	8.5
Scar orientation (°)	40
Scar symmetry	N
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Moderate
Suspected origin	**Secondary stem tear near base of trunk**
Notes	
Estimated tree age (years)	124
Estimated scar age (years)	50 (Burns 2016)

Plate 36. Tree VS16.

Plate 37. Scar on Tree VS16.

Tree Number	VS17
Location (GDA94 - Zone 56)	231828 6590581
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Mature tree with some minor dieback and branch fall
Estimated height (m)	15
Tree girth at 1.5 m (m)	2.15
Diameter of tree (cm)	68
Scar dimensions (m)	0.75x0.06
Scar height above ground level (m)	0.4
Overgrowth (cm)	5 (top), 5 (mid left), 6 (mid right), 3 (bottom)
Average overgrowth (cm)	4.75
Scar orientation (°)	80
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	Y
Heartwood weathering	Moderate
Suspected origin	Secondary stem tear near base of trunk
Notes	Bifurcated trunk growing from below scar
Estimated tree age (years)	98
Estimated scar age (years)	47 (Burns 2016)

Plate 38. Tree VS17.

Plate 39. Tree VS17 showing scar.

Plate 40. Scar on Tree VS17.

Tree Number	VS18
Location (GDA94 - Zone 56)	231865 6590633
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Live, healthy tree
Estimated height (m)	20
Tree girth at 1.5 m (m)	2.85
Diameter of tree (cm)	91
Scar dimensions (m)	1.02x0.15
Scar height above ground level (m)	1.06
Overgrowth (cm)	9 (top), 20 (mid left), 20 (mid right), 19 (bottom)
Average overgrowth (cm)	17.0
Scar orientation (°)	180
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Light/ moderate although much of exposed heartwood has decayed.
Suspected origin	Decay caused by a branch/secondary stem dying
Notes	Located near homestead and road junction. .
Estimated tree age (years)	130
Estimated scar age (years)	67 (Burns 2016)

Plate 41. Tree VS18.

Plate 42. Scar on Tree VS18.

Tree Number	VS19a
Location (GDA94 - Zone 56)	229138 6589594
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Mature tree with some minor dieback and branch fall
Estimated height (m)	13.5
Tree girth at 1.5 m (m)	3.2
Diameter of tree (cm)	102
Scar dimensions (m)	Scar 1 – 0.8x0.03 Scar 2 – 0.58x0
Scar height above ground level (m)	Scar 1 – 0.4 Scar 2 – 0.64
Overgrowth (cm)	Scar 1 - 20 (top), 25 (mid left), 25 (mid right), 26 (bottom) Scar 2 - - (top), - (mid left), - (mid right), - (bottom)
Average overgrowth (cm)	Scar 1 – 24.0 Scar 2 – -
Scar orientation (°)	Scar 1 - 90 Scar 2 – 200
Scar symmetry	Scar 1 - Y Scar 2 – Y
Scar shape	Scar 1 – Narrow linear Scar 2 – Narrow linear
Epicormic growth	N
Heartwood weathering	Scar 1 – Light/ moderate Scar 2 – concealed by regrowth
Suspected origin	Scar 1 – secondary stem tear, probably caused by farming activity Scar 2 – secondary stem tear, probably caused by farming activity
Notes	Located near a fenceline and other farm infrastructure
Estimated tree age (years)	146
Estimated scar age (years)	Scar 1 – 90 (Burns 2016) Scar 2 – 90 (Burns 2016)

Plate 43. Tree VS19a.

Plate 44. Scar 1 on Tree VS19a.

Plate 45. Scar 1 on Tree VS19a.

Plate 46. Scar 2 on Tree VS19a.

Tree Number	VS19b
Location (GDA94 - Zone 56)	229146 6589629
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Live, healthy tree
Estimated height (m)	13
Tree girth at 1.5 m (m)	3.05
Diameter of tree (cm)	97
Scar dimensions (m)	0.84x0.08
Scar height above ground level (m)	0.7
Overgrowth (cm)	15 (top), 15 (mid left), 15 (mid right), 10 (bottom)
Average overgrowth (cm)	13.75
Scar orientation (°)	330
Scar symmetry	N
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Exposed heartwood has decayed.
Suspected origin	Natural scarring due to fire/ branch fall or recent accidental trunk damage associated with tree clearing or other pastoral activities
Notes	Located near homestead and fenceline. Possible cultural origin.
Estimated tree age (years)	139
Estimated scar age (years)	53 (Burns 2016)

Plate 47. Tree VS19b.

Plate 48. Scar on Tree VS19b. Scale in cm. Note decayed heartwood and termite residue.

