The wet sieving of deposits. Wallarah Creek is behind the workers.

Test Excavation Programme

Wallarah Creek Sensitive Archaeological Landform

Wallarah 2 Coal Project, Central Coast, NSW

April 2010

Report Prepared by

OzArk Environmental and Heritage Management Pty Ltd

For International Environmental Consultants P/L

on behalf of

Wallarah 2 Coal Project

Environmental and
Heritage Management P/L

OzArk EHM
145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118
Fax: (02) 6882 0630
jodie@ozarkehm.com.au
phil@ozarkehm.com.au
www.ozarkehm.com.au

Executive Summary

This report documents archaeological test excavations undertaken on both banks of Wallarah Creek at the Tooheys Road site (also referred to as the Bushells Ridge site in previous reports) for the Wallarah 2 Coal Project.

The archaeological test excavation programme follows on from the previous assessment of the banks of Wallarah Creek in this location as holding archaeological sensitivity (ERM 2001, OzArk 2009). No Indigenous heritage items were recorded in this vicinity by the previous heritage surveys and the current test programme was instigated to clarify the archaeological nature of area.

The area investigated by the test excavation programme is located on the north and south banks of Wallarah Creek. Excavation was limited within the landscape to the area where the proposed impacts will be severe in the form of the construction of a rail loop (Eastern and Western Arm), a conveyor belt loop, a road and pit top facilities for the Wallarah 2 Coal Project.

OzArk 2009: 57 recommended a test excavation programme in this area because:

- Both ERM 2001 and OzArk 2009 have assessed the area along the north and south bank of Wallarah Creek as being archaeologically sensitive;
- The level of the proposed impacts will be high on any potential heritage items;
- A site complex (WC IF1, WC OS1, WC ST1) was recorded during the OzArk 2009 assessment on the banks of Wallarah Creek (a few kilometres west of the Tooheys Road site within the ecological offset investigation area), confirming the sensitivity of this landform;
- The landform and soil depth in the area suggest that intact subsurface deposits could be present;
- There was low ground surface visibility at the time of survey that hindered the detection of sites.

The full DECCW *Interim Community Consultation Requirements* (ICCRs) process has been followed from project inception in 2006. The group of Registered Stakeholders comprises the Darkinjung Local Aboriginal Land Council (DLALC), within which the boundary of the Study Area falls, and Guringai Tribal Link Aboriginal Corporation (GTLAC).

A total of 60 1 x 1 metre excavation pits were excavated across four landforms within the Tooheys Road site, namely:

- South Bank of Wallarah Creek (42 pits);
- Levee Bank on south bank of Wallarah Creek (3 pits);
- North bank of Wallarah Creek (11 pits), and;
- North bank of Wallarah Creek on the Eastern Arm of the proposed Rail Loop (4 pits).

Excavations targeted areas of direct impact that will result from the proposed construction of the Wallarah 2 Coal Project. Excavation was concentrated on the southern bank of Wallarah Creek as this area will be impacted to a greater degree when compared to the north bank. Excavation on the north bank was therefore less random than the pit layout on the southern bank, but instead targeted areas of direct impact that will result from the proposed construction of the rail loop (Western Arm),

conveyor and road. Test excavation was also carried out at the location of the Eastern Arm of the rail loop where it crosses Wallarah Creek. Here excavation pits were confined to the northern bank because the southern bank at this location was:

- Heavily eroded with B Horizon soils exposed, and;
- Very difficult to access with vehicles due to the regenerating scrub.

The main aims of the test excavations were to:

- Investigate the nature of the deposits, and;
- Provide management recommendations.

The results of this test excavation programme are as follows.

Across the 60 pits a very low frequency of artefacts was recorded and no pit displayed evidence of the existence of a site — even of low complexity. In total, only one tool was recorded, along with five un-retouched flakes and three broken, un-retouched flakes. There was, however, evidence of lithic manufacture in the area with one core-trimming element and four flakes identified as debitage recorded. While evidence of lithic manufacture was present, its distribution was not concentrated and suggests random tool re-sharpening and isolated events rather than an occupational camp.

All recorded artefacts (tool, flakes and debitage) only totalled 14 across the 60 excavation pits.

No pit displayed archaeological stratigraphy and no features were recorded.

Specifically, the test excavation confirmed that:

- there is very low archaeological potential within the area investigated. While items of Indigenous heritage (i.e. artefacts) are present, the distribution and nature of these items suggest a random 'background' scatter, rather than the nearby presence of a site that would display intactness and complexity.

Due to the results of previous surveys and the current test excavation programme, management recommendations for the areas investigated are as follows:

South Bank of Wallarah Creek within the presently cleared field (from the F3 Freeway to c. 600 m east). From the creek line to the Motorway Link Rd c. 600 m south:

- Where practical, topsoil above the underlying clays (5–20 cm deep) should be stockpiled and reused on site following the construction phase. This would ensure that artefacts contained within the soil would remain on site.
- Due to the likelihood of artefacts being present at a low frequency, crews involved with the initial clearing and preparation of the site, including all crews involved with earth moving, should be appropriately inducted to inform them:
    a) That no identifiable Aboriginal site has been recorded in the area;
    b) That there may, nonetheless, be isolated Aboriginal artefacts present in the landscape (a printed copy showing typical artefacts should be distributed. Section 5.2.2 of this report could form the basis of such printed information);
    c) That should a noticeable concentration of items work crews suspect may be Aboriginal in origin be encountered, then work should cease in that area and DECCW consulted on how to best proceed;

d) That should a suspected isolated Aboriginal artefact be noticed, it should be removed to a safe location and DECCW informed; and

e) All crews involved with the initial clearing and site preparation work should read and sign the induction.

- If the induction is undertaken, there is no constraint to the proposed construction as outlined in this report on cultural heritage grounds.

North Bank Wallarah Creek from the F3 freeway to c. 600 m east. From the creek line to a distance of 100 m from its banks.

- The final Works Design should attempt to limit ground disturbing works in this area to the impact footprint of each piece of infrastructure: the conveyor, Western Arm Rail Loop and the road to the pit top facilities.
- Where practical, topsoil above the underlying clays (5–20 cm deep) should be stockpiled and reused on site following the construction phase. This would ensure that artefacts contained within the soil would remain on site.
- Due to the likelihood of artefacts being present at a very low frequency, crews involved with the initial clearing and preparation of the site, including all crews involved with earth moving, should be appropriately inducted to inform them of the same five dot points as delineated above (a–e).
- If the induction is undertaken, there is no constraint to the proposed construction as outlined in this report on cultural heritage grounds.

Eastern Arm Rail Loop

- The final Works Design should attempt to limit ground disturbing works in this area to the impact footprint of the Eastern Arm Rail Loop, particularly within 100 m of the creek's banks on both sides.
- No induction of workers is necessary if only working in this area.
- There is no constraint to the proposed construction as outlined in this report on cultural heritage grounds.

Contents

Figures

Tables

Plates

1.0 Introduction

1.1 Brief description of the project

This report was commissioned by International Environmental Consultants (IEC) on behalf of the Wallarah 2 Coal Project. It details the results archaeological test excavations at the Tooheys Road Study Area, Wyong, NSW.

The initial cultural heritage survey for this project was carried out by ERM (2001). This survey did not record any Aboriginal sites at the Tooheys Road Study Area, but recommended that the banks of Wallarah Creek be regarded as 'archaeologically sensitive'. This assessment was based on the fact that Wallarah Creek contains permanent water, its banks are gently sloping and that other sites had been recorded in the vicinity.

OzArk 2009 reinvestigated the area and, like ERM before them, did not record any Aboriginal sites at the Tooheys Road Study Area. OzArk agreed with ERM that the banks of Wallarah Creek constituted an archaeologically sensitive area: especially as the site complex (WC IF1, WC OS1, WC ST1) was recorded during the OzArk 2009 assessment a few kilometres west of the Tooheys Road Study Area on the banks of Wallarah Creek. This confirmed the sensitivity of this landform along Wallarah Creek within the Tooheys Road Study Area.

In order to gain a higher degree of certainty for the management recommendations concerning the Tooheys Road Study Area, the Wallarah 2 Coal Project agreed that test excavations should be carried out within the zone of archaeological sensitivity to determine the exact nature of any archaeological deposits in the area. Approvals for this programme in relation to relevant legislation can be found in **Appendix 2**.

1.2 Location

The Tooheys Road Study Area (also known as the Bushells Ridge site) is located in a triangle of land bounded by the F3 Freeway to the west and the Motorway Link Road to south. The Study Area is dissected by Wallarah Creek that runs approximately east/west within the Study Area. The Study Area is located approximately 8.5 km north/northeast from the township of Wyong on NSW's Central Coast.

1.3 Date of excavation programme

The test excavation programme was undertaken from 15–19 March 2010.

1.4 Aboriginal community involvement

This project has being undertaken as per the Department of Environment and Conservation (DEC 2004) *Interim Community Consultation Requirements* (ICCRs) as recommended in the DEC 2005 *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (for Part 3A assessments).

As a result of the ICCR process initiated in 2006, the group of Registered Stakeholders comprises the Darkinjung Local Aboriginal Land Council (DLALC), within which the boundaries of the Study Area fall, and Guringai Tribal Link Aboriginal Corporation (GTLAC). Representatives from these groups have participated in subsequent fieldwork relating to the W2CP project (OzArk 2009a, 2009b) and been involved in all aspects of the development to date.