Tree Number	VS20
Location (GDA94 - Zone 56)	230778 6590607
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Live tree with some branch dieback
Estimated height (m)	8.5
Tree girth at 1.5 m (m)	3.1
Diameter of tree (cm)	99
Scar dimensions (m)	0.1x0.1
Scar height above ground level (m)	0.84
Overgrowth (cm)	3 (top), 5 (mid left), 5 (mid right), 3 (bottom)
Average overgrowth (cm)	4.0
Scar orientation (°)	80
Scar symmetry	Y
Scar shape	Orbicular (circular)
Epicormic growth	N
Heartwood weathering	Heartwood has been consumed by termites
Suspected origin	Natural scarring due to secondary stem tear
Notes	Largely encapsulated wound
Estimated tree age (years)	141
Estimated scar age (years)	27 (Burns 2016)

Plate 49. Tree VS20.

Plate 50. Scar on Tree VS20.

Tree Number	VS21
Location (GDA94 - Zone 56)	230894 6590618
Species	Narrow leaf ironbark (*Eucalyptus crebra*)
Condition of tree	Live tree with some branch dieback
Estimated height (m)	15
Tree girth at 1.5 m (m)	2.46
Diameter of tree (cm)	78
Scar dimensions (m)	2.01x0.3
Scar height above ground level (m)	0
Overgrowth (cm)	10 (top), 10 (mid left), 10 (mid right), 0 (bottom)
Average overgrowth (cm)	10.0
Scar orientation (°)	160
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Extensive erosion and sculpting of heartwood
Suspected origin	Branch or secondary stem tear near base of the trunk
Notes	This tree species not known as used for Indigenous bark re moval
Estimated tree age (years)	112
Estimated scar age (years)	57 (Burns 2016)

Plate 51. Tree VS21.

Plate 52. Scar on Tree VS21.

Tree Number	VS22
Location (GDA94 - Zone 56)	230880 6590511
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Live tree with branch dieback
Estimated height (m)	10
Tree girth at 1.5 m (m)	2.15
Diameter of tree (cm)	68
Scar dimensions (m)	0.56x0.2
Scar height above ground level (m)	0.58
Overgrowth (cm)	10 (top), 15 (mid left), 12 (mid right), 6 (bottom)
Average overgrowth (cm)	10.75
Scar orientation (°)	170
Scar symmetry	N
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Moderate weathering of heartwood
Suspected origin	Low branch or stem tear, metal axe marks within the scar
Notes	Termite infestation with heartwood damage
Estimated tree age (years)	98
Estimated scar age (years)	67 (Burns 2016)

Plate 53. Tree VS22.

Plate 54. Scar on Tree VS22 showing termite debris and moderately weathered heartwood.

Tree Number	VS24
Location (GDA94 - Zone 56)	229191 6590768
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Live tree with extensive branch dieback
Estimated height (m)	12
Tree girth at 1.5 m (m)	1.9
Diameter of tree (cm)	60
Scar dimensions (m)	1.58x0.32
Scar height above ground level (m)	4.1
Overgrowth (cm)	5 (top), 4 (mid left), 3 (mid right), 6 (bottom)
Average overgrowth (cm)	4.50
Scar orientation (°)	125
Scar symmetry	Y
Scar shape	Irregular truncate
Epicormic growth	N
Heartwood weathering	Moderate
Suspected origin	Bird/ insect attack
Notes	Too high on the trunk to an Aboriginal cultural scar (accessible only with ladder)
Estimated tree age (years)	86
Estimated scar age (years)	20 (Burns 2016)

Plate 55. Tree VS24. Scar is located above Dr Kamminga's hand.

Plate 56. Scar on Tree VS24 showing moderately weathered heartwood.

Tree Number	VS25a and VS33 (Same tree originally recorded)
Location (GDA94 - Zone 56)	228953 6588990
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Dying tree with extensive dieback and crown damage
Estimated height (m)	10.5
Tree girth at 1.5 m (m)	3.13
Diameter of tree (cm)	100
Scar dimensions (m)	Scar 1 – 2.1x0.44 Scar 2 – 1.9x0.5 Scar 3 – 2.43x0.22
Scar height above ground level (m)	Scar 1 – 0.01 Scar 2 – 0 Scar 3 – 0
Overgrowth (cm)	Scar 1 - 21 (top), 11 (mid left), 18 (mid right), 18 (bottom) Scar 2 - 6 (top), 9 (mid left), 13 (mid right), 0 (bottom) Scar 3 - 7 (top), 5 (mid left), 4 (mid right), 0 (bottom)
Average overgrowth (cm)	Scar 1 – 17.0 Scar 2 – 9.33 Scar 3 – 5.33
Scar orientation (°)	Scar 1 - 330 Scar 2 – 140 Scar 3 – 310
Scar symmetry	Scar 1 - N Scar 2 – N Scar 3 – Y
Scar shape	Scar 1 – Oblong Scar 2 – Acuminate Scar 3 – Spear shaped
Epicormic growth	N
Heartwood weathering	Scar 1 – Moderate Scar 2 – Moderate Scar 3 – Little
Suspected origin	Scar 1 – low branch or secondary stem tear Scar 2 – low branch or secondary stem tear Scar 3 - low branch or secondary stem tear
Notes	Hollow tree with termite damage
Estimated tree age (years)	142
Estimated scar age (years)	Scar 1 – 57 (Burns 2016) Scar 2 – 33 (Burns 2016) Scar 3 – 10 (Burns 2016)

Plate 57. Scar on Tree VS25a.

Plate 58. Scar 1 on Tree VS25a.

Plate 59. Scar 2 on Tree VS25a.

Plate 60. Scar 3 on Tree VS25a.

Tree Number	VS37
Location (GDA94 - Zone 56)	229150 6589075
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Healthy tree with minor crown damage
Estimated height (m)	12
Tree girth at 1.5 m (m)	3.09
Diameter of tree (cm)	98
Scar dimensions (m)	1.15x0.15
Scar height above ground level (m)	0.63
Overgrowth (cm)	24 (top), 25 (mid left), 25 (mid right), 32 (bottom)
Average overgrowth (cm)	26.50
Scar orientation (°)	220
Scar symmetry	N
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Moderate/ severe
Suspected origin	Low branch tear
Notes	Hollow trunk with extensive regrowth pushing remaining heart wood inwards
Estimated tree age (years)	141
Estimated scar age (years)	100, probably younger (Burns 2016)

Plate 61. Tree VS37.

Plate 62. Scar on Tree VS37.

Tree Number	VS38
Location (GDA94 - Zone 56)	229171 6589130
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Dying tree with extensive crown damage
Estimated height (m)	7
Tree girth at 1.5 m (m)	1.51
Diameter of tree (cm)	48
Scar dimensions (m)	1.72x0.22
Scar height above ground level (m)	0.25
Overgrowth (cm)	6 (top), 0 (mid left), 13 (mid right), 13 (bottom)
Average overgrowth (cm)	10.67
Scar orientation (°)	135
Scar symmetry	N
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Severe
Suspected origin	Low branch or secondary stem tear
Notes	Hollow trunk with chainsaw cut to timber at side, top and base of scar. Original scar older than chainsaw cuts
Estimated tree age (years)	69
Estimated scar age (years)	30 (Burns 2016)

Plate 63. Tree VS38.

Plate 64. Scar on Tree VS38. Note chainsaw cut on left-hand side of scar.

Tree Number	VS39
Location (GDA94 - Zone 56)	229125 6589121
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Small tree with some upper trunk damage from wind
Estimated height (m)	8
Tree girth at 1.5 m (m)	2.0
Diameter of tree (cm)	64
Scar dimensions (m)	2.15x0.15
Scar height above ground level (m)	0
Overgrowth (cm)	5 (top), 12 (mid left), 16 (mid right), 0 (bottom)
Average overgrowth (cm)	11.0
Scar orientation (°)	130
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	Severe
Suspected origin	**Low branch or secondary stem tear early in life of tree**
Notes	Hollow trunk with the heartwood extruded by regrowth
Estimated tree age (years)	91
Estimated scar age (years)	30 (Burns 2016)

Plate 65. Tree VS39.

Plate 66. Scar on Tree VS39.

Tree Number	VS40
Location (GDA94 - Zone 56)	229136 6589136
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Mature tree with some upper branch dieback
Estimated height (m)	12
Tree girth at 1.5 m (m)	3.75
Diameter of tree (cm)	119
Scar dimensions (m)	1.4x0.22
Scar height above ground level (m)	0.59
Overgrowth (cm)	20 (top), 22 (mid left), 16 (mid right), 0 (bottom)
Average overgrowth (cm)	19.33
Scar orientation (°)	220
Scar symmetry	Y
Scar shape	Acuminate
Epicormic growth	Y
Heartwood weathering	Severe
Suspected origin	Early secondary stem tear with subsequent decay of wood
Notes	Hollow trunk with termite damage. Bifurcated trunk.
Estimated tree age (years)	171
Estimated scar age (years)	67 (Burns 2016)

Plate 67. Tree VS40.

Plate 68. Scar on Tree VS40.