Aboriginal community involvement was essential for the success of the excavation programme. Primarily, the community representatives were involved with the wet-sieving of deposits (**Plate 1**) and in providing feedback on the excavation methodology.

A list of the community representatives who participated in the excavation fieldwork can be found in Section 5.2. **Appendix 1** lists correspondence with the Aboriginal communities in respect of the excavations.

shows the location of the Study Area.

1.3 Date of excavation programme

The test excavation programme was undertaken from 15–19 March 2010.

1.4 Aboriginal community involvement

This project has being undertaken as per the Department of Environment and Conservation[1] (DEC 2004) *Interim Community Consultation Requirements* (ICCRs) as recommended in the DEC 2005 *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (for Part 3A assessments).

As a result of the ICCR process initiated in 2006, the group of Registered Stakeholders comprises the Darkinjung Local Aboriginal Land Council (DLALC), within which the boundaries of the Study Area fall, and Guringai Tribal Link Aboriginal Corporation (GTLAC). Representatives from these groups have participated in subsequent fieldwork relating to the W2CP project (OzArk 2009a, 2009b) and been involved in all aspects of the development to date.

Aboriginal community involvement was essential for the success of the excavation programme. Primarily, the community representatives were involved with the wet-sieving of deposits (**Plate 1**) and in providing feedback on the excavation methodology.

A list of the community representatives who participated in the excavation fieldwork can be found in Section 5.2. **Appendix 1** lists correspondence with the Aboriginal communities in respect of the excavations.

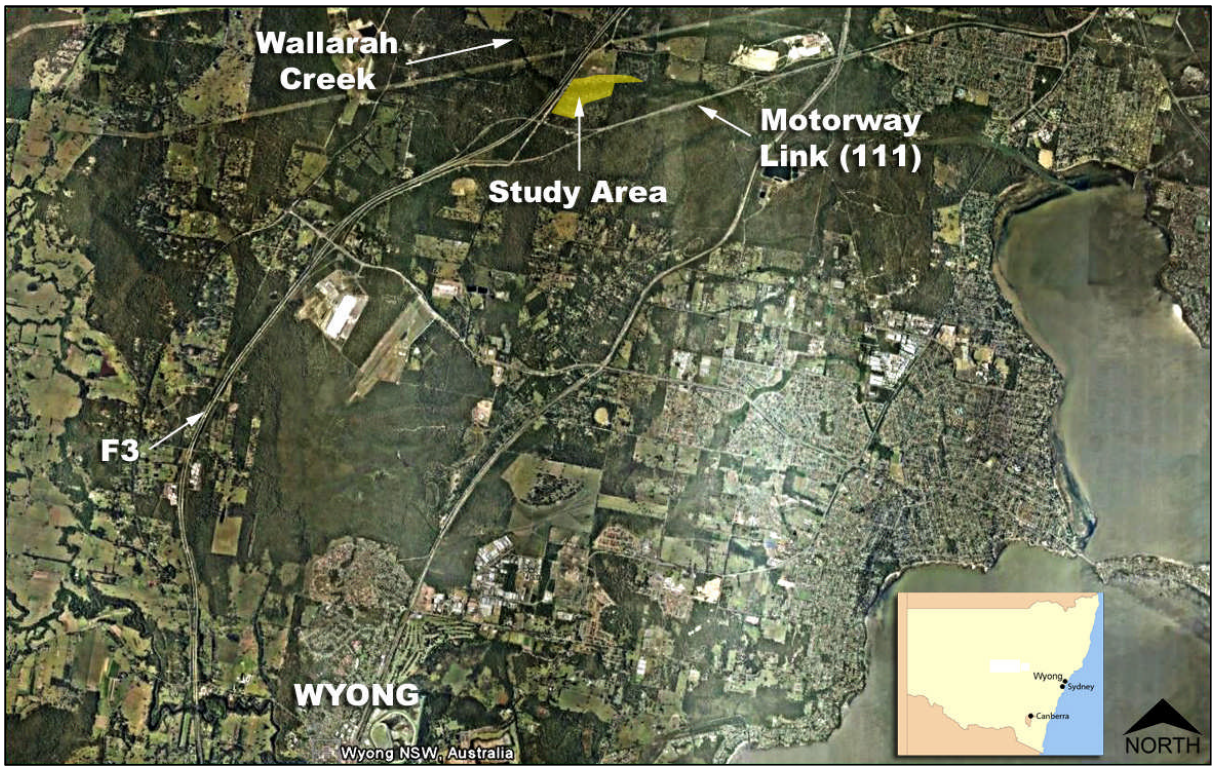
Discussions were held in the field at the location of excavation areas between archaeologists and the community to define the type and nature of each impact and assessed requirements for mitigation or management measures. The community were encouraged to bring forward any issues of concern and had full access to representatives of the client, the archaeologist and other communities for confidential or group discussions.

1.5 OzArk EHM involvement

This report was written by Ben Churcher. Ben Churcher undertook the artefact identification and analysis. Dr Jodie Benton (OzArk Director) and Ben Churcher (Senior Archaeologist) directed the excavation, Kim Tuovinen (Archaeologist) assisted and Phillip Cameron was the Operations Manager. The report was reviewed and edited by Dr Jodie Benton.

[1] Now Department of Environment, Climate Change and Water (DECCW).

Figure 1: Location of the Tooheys Road Study Area.



2.0 The Project

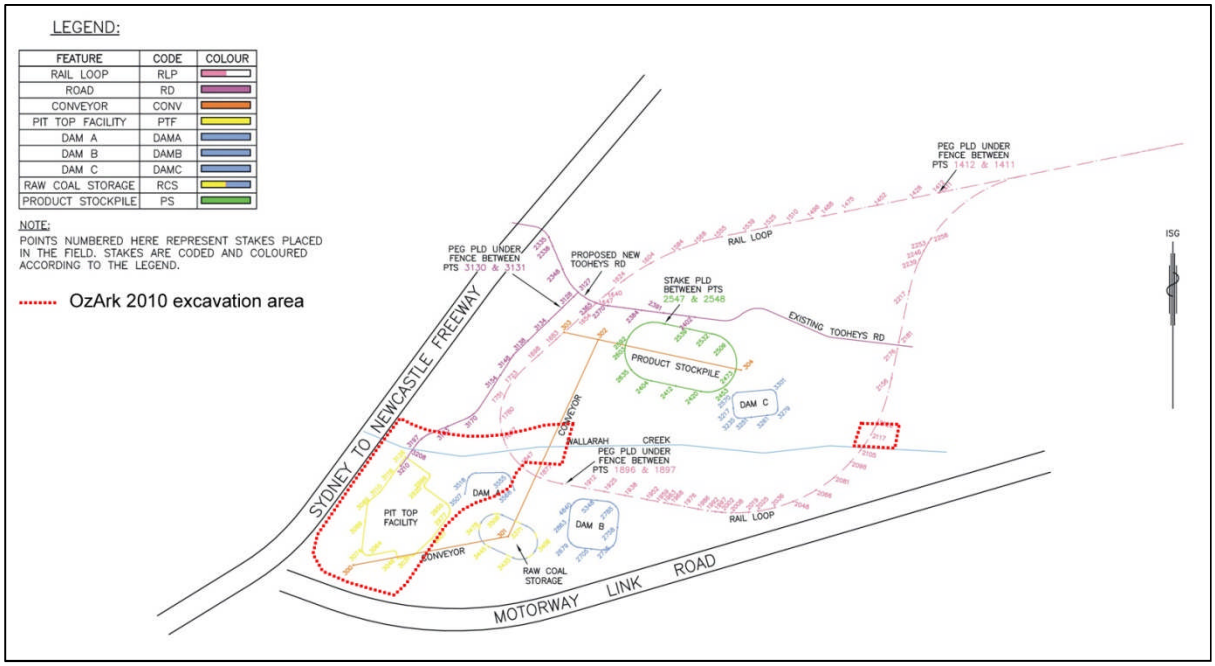
The Wallarah 2 Coal Project is a new development that requires the construction of a rail loop, conveyor, road and pit top facilities in the Tooheys Road Study Area. **Figure 2** shows the location of this infrastructure along with the OzArk 2010 excavation area.

2.1 Proposed Works

The proposed infrastructure for the Tooheys Road Study Area includes:

- Rail spur and loop with coal loader and two rail overbridges along Tooheys Road;
- Office facility, inclusive of administration offices, bathrooms, training facilities;
- Site access roads including at least partial relocation of Tooheys Road;
- Mine access drift and portal;
- Gas extraction and treatment plant;
- Coal stockpiles and material handling facilities;
- Car parking facilities; and
- Mine water and surface runoff settling ponds.

Figure 2: Detail of the proposed works at the Tooheys Road Study Area.

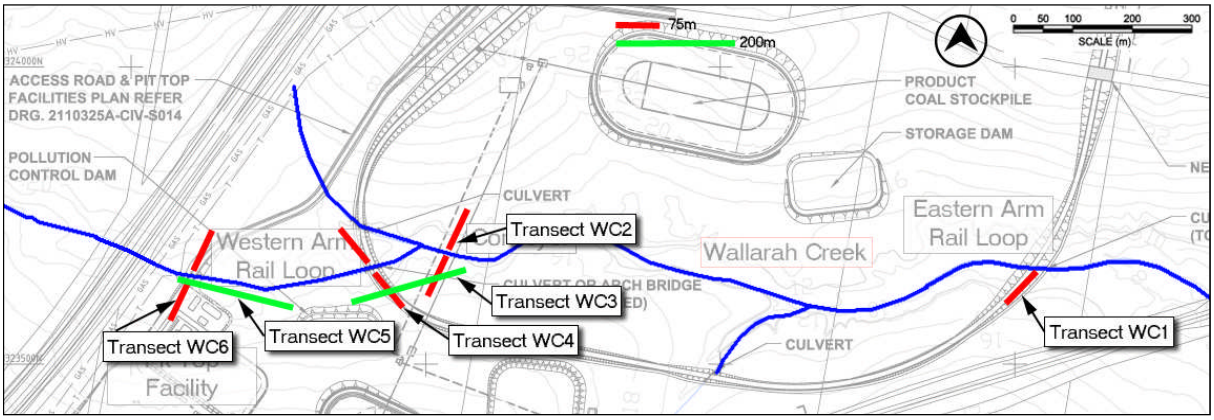


As can be seen in **Figure 2**, the majority of this infrastructure is located to the south of Wallarah Creek and this bank will suffer severe disturbance from the proposed works. Proposed works on the northern bank are severe in places but are more linear in their impact, and not as widespread, as the impact of the proposed works on the southern bank.

2.2 Archaeological Methodology

In OzArk 2009 (pp 57 ff), a test excavation methodology for the Tooheys Road Study Area was outlined. This methodology suggested that six transects would cover those areas that would be directly impacted by the proposed works. **Figure 3** reproduces the test excavation methodology as it was originally envisioned. Transects 1, 2, 4 and 6 were orientated to align with the impact area of the proposed works; namely the Eastern Arm Rail Loop, Conveyor, Western Arm Rail Loop and road respectively. Transects 3 and 5 were designed to test the areas immediately adjacent to these areas of direct impact.

Figure 3: Test excavation methodology as set out in OzArk 2009 (Figure 21).



However, when a review of the test excavation methodology was undertaken in 2010 prior to excavation work commencing, representatives from the Wallarah 2 Coal Project indicated that the impacts to the south of Wallarah Creek would not be as contained as the excavation methodology set out above seemed to indicate. Rather, the representatives stated, the whole southern bank in the vicinity of the pit top facilities, conveyor and Western Arm Rail Loop would undergo some sort of disturbance throughout the construction programme. They further indicated that the disturbances to the northern bank in this area would be more localized and centred on the location of specific infrastructure such as the Western Arm Rail Loop. **Figure 4** shows an aerial view of the Tooheys Road Study Area and indicates the main area of impact from the proposed works.

Therefore, in consultation with the Aboriginal community representatives, it was decided to alter the test excavation methodology as previously set out in OzArk 2009. As disturbance from the proposed works would include most of the southern bank of Wallarah Creek, it was decided that the test programme should sample the whole of the southern bank within the impact area, as well as the hill slope to the south where the pit top facilities are proposed to be located.

The proposed works indicated that the impacts on the northern bank were more specific in their extent and, therefore, the methodology set out in OzArk 2009 was adhered to. Thus, on the northern bank, a series of pits were excavated to assess the areas that would be directly impacted and, unlike on the southern bank, did not extend all the way along the northern bank.

The other area where the test excavation methodology was altered was at the Eastern Arm Rail Loop. In OzArk 2009 (as seen in **Figure 3**), it was originally planned to excavate on the southern bank only. However, closer inspection of this area showed that it had suffered from sheet erosion and that the A Horizon soils were very thin, or non-existent. This diminished the possibility of locating intact, sub-surface archaeological deposits in this area. Further, dense regenerating bushland at this location has made access extremely difficult. In consultation with Wallarah 2 Coal Project and Aboriginal

community representatives, it was decided to shift the focus of the excavation to the northern bank where it was considered that the soil depth would be deeper and more archaeologically productive.

Further details of the excavation methodology are contained in Section 5.3.

Figure 4: Location of impacts to archaeologically sensitive areas.

2.3 Project Constraints

There were no constraints to the methodology set out in Section 2.2. The weather was fine and all portions of the Study Area were able to be accessed.

3.0 The Study Area

The location being investigated is summarised in **Figure 5**.

Figure 5: Views of the landscape with the Study Area.

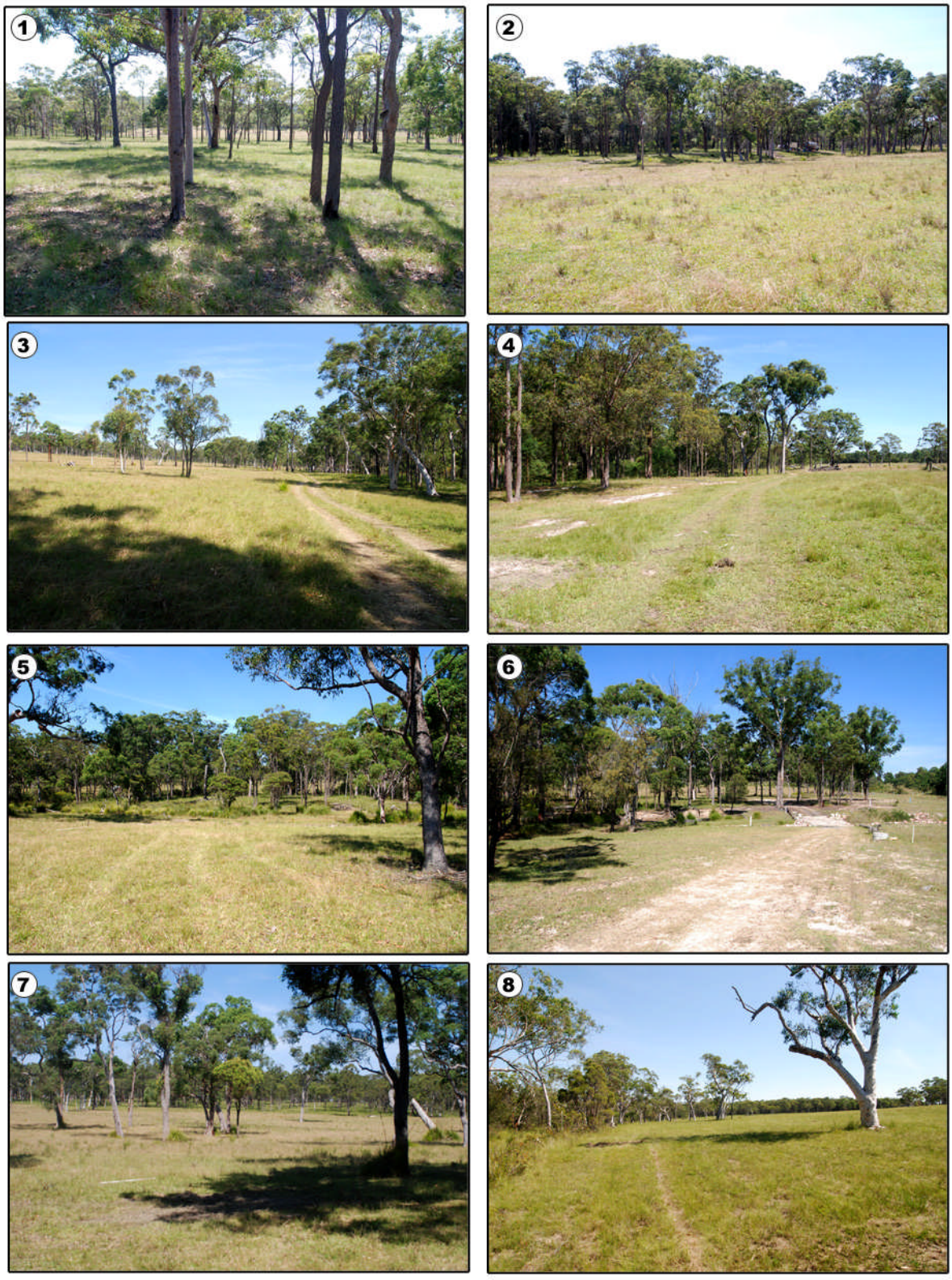


Figure 6: Aerial view of the Tooheys Road Study Area showing the location of photographs in Figure 5.

As can be seen in **Figure 5**, the excavation areas can be characterised as primarily consisting of gently sloping, cleared land. While soils are reasonably deep within accumulation areas on the valley floor along Wallarah Creek, the hill sides tend to have shallow soils. All areas investigated had undergone relatively severe prior disturbances in the form of tree clearing, erosion and, in places, ploughing for pasture improvement.

3.1 Topography and Geology of the Study Area

Topography within the study area is characterised by gentle rises ranging in elevation from c. 10 m Australian Height Datum (AHD) surrounding Wallarah Creek to c. 50 m AHD in the south-western portion of the Study Area where the Pit Top Facility is to be located.

According to the Sydney 1:25k Geological Series Sheet SI 56-5, the Study Area is within the Clifton Subgroup of the Narrabeen Group and forms part of the Tuggerah Formation. These areas have moderately deep (50–150 cm) yellow earths, yellow podsolic soils and soloths with low usable nutrients.

3.2 Hydrology of the Study Area

Hydrology within the Tooheys Road Study Area features Wallarah Creek that drains east into the Budgewoi Lake.

Wallarah Creek is a permanent source of water. The headwaters for this creek are c. 2 km west. Approximately 700 m of this creek occurs within the Study Area.

Figure 7 shows the specific areas that comprise the excavation Study Area. They are both banks of Wallarah Creek in the southwest of the Tooheys Road Study Area and the northern bank of Wallarah Creek in the vicinity of the Eastern Arm Rail Loop.