Tree Number	VS41
Location (GDA94 - Zone 56)	229127 6589205
Species	Poplar box (*Eucalyptus populnea*)
Condition of tree	Healthy tree with some upper branch dieback
Estimated height (m)	13
Tree girth at 1.5 m (m)	1.5
Diameter of tree (cm)	48
Scar dimensions (m)	0.63x0.14
Scar height above ground level (m)	3.7
Overgrowth (cm)	4 (top), 3 (mid left), 4 (mid right), 3 (bottom)
Average overgrowth (cm)	3.5
Scar orientation (°)	20
Scar symmetry	Y
Scar shape	Elliptic
Epicormic growth	N
Heartwood weathering	Little
Suspected origin	Branch tear
Notes	Scar high up on trunk
Estimated tree age (years)	68
Estimated scar age (years)	17 (Burns 2016)

Plate 69. VS41. Scar is located high on trunk.

Plate 70. Scar on Tree VS41.

Tree Number	VS53
Location (GDA94 - Zone 56)	228966 6591159
Species	River red gum (*Eucalyptus camaldulensis*)
Condition of tree	Mature tree with upper trunk wind damage and erosion around roots
Estimated height (m)	11.7
Tree girth at 1.5 m (m)	3.3
Diameter of tree (cm)	105
Scar dimensions (m)	0.62x0.006
Scar height above ground level (m)	1.17
Overgrowth (cm)	9 (top), 15 (mid left), 17 (mid right), 10 (bottom)
Average overgrowth (cm)	12.75
Scar orientation (°)	45
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	N
Heartwood weathering	No visible heartwood -
Suspected origin	European cultural scar
Notes	Recent damage from use as a fence corner post with fence wire and metal spikes driven into trunk. Adjacent to Namoi River
Estimated tree age (years)	150
Estimated scar age (years)	50 (Burns 2016)

Plate 71. Tree VS53 on bank of the Namoi River.

Plate 72. Scar on Tree VS53.

Tree Number	VS75
Location (GDA94 - Zone 56)	231776 6589284
Species	Inland grey box (*Eucalyptus macrocarpa*)
Condition of tree	Living tree with termite infestation
Estimated height (m)	13
Tree girth at 1.5 m (m)	2.43
Diameter of tree (cm)	77
Scar dimensions (m)	2.6x0.26
Scar height above ground level (m)	0
Overgrowth (cm)	0 (top), 10 (mid left), 12 (mid right), 20 (bottom)
Average overgrowth (cm)	10.67
Scar orientation (°)	30
Scar symmetry	Y
Scar shape	Linear
Epicormic growth	Y
Heartwood weathering	Little
Suspected origin	Secondary stem tear
Notes	
Estimated tree age (years)	110
Estimated scar age (years)	87 (Burns 2016)

Plate 73. Tree VS75.

Plate 74. Scar on Tree VS75.

Tree Number	ST1 (not previously recorded)
Location (GDA94 - Zone 56)	231840 6589365
Species	Grey box (*Eucalyptus microcarpa*)
Condition of tree	Healthy tree with some minor dieback
Estimated height (m)	8
Tree girth at 1.5 m (m)	1.73
Diameter of tree (cm)	55
Scar dimensions (m)	Scar 1 – 1.79x0.68 Scar 2 – 0.08x0.05
Scar height above ground level (m)	Scar 1 – 0.6 Scar 2 – 0.95
Overgrowth (cm)	Scar 1 - 3 (top), 8 (mid left), 3 (mid right), 0.5 (bottom) Scar 2 - 6 (top), 4 (mid left), 4 (mid right), 3 (bottom)
Average overgrowth (cm)	Scar 1 – 3.63 Scar 2 – 4.25
Scar orientation (°)	Scar 1 - 95 Scar 2 – 180
Scar symmetry	Scar 1 - N Scar 2 – N
Scar shape	Scar 1 – Linear/ ovate Scar 2 – Cuneate (wedge shaped with acute base)
Epicormic growth	N
Heartwood weathering	Scar 1 – Nil/ light Scar 2 – Light/ moderate
Suspected origin	Scar 1 – Natural branch tear/ insect/ bird attack Scar 2 – Natural branch tear/ insect/ bird attack
Notes	Recent active regrowth around edges of Scar 1
Estimated tree age (years)	79
Estimated scar age (years)	Scar 1 – 10 (Burns 2016) Scar 2 – 12 (Burns 2016)

Plate 75. Tree ST1.

Plate 76. Scar 1 on Tree ST1.

Plate 77. Scar 1 on Tree ST1.

Plate 78. Scar 2 on Tree ST1.