3.1 Topography and Geology of the Study Area

Topography within the study area is characterised by gentle rises ranging in elevation from c. 10 m Australian Height Datum (AHD) surrounding Wallarah Creek to c. 50 m AHD in the south-western portion of the Study Area where the Pit Top Facility is to be located.

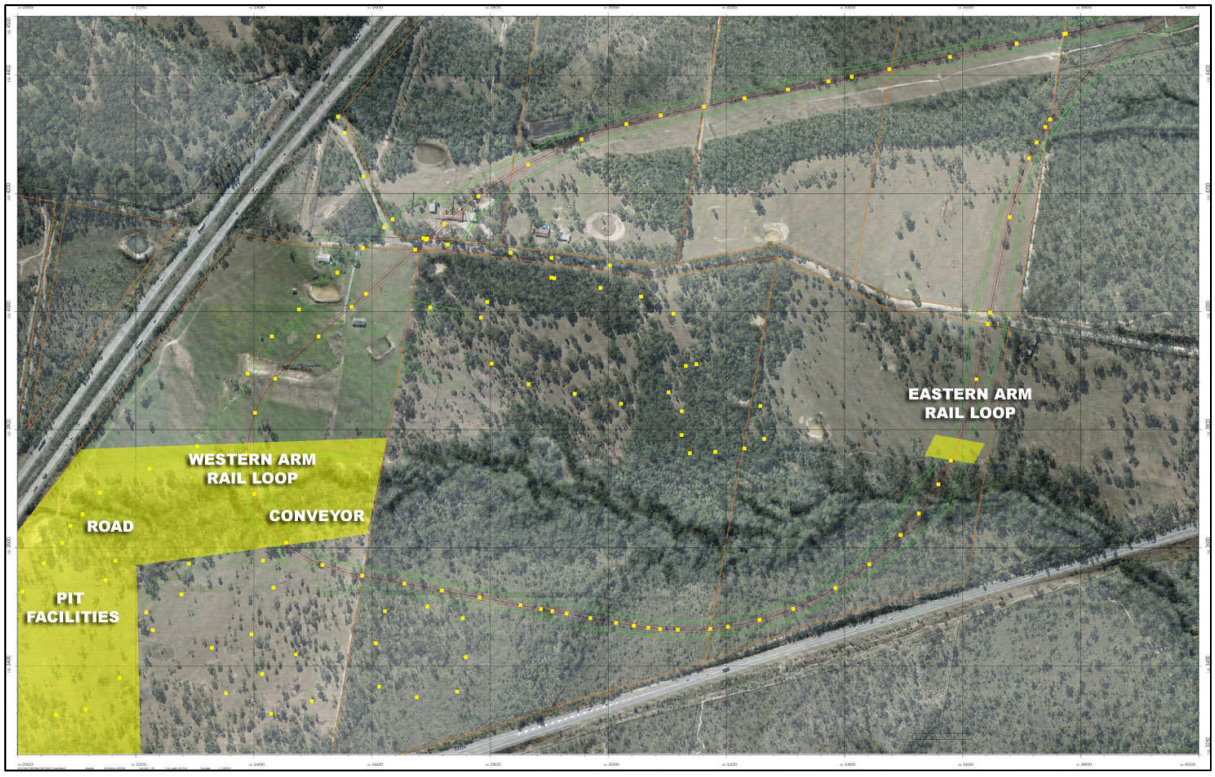
According to the Sydney 1:25k Geological Series Sheet SI 56-5, the Study Area is within the Clifton Subgroup of the Narrabeen Group and forms part of the Tuggerah Formation. These areas have moderately deep (50–150 cm) yellow earths, yellow podsolic soils and soloths with low usable nutrients.

3.2 Hydrology of the Study Area

Hydrology within the Tooheys Road Study Area features Wallarah Creek that drains east into the Budgewoi Lake.

Wallarah Creek is a permanent source of water. The headwaters for this creek are c. 2 km west. Approximately 700 m of this creek occurs within the Study Area.

Figure 7: Aerial photograph of the Tooheys Road Study Area showing the areas investigated by the current test excavation programme.



3.3 Vegetation of the Study Area

The Study Area has been cleared, at some point in the past, of almost all of its original vegetation. Only isolated trees, that were either young when the clearing took place or have regenerated since, survive within the Study Area. The grass cover is thick and while native species are regenerating, the majority are exotic grasses.

3.4 Existing levels of disturbance

Portions of Wallarah Creek have undergone heavy disturbance as can be seen by the highly modified open channels in the west of the Study Area at the location of works associated with the construction of the Morisset to Warnervale water trunk main (Hunter Water Pipeline) and numerous other services and pipelines.

Other areas along Wallarah Creek have been trampled by stock and there is evidence of in-filling in recent years with identifiable levee banks of alluvium. Areas of erosion occur resulting from land clearing practices and prior agriculture.

Vegetation has been largely cleared within the past 50–80 years. Although some remnant trees remain and varying levels of soil disturbance have occurred, there has been some regeneration of native vegetation, particularly associated with the creek.

In general, the Study Area has undergone heavy disturbance from past land uses and while the disturbance is variable, there are no areas within the Study Area that are not disturbed to some level.

4.0 Archaeological Context

Although the exact position of pre-European tribal boundaries is not clear, most of the Central Coast in the Gosford and Wyong area was the country of the Darkinjung tribe; an area today covered by the two local government areas. Their neighbours were the Daruk people, whose country included the shores of Broken Bay and extended south to Sydney Harbour, the Awabakal tribe, who lived around Lake Macquarie in the north, the Wiradjuri tribe to the west, and the Wonnarua tribe to the inland north (www.samuseum.sa.gov.au).

The Darkinjung lived by fishing, gathering bush foods and hunting. The region was part of an extensive trade network and large ceremonies were held at times of the year when fish were plentiful. Ourimbah, in the middle of the Central Coast region, was a ceremonial ground in which boys were initiated (Vinnicombe 1980).

The European occupation of Australia started at Sydney in 1788 and its effects were soon felt in Darkinjung country. Smallpox, measles and other exotic diseases quickly reduced the population (Stinson 1979: 11). It is also recorded that the Darkinjung men did not take too kindly to the invasion of white settlers to the area. According to the Town and Country Journal, 6th March 1875 Aboriginal men were “ruthlessly slaughtered” when reacting to the provocation of the stealing of land or women.

Before the invasion there may have been 1,500 Aborigines in 12 family groups living between the Hawkesbury River and Lake Macquarie. In six years, between 1821 and 1827, the Darkinjung population was reduced from 200 to 65. A second smallpox epidemic in about 1828 almost completely destroyed the local population. In 1874 Billy Fawkner, said to be the last remaining Darkinjung, drowned in Tuggerah Lake, which had been the source of life for his people (Stinson 1979).

After the dispossession of Aboriginal people from their land, Aborigines and White Australians tended to live separately in space (Coombs 1994: 70). Though there were a few people who may have been descendants of the original inhabitants living near Mangrove Mountain (Vinnicombe 1980). The Central Coast region grew rapidly as a centre of European population. By 1968 a local historian could comment that 'these friendly and worthy people... are no longer with us' (Bennett 1968: 3).

4.1 Regional Heritage Surveys

Although there is quite a long history of archaeological investigations in the Central Coast region, much of this research has been somewhat limited, with areas selected on the basis of development or specific site types. Studies have generally been based on coastal areas, with little work carried out to the west of the lakes. As a result, there is not enough information available for a regional model of Aboriginal settlement and population movements to be developed (Dallas 1986:4, Dallas *et al* 1987). However, results of previous work indicate that all of the available environments (rocky shore, estuarine, beach and swamp) were exploited by Aboriginal populations. Known sites in this area include open camp sites, axe grinding grooves, middens, scarred/modified trees, shelters with art/deposits, burials and quarries. Approximately 270 Aboriginal sites within the Wyong area are listed on the NSW DECCW AHIMS database. More sites are added to the list as further specific studies are completed (Wyong Shire Council 2004). The oldest date for the region (11,050 years BP) is based on evidence from Logger’s Shelter at Mangrove Creek, located by Attenbrow (as cited in Vinnicombe 1980).

Wyong Shire

Patricia Vinnicombe (1980) undertook a major survey that sought to categorise and define Aboriginal heritage resources in the Gosford/Wyong area (further to the south of the Tooheys Road Study Area) as a means to integrate cultural heritage into the early stages of development planning. The project comprised a thorough background research, detailed survey and analysis of results to produce a predictive model for the region. Vinnicombe identified various ecological zones within the study area and sought to determine the differences within and between these areas that might make Aboriginal site prediction more accurate. Three different environments were investigated, including open coastline and coastal estuary, riverine estuary and inland sclerophyll forest.

Vinnicombe conducted intensive 10 km^2 surveys within each of these three zones, identifying an average of 11 sites/km^2 in coastal estuary areas, 8 sites/km^2 in riverine estuary areas and 6 sites/km^2 in inland sclerophyll zones. Given the (then) current levels of development and the ecological make up of the Gosford/Wyong area, Vinnicombe predicted that there could be an overall total of 13,000 sites within the locality. Vinnicombe was also able to postulate that decreasing site densities are directly related to the distance from marine resources.

A total of 243 sites were recorded during intensive survey, as well as additional sites recorded in spot surveys and ad hoc inspection[2]. A total of 127 rock shelters with occupation evidence were located, along with another 469 shelters considered to be potentially habitable. These were mainly associated with Hawkesbury sandstone rather than the type of geology found in the Wallarah 2 Coal Project area.

Vinnicombe concluded, on the basis of recorded rock shelters with evidence of human occupation, that proximity to permanent water sources was not a factor in site selection, as habituated shelters were most commonly found on high ridge tops, far from drainage lines; although water was still available, either from rock pools, seepage or aquifers.

Art sites within shelters (67) occurred in both high ridge tops and on lower valley slopes. The size and aspect of the shelter did not seem to be a key factor in the location of art sites. Art included figurative and non-figurative work in wet pigment paintings (mostly red with some white and black), stencils (predominantly white, red, yellow and pink) and dry pigment drawings (most commonly black). Images were found on both ceilings and walls. Engravings within shelters were rare.

A total of 49 middens were recorded in sandy, alluvium and Narrabeen Formation landscapes, and these were most often observed near freshwater creeks/aquifers at the bottom of slopes towards the valley floor.

Artefact scatters were not commonly observed during survey. Five were located (only one is recorded as a separate site, the others as middens or shelter with deposit), all of which were either associated with middens or found on creek banks or a high plateau.

A total of 54 grinding grooves were found, mostly in and along creek beds at the heads of valleys on Hawkesbury Sandstone. These were also found on Narrabeen Group sandstone(s) although not as often as in Hawkesbury Sandstone.

Engravings usually consisted of pecking, abrasion or both. Most motifs were human, fish or macropods, with birds and other animals, weapons and animal/human tracks also being observed. Of

[2] The results of Vinnicombe's 1980 survey have been cited from ERM 2001.

the 12 engravings recorded, they were usually found in Hawkesbury Sandstone on ridge tops and plateaus. Others were found on Narrabeen Group sandstone(s) at sea level.

As the Gosford-Wyong area has been heavily logged in the past, scarred trees were considered rare in the region.

The majority of the 1000 registered sites listed on NPWS records for the Gosford-Wyong area at the time of the Vinnicombe study were engravings, axe grinding grooves, rock shelters containing art and shelters with deposit. Shell middens, stone arrangements, open camp sites, burials and quarries were also recorded but in far fewer numbers. Vinnicombe argued that the bias in favour of engravings in the NPWS register largely reflected past survey strategies. In addition, the greater Gosford-Wyong area was dominated by Hawkesbury Sandstone ridges and as a result, the predominance of sandstone-derived sites recorded may have contributed to this trend.

Tuggerah-Sterland 330 kV Transmission Line

Dyall (1981) conducted a survey for the then Electricity Commission of NSW on the route of the Tuggerah-Sterland 330 kV transmission line located 10km south of the study area. A total area of 120 square kilometres was covered by this survey, encompassing a variety of landforms, including steep Narrabeen sandstone ridges and Gosford sandstone (Terrigal Formation) outcrops. Particularly the eastern portion of the survey covered similar landforms to those found in the current study area.

Thirteen Aboriginal occupation sites were recorded during the survey. An ‘art gallery’ was identified at the head of Moran’s Creek. Six rock shelters were located, one with a single drawing. Six sets of grinding grooves were also identified, ranging from a single groove to a set of seventeen, all located in minor creeks, at locations where the creeks flow over sandstone shelves, high on the ridges. Two isolated finds of stone flakes were also recorded.

Based on the results of the preliminary survey, Dyall hypothesised that while it was unlikely that more art would be found within the study area, a more detailed survey should reveal more Aboriginal material, especially around the swamp areas.

Hue Hue Road

In 1986 the Wyong Shire Council commissioned an archaeological survey along Hue Hue Road as part of their Draft LEP (Dallas 1986). The study area consisted of land abutting Hue Hue Road, to the west of the Sydney-Newcastle Freeway.

Based on the limited previous archaeological work in the area and the environmental setting of the site, Dallas limited site prediction to open camp sites and scarred trees.

A surface scatter of three artefacts was identified, on compact exposed clays and gravels, located on a slope overlooking a creek. The artefacts consisted of a yellow mudstone flake, a grey silcrete flake and a yellow chert flake. It was assessed as unlikely that any undisturbed subsurface deposits remain in the area.

The scatter was interpreted to represent sporadic use of the area. Its location may indicate use of the area by small foraging groups who would have exploited the resources of the nearby swamp. However, European land use practices are likely to have obliterated any traces of substantial significant occupation sites within Dallas’ study area.

Morisset Forestry District

An archaeological assessment in the Morisset Forestry District (MFD), north of the study area, was undertaken by Kinhill Engineers (Kinhill 1995) as part of an EIS for proposed forestry operations. The study aimed to describe the Aboriginal heritage and cultural values of the area and considered the likely environmental impact of forestry operations on Aboriginal heritage sites. The study also endeavoured to establish the nature and distribution of stone artefact scatters across the landscape, as it appeared that the database for sandstone sites was sufficiently large enough for predictive purposes.

The study area was approximately 1,160 square kilometres in area, and was divided into 10 environmental zones based on geology and topography. The geographical nature of these zones was used to predict the frequency and distribution of different site types.

A total of 41 Aboriginal sites were recorded during survey, including open artefact scatters, axe-grinding grooves and rock shelters. Of the 22 open artefact scatters, the majority were low density sites with an average of six artefacts per site. The largest artefact scatter contained 34 pieces. Most scatters were located on ridge tops or valley floors (ERM 2001).

The Kinhill study concluded that the area's long logging tradition explained the low numbers of open artefact scatters. Years of logging had disturbed those areas where artefact scatters usually occur (ridge tops and valley floors), while the higher number of sandstone sites (rock shelters and engravings) was probably due to the fact that logging activities were concentrated away from sandstone outcrops.

Ourimbah State Forest

An archaeological investigation in the Ourimbah State Forest, Mangrove Mountain near Gosford, NSW, (approximately 5 kilometres southwest of the Study Area) was conducted by Silcox (1996) in preparation for further forestry activities.

Silcox recorded a total of 59 new sites during survey, including 40 axe grinding groove sites, 18 shelter sites and one boulder with art. Of the axe grinding sites, 50 percent were found on creek beds of major tributaries on valley floors, 32.5 percent on top of or on the side of ridge tops, 12.5 percent on the plateau surface, and 5 percent were found on the sloping sides of plateau. The number of grooves in each site ranged from two to 131.

Of the shelters, 72 percent were found along the ridge sides and ridge tops/cliff lines, 17 percent were found on the plateau surface, 5.5 percent were found on the side of the plateau, and 5.5 percent were found on the lower side of a valley.

Hue Hue Road

Nexus Environmental Planning (1998) undertook an archaeological survey at the proposed Green Waste Processing Facility on Hue Hue Road, Warnervale, adjacent to the Buttonderry study area, as part of an EIS in preparation for a development application.

The site had previously been used as a waste disposal area and therefore it had already been highly disturbed and stripped of vegetation due to previous land use. Further, the new facility was to be built on land fill. No items of archaeological or heritage significance were found on the site. It was also concluded that any items which may have previously existed, were probably removed during the previous stage of site development.

4.2 Regional and Local Archaeological Context – Excavated Lithics

Lake Macquarie to Broken Bay

In 1975–1976 a survey was undertaken to locate shell middens between Lake Macquarie and Broken Bay (Stockton 1977). This 79 km coastline has at least 40 sites resulting in a density of 0.51 sites/km. A cluster of 7 sites were recorded at Norah Heads at the southern end of Budgewoi Beach, approximately 15 km southeast from the Study Area. The middens recorded were beach, dune and cliff-top middens and while the middens in general lacked large numbers of stone tools, one midden at Norah Head (midden #17) contained a good assemblage of artefacts of the small tool tradition that included Bondi Points.

Mangrove Creek Dam

The largest systematic and best-published survey in the region took place in the 1970s and the 1980s in the Mangrove Creek dam catchment area located in the sandstone hinterland of the central coast and approximately 30km southwest of the study area. During the salvage programme, Pat Vinnicombe introduced the concept of potential habitation (PH) shelters as it was realised that many rockshelters without any visible sign of Aboriginal use had deposits that looked as if they would contain archaeological materials. Important to future archaeological investigations, this work introduced the concept of potential archaeological deposits (PADs) to Australia (Attenbrow 2004a). 28 rockshelters with deposit were excavated during this salvage programme, along with many open artefact scatter sites. Of the 28 rockshelters, only 16 had been recorded as having archaeological deposit from the presence of surface artefacts sighted during the site survey. Of the twelve potential archaeological deposits in rockshelters that were test excavated, eight (67%) proved to contain sub-surface cultural materials. Additionally, this salvage programme was among the first pieces of research aimed at the scientifically rigorous understanding of an environmentally defined area that was able to shed light on the processes of ‘intensification’ of Aboriginal occupation during the late Holocene around 4000 BP (Attenbrow 2004b).

4.3 Potential Lithic Sources

Geological data indicates that the Study Area lies in an area dominated by sandstones. While this environment provided habitation opportunities, it was not a desirable stone for lithic manufacture. In environments, such as at the Tooheys Road Study Area, most stone used to manufacture stone tools or lithics would have been imported — some over considerable distances. Without technical analysis of the stone, it is impossible to determine the quarry source but with easy access to the coast, the Aboriginal inhabitants of the Tooheys Road area would have been in touch with vigorous trade routes. Anecdotal evidence from the land manager of the Tooheys Rd site, whose family has been in the area for three generations, did note that the ridge top south of Wallarah Creek had been used as a track by Aboriginal people in the late nineteenth century and that they had used this route to access some stone resources further to southwest, although the location of this resource was unknown.

5. Field and Analytical Methods

5.1 Objectives of the excavation programme

Ground surface visibility during the heritage assessment of the Tooheys Road Study Area was extremely variable (OzArk 2009). While no sites were recorded during the course of the survey, areas with very low ground surface visibility were, nevertheless, in landforms that had potential to contain archaeological deposits. This area was termed a zone of archaeological sensitivity.

The excavation programme was therefore designed to determine the following:

- Whether further archaeological material was present in the zone of archaeological sensitivity and if so, determine the integrity, extent, spatial distribution and nature of this material; and
- On the basis of these investigations, further management recommendations for the proposed works could be formulated.

To determine the *integrity* of the deposit involves an assessment of the 'intactness' of the archaeological material within the landscape. This leads into the second factor, which involves an assessment of the amount of disturbance that has occurred in the landscape either through taphonomic processes or through other forms of sub-surface disturbance such as agriculture practices etc.

A determination of the *spatial distribution* of artefactual material within the limits of a site involves quantifying their presence relative to the identified landscape units. In this case, information on this aspect of the investigation was necessarily limited as the research design was to limit impact to particular sites by only excavating in areas facing direct impacts from the proposed works. Thus broad scale excavation was not required due to the limited nature of the direct impacts.

Determining the *extent* of the site/archaeological landscape involves broad assessment of the boundaries of the artefactual material. This includes attempting to determine the background presence of artefacts versus higher densities or unusual/diagnostic artefact types (i.e. 'features'). In accordance with the Draft Statement of Commitments and Recommendations (OzArk 2009) for the project, excavations were restricted to areas of direct impact. This means that information relating to the extent of the sites would be limited within this particular excavation programme due to the small number of pits being proposed at each location.

The *nature* of the site refers to the type of site or types of activities indicated by the artefactual material. In essence, the nature of the Aboriginal cultural and economic use of the area and its resources and how this may be reflected in the material cultural remains at the site.

Data retrieved from the excavations may also shed light on other interesting research issues including:

- The procurement of raw materials and the type of artefacts in relation to raw material choice and availability; and
- A desk-top comparison between the assemblage retrieved from these excavations in comparison with those from excavated sites both nearby, and those further afield but within the same broader region (this would include Yamble Bridge (OzArk 2004a), Wollar to Wellington ETL excavation sites (OzArk 2008), shelter sites at Bobadeen

(Moore 1970 and 1981), HSG5 (White 1999), Botobolar (Pearson 1981), and somewhat closer to the Study Area, Capertee 3 (Johnson 1979, Hiscock & Attenbrow 2004) and Lidsdale (OzArk 2004b), and Moolarben Coal Mine study by Hamm & Tickle (2006).

In conclusion, the results of the excavation programme will enable an assessment of the significance of the site and/or landscape based on the factors outlined above. In combination with information concerning the nature of the proposed impacts, this data will contribute to a determination of appropriate management recommendations.

5.2 Personnel

Section 1.4 outlines the consultation process with the Aboriginal community, while the following is specific to the excavation programme.

The test excavation programme was undertaken from 15–19 March 2010. The excavations were directed by Dr Jodie Benton and Ben Churcher. They were assisted by archaeologist, Kim Tuovinen. Phillip Cameron was Operations Manager. Listed below and representing the following groups, are the personnel who worked at various times throughout the excavation programme:

- 15–17 March
  - Sharon Hodgetts (Darkinjung Local Aboriginal Land Council: DLALC)
  - Tracey Howie (Guringai Tribal Link Aboriginal Corporation: GTLAC)
  - Chevy Heath-Walker (GTLAC)
  - Warren Howie (GTLAC)
  - Kevin Robinson (GTLAC)
  - Trudy Smith (GTLAC)
- 18–19 March
  - Sharon Hodgetts (DLALC)
  - Darren Carney (DLALC)
  - Yvette Walker (GTLAC)
  - Tracey Howie (GTLAC)
  - Warren Howie (GTLAC)
  - Kevin Robinson (GTLAC)

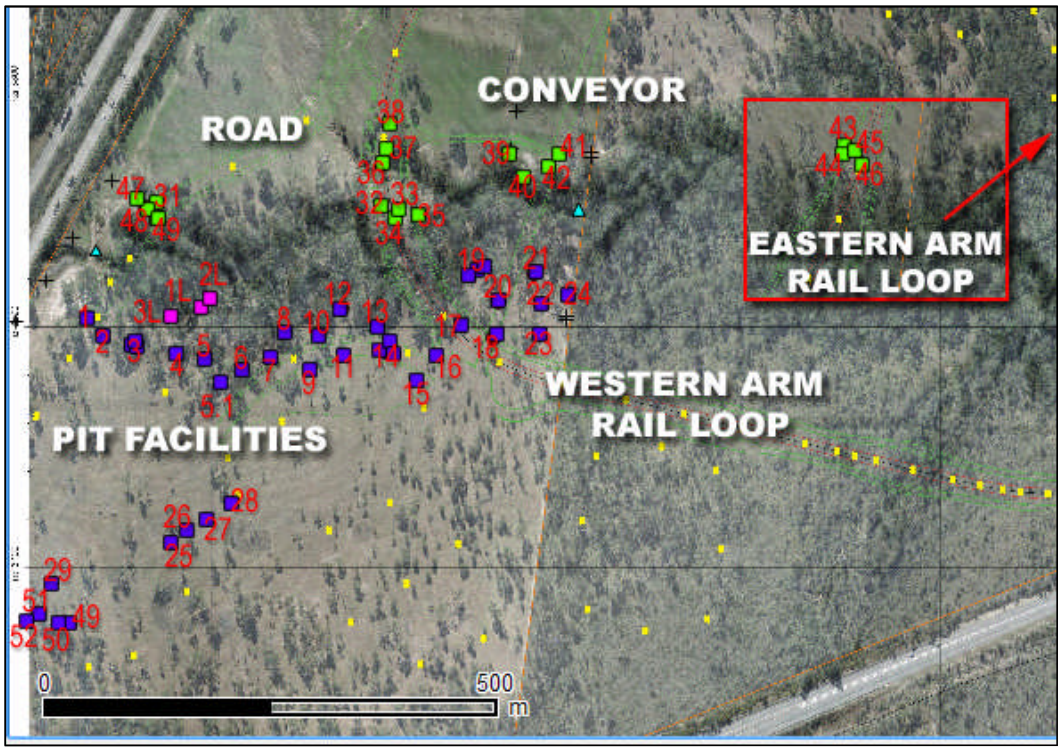
5.3 Layout of excavation squares

Sixty 1 x 1 metre excavation pits were laid out to fully sample the impact areas.

As the greater potential impact is on the southern bank of Wallarah Creek, 45 excavation pits were randomly placed to capture information about deposits along Wallarah Creek, as well as from the creek up the hill to the south. As can be seen in **Figure 8** the majority of the excavation pits (36 of the 45) were clustered along Wallarah Creek on landforms that had not been severely impacted by flooding. The remaining nine excavation pits were placed to the south of the creek to assess the nature of the deposits on the hill side.

Beyond the test excavation methodology outlined in Section 2.2, it was determined that as we had the capability to do preliminary analysis of stone artefacts in the field, that artefacts would be immediately identified. This allowed the excavation team to place further excavation pits around the location of a pit that recorded an artefact. The aim of this was to determine if the recorded artefact was likely to be an isolated find, or part of a site. This expansion around an original excavation pit occurred at four locations surrounding: pit 3, pit 14, pit 19 and pit 20.

Figure 8: Aerial photography of the Tooheys Road Study Area showing the location of the excavation pits. Purple pits are on the southern bank, green pits are on the north bank, and pink pits are on a levee bank on the south bank.



On the north bank of Wallarah Creek the test excavation methodology was to target areas of direct impacts. Therefore pits 31, 47, 48 and 49 were to assess the area of the road to the pit top facility, pits 32–38 were to assess the location of the Western Arm Rail Loop and pits 39–42 assess the location of the conveyor where it crosses Wallarah Creek (**Figure 8**). The location of these infrastructure items were marked in the field by surveyor's pegs.

To the east where the Rail Loop crosses Wallarah Creek (Eastern Arm Rail Loop), four pits (pits 43–46) assessed the northern bank of Wallarah Creek.

In this way the location of the pits enabled a considered examination of the archaeological potential of the entire southern bank of Wallarah Creek within the Study Area, as well as areas of direct impact in other areas.

5.4 Artefact retrieval

The sampling methodology adopted allowed a large number of pits to be examined. As mentioned in Section 5.3, this sampling methodology did allow additional excavation pits to be dug around any pit containing an Aboriginal artefact in an effort to determine more closely the nature of the deposit.

The sampling strategy called for a random placement of pits within landforms that were not extensively impacted by flooding, machine excavation of all pits (**Plate 2**) (with accompanying tidy-up work: **Plate 3**) and wet sieving 10 buckets of deposit from each spit[3] (**Plate 1**).

In this way it was hoped that the excavation would give an indication of the nature of the archaeological deposits across a broad area: especially given that the proposed impact to the area will be severe.

All excavation pits were excavated down to, or into, the B Horizon clays[4].

All sampled deposits were wet sieved on site using a water truck and nested sieves of 6.2 mm and 3.2 mm mesh. This allowed the retrieval of small flakes and other debitage.

5.5 Stone artefact analysis[5]

5.5.1 Objectives of the Lithic Analysis

Lithic items were recorded in certain technical ways, but the variables were designed to access information on what people were doing – to learn something of what people did with stone and how they organised its use. From this it is possible to understand something of the technological strategies that were in place and perhaps develop – or contribute to – a model of site use/occupation. The analysis was carried out within the general framework afforded by "technological organisation".

Nelson (1991: 57) has defined technological organisation as:

> *...the study of the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance.*

A starting point for such a study is the use of raw materials. What stone types were used? Was the stone of good flaking quality? Was the stone transported a long way from its source? In what form was the stone transported (e.g. small pebbles, larger cobbles, flakes struck from cobbles, or spalled pieces)? How big was the transported stone? Was the stone prepared at or close to its source before being transported to domestic contexts? Were there differences in the way different types of stone were obtained and consumed?

How was the reduction of stone and the production of tools organised? Did people flake a lot of stone in one location and make tools *en masse* (as on a reduction site or knapping floor on which backed artefacts were made)? Was a core carried around and just one or a few flakes struck from it when needed (expedient flake production, e.g. Hayden 1977: 179)? Is there evidence for tool retouching (e.g. debitage which had been struck from tools even if the tools are not present in the assemblage)?

The analysis presents technical data, which can be used for comparative purposes for other projects. The data is also interpreted in behavioural terms to describe something of peoples' activities and/or the technological strategies that they put in place.

---

3 Spit = 1 m^2 x c.10 cm deep layer (i.e.) one 1 x 1 m^2 'pit' may be comprised of several 1 m x 10 cm 'spits' or layers. Sieving 10 buckets from each spit normally meant that over three quarters of the deposit was sieved. Spits were used as there was no archaeological stratigraphy present in any of the pits.

4 The B Horizon is where archaeological material will not occur below.

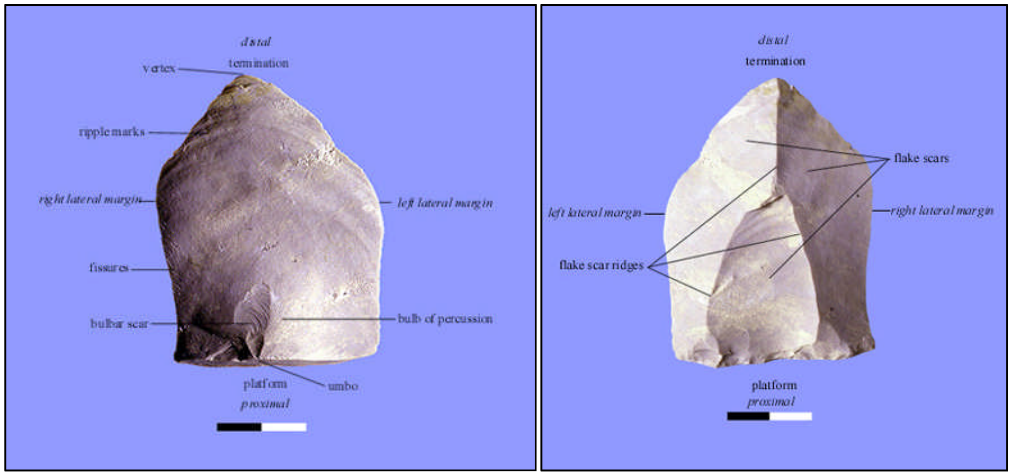
5 Compiled from lithic analysis research designs for other OzArk projects, primarily based on the work of Dr. Elizabeth White and Dr. Chris Clarkson.

5.5.2 Artefact identification

Stone artefacts are identified using technical criteria based on stone fracture mechanics, as described by Speth (1972) and Cotterell & Kamminga (1987), and discussed by Baker (1996). A glossary of terms is included in Section 5.5.3.

A flake is a piece of stone which was struck from a larger rock. The larger rock (called a core) may be held in one hand or rested on an anvil, and hit with a hammer stone to break off smaller pieces (called flakes). Flakes show specific technical features (see **Figure 9**). Essentially, a flake must have a platform, a point of impact (force application), a Hertzian cone, and a bulb of percussion. Flakes may also show lines resulting from shear fracture, a bulbar scar (also called eraillure scar) and ripple marks (Speth 1972: 35). These features may be more or less pronounced, depending on the quality of the stone material, the hardness of the hammer relative to the stone, and whether an anvil was used and the manner of its use.

Figure 9: Main characteristics of a flake. Ventral surface to left, dorsal surface to right[6].



5.5.3 Recording Scheme

The recording scheme used for this project has been designed to provide information on the research design of the project and to be comparable to other artefact assemblages recorded in the area.

Provenance data

The pit and spit number is recorded for artefacts recovered from the excavations.

Artefact Type

This category records the type of artefact in each record. Potentially these descriptors could include:

- *Core* (functioning as a raw material supply). A piece of stone, which was flaked to produce artefacts that could be used as, tools. The piece of stone may have originally been a cobble, a flake, a broken flake, a flake fragment, a flaked piece, a heat shatter or a naturally broken rock. Cores are identified as artefacts with negative flake scars only, or where flakes (or broken flakes or flake fragments) are reduced as cores. Four

[6] Figures 9–13 from S. Holdaway, N. Stern, *A Record in Stone*, Museum Victoria and AIATSIS, 2007.

types of cores are distinguished in this report: unifacial (all flakes struck from one platform), bi-directional (flakes struck from two platforms on the one face of the core), bi-facial (flakes removed from two faces of the core, often along one ridge that forms the platform) and multi-directional (two or more platforms where the flakes have been removed in a variety of directions). **Figure 10** illustrates these major core types. **Figure 11** illustrates the description of the type of flake that has been removed from a core (entered under 'notes').

- *Core Fragment*. During the use of a core it may break when pressure is applied, or more commonly, a portion of the core is removed to make the core a more acceptable shape for the knapper. Core Fragments often have the appearance of a flake (i.e. they have flake-like features on the ventral surface) but their dorsal surface displays the attributes of its previous use as part of a core (such as ridged blades).
- *Flake.* The lithic struck from a core that has not been modified. A flake is determined as being more than twice as wide as it is long.
- *Flake Fragment.* A flake that has been broken, most often post-use. A flake fragment may have either the proximal or distal end missing.
- *Blade.* A blade, also struck from a core as is a flake but often from unifacial or bifacial cores with parallel ridge scars. Blades are more than twice as long as they are wide.
- *Backed artefact*. A flake, flake fragment or blade with blunting (vertical) retouch along one or more margins. The retouch must have occurred after the artefact was struck from its core. The retouch is usually initiated from the ventral surface. Backed artefacts may be of any shape, and particular forms may have included Bondi points, geometrics or amorphous backed artefacts. The presence of chord use-wear is noted where present.
- *Hand-axe*. Essentially taking the form of cores in that they display reverse scars only (and often referred to as core tools), hand-axes are often manufactured from fine-grained volcanic rocks (such as greenstone). When complete they show evidence of edge grinding on the cutting edge. A hand-axe blank is a hand-axe that has been roughly shaped by removing flakes, but shows no evidence of edge grinding (the manufacturing process was interrupted for whatever reason).
- *Burin*. A burin is formed from a flake after it has been removed from a core. The distinguishing feature of a burin is the removal of a flake (burin spall) originating from the distal end of the flake that partially removes one of the flake's lateral edges. This produces a sharp point at the flake's distal end that was often used for engraving stone or wood.
- *Scraper*. A scraper can be formed from a flake or have the appearance of a core tool. The distinguishing feature of a scraper is steep retouch at one end of the artefact that would enable the tool to be used for wood carving or scraping down the hides of animals for hide preparation.
- *Grinding stone*. Often manufactured from sandstone, grinding stones show evidence of smoothing on one or both sides. Not only does the grinding make the sandstone smooth to touch, but it often causes a concave to be formed in the rock.

- *Anvil*. A rock showing pitting on one or both faces. An anvil could have been used in lithic manufacture.
- *Hammer stone*. As the hammer stone was hand-held it often takes the form of an elongated cobble with evidence of pitting and bashing on at least one of the sides. Hammer stones were used in lithic manufacture, as well as tasks such as breaking down bones (for marrow), or tough vegetation for food preparation.
- *Debitage*. Small flaked artefacts and chips produced as a by-product of lithic manufacture.

Figure 10: Types of cores. From left: unifacial, bi-directional, bi-facial and multi-directional.

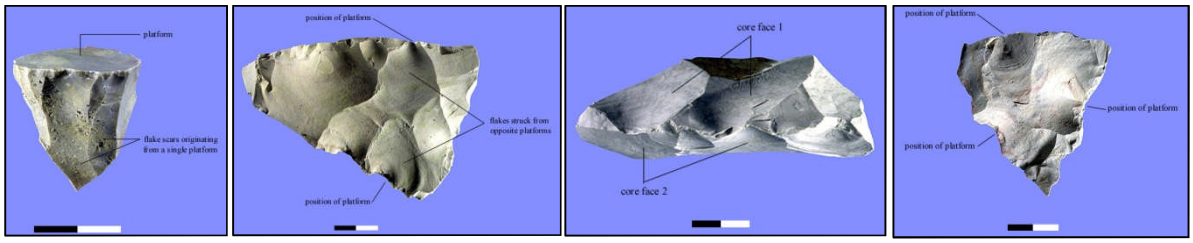
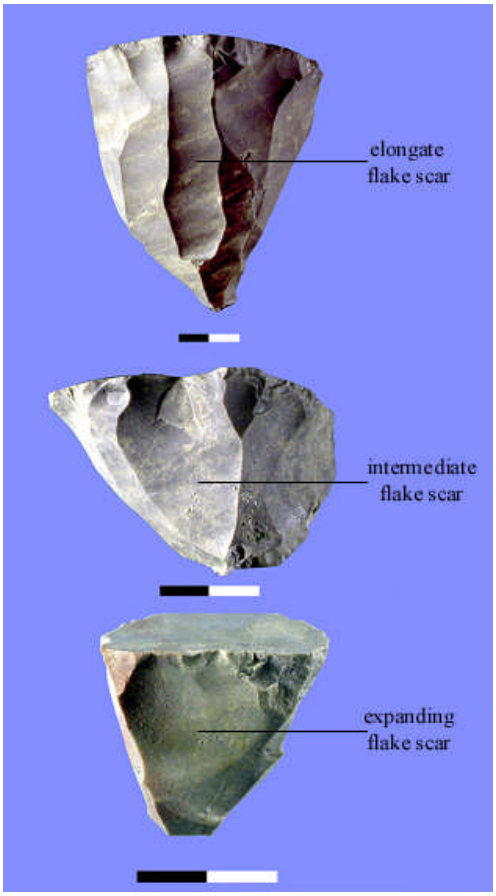


Figure 11: Descriptions of flakes removed from a core.

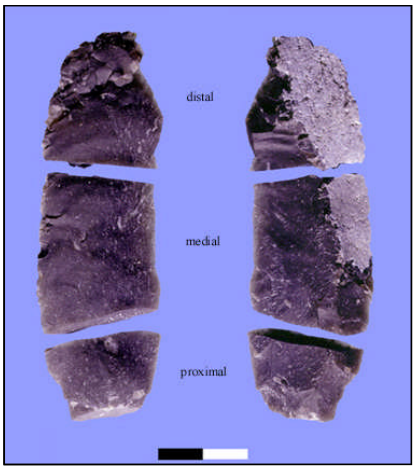


Break type

Denotes whether the flaked piece has been broken proximal, medial or distal (i.e. if the break is proximal, the proximal portion of the flake is missing: **Figure 12**). Notes are also made if the break is a snap (no sign of retouch), or terminated (evidence of deliberate retouch). Snapped flaked pieces

can either be as a result of intentional manufacture, use or post-use damage. Terminated flakes are deliberately created.

Figure 12: Ventral and dorsal views of a flake showing the different types of breaks.



Raw Material Type

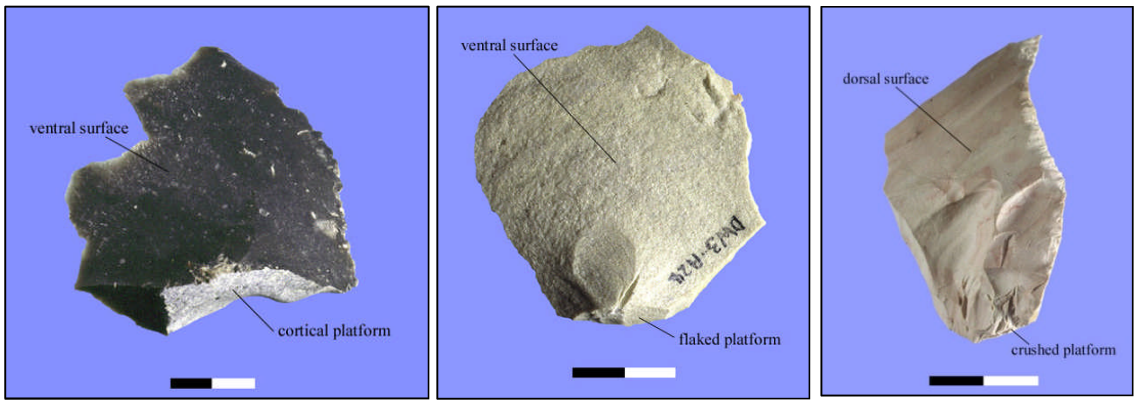
The raw material types potentially could include:

- *Chert* – often called silicified tuff or indurated mudstone
- *Quartz* – most often white or milk quartz.
- *Quartzite*. Siliceous stone with granular composition (metamorphosed sandstone)
- *Sandstone*. Stone with granular composition but less consolidated than quartzite.
- *FGS* (other fine grained siliceous). This category includes other fine-grained siliceous materials which are not silicified tuff, including chalcedony, agate, etc.
- *Igneous materials*. These include basalt, porphyrytic volcanic, and other igneous rock types. Due to the small numbers of artefacts of these raw materials, their usually coarse-grained textures, and presence of weathered surfaces, the generic term "igneous" is used rather than more specific identifications being attempted.
- *Other*. Other rock types which were unidentifiable, usually fairly coarse-grained materials.

Platform

Three descriptors are used in this category: Fine, Moderate and Wide. 'Fine' is used to describe platforms less than 0.5 cm wide, while 'Wide' is used to describe platforms more than 1 cm in width. 'Moderate' is for platform sizes between 0.5–1 cm. The width of the platform is often either a function of the type of raw material being used (i.e. finer-grained rocks are able to have finer platforms) or manufacturing techniques (finer platforms are often created by indirect percussion where a bone punch is used to precisely direct the knapper's blow). It is also noted whether the platform is cortical (is covered with cortex indicating that the flake has been removed from a cobble with little previous working), flaked (evidence of platform preparation prior to the flake being removed from the core) or crushed (crushing on platform removes any distinguishing features). **Figure 13** demonstrates the three forms of platform distinguished here. Not applicable (n/a) in this feature denotes that the platform has been removed by a break or the artefact is a core or other lithic without platforms.

Figure 13: The three forms of platform distinguished in this report. From left: cortical, flaked and crushed.



Termination

Largely dependent on the platform size and the force applied by the knapper, this report distinguishes three types of termination of a flaked piece at its distal end: feather termination (minimal thickness at the distal end and an acute angle between the dorsal and ventral surfaces), hinge termination (formed when the fracture meets the surface of the core at approximately right angles to the longitudinal axis of the flake) and step termination (when a flake terminates abruptly in a right-angled break).

Number of Reverse Flakes

A count of the number of flake scars on the dorsal surface of the flake. This count includes full and partial flake scars. Indistinct (often applied to white or milky quartz) is where the nature of the raw material makes it difficult to ascertain whether facets on the dorsal surface are natural or due to human manufacture. The number of reverse flakes is often an indicator of how much cores were worked at a particular site. If the majority of flakes have 2 or more reverse flakes it indicates that cores were extensively worked, while low reverse flake counts indicates that cores were not so intensively worked (as the site had abundant available raw materials for lithic manufacture?).

Cortex

Cortex is the weathered, natural surface of a cobble from which a flake has been struck. A flake without cortex is from a core already reduced by previous flakes (that have removed the cortex), while a flake with cortex is from a less-reduced core.

Dimensions

The dimensions of the artefact are given in L x W x D. For flake fragments or broken blades, only the extant length is given. *Length* measures the maximum length from the proximal to the distal ends of the artefact, *Width* is the maximum dimension from one lateral edge to the other and *Depth* is the maximum measurement from the dorsal to the ventral surfaces.

Notes

This category records the photo number of the artefact and any features such as the type of core, or the position of retouch.

6.0 Results

6.1 Soils and Stratigraphy

The excavations pits were positioned to gather as much information about the south bank of Wallarah Creek and areas of direct impact on the northern bank. As such pits were separated by up to 500 m as a large area of land was sampled. Consequently soil profiles in the excavation pits varied depending on where the pit was located. Generally, although this could vary even between adjacent pits, the soil profile was thin topsoil with humic matter, a mixed layer of sandy–clay and then either a consistent, deep layer of moist orange clay or hard-packed white clay. The soil profile was deeper in excavation pits located closer to the valley floor and they were generally deeper on the southern side of the creek when compared to the north.

None of the excavated pits contained archaeological stratigraphy, although in all cases there was a reasonable amount of taphonomic disturbance by plant roots and insect burrows.

6.1.1 Pit Descriptions

Figure 14 illustrates a sample of pits from across the excavation locations. As can be seen in this figure, the depth of deposits varied with deeper deposits in those pits closer to the creek. Generally the soils went from a shallow layer of humic 'topsoil' into a sandy–clay layer that varied in depth from a few centimetres to 20 cm. At the bottom of this sequence was moist orange clay (such as

Figure 14, pit 3) or very hard fine–white clay (such as **Figure 14**, pit 41) depending on the pit's location.

At one location (pit 20C) the excavator dug down into the clay horizon to assess the depth of the deposits and to ensure that no cultural material was below the clay (**Figure 16**). The result of this sondage show the classic sequence of soils at the site, although being close to the creek, pit 20C displayed deeper deposits than most: humic topsoil (to 10 cm), sandy–clay containing humic material, plant roots and ant burrows (to 40 cm) and, at the bottom in this instance, moist orange clay that appears to go to some depth.

Results show that no cultural material comes from the B Horizon clays and that all cultural material was recorded in the A horizon soils: either the topsoil (spit 1), or from the sandy–clays (spits 2–3).

All profiles lacked archaeological stratigraphy and there was disturbance evident in the form of plant roots and ant burrows in the artefact-bearing deposits. Further, many pits (such as **Figure 14**, pit 26) displayed disturbance in the fact that the upper layers of soil were 'blurred' possibly indicating disturbance from ploughing.

Figure 14: A selection of pit profiles from across the excavation area. Locations for each pit are shown in Figure 15**.**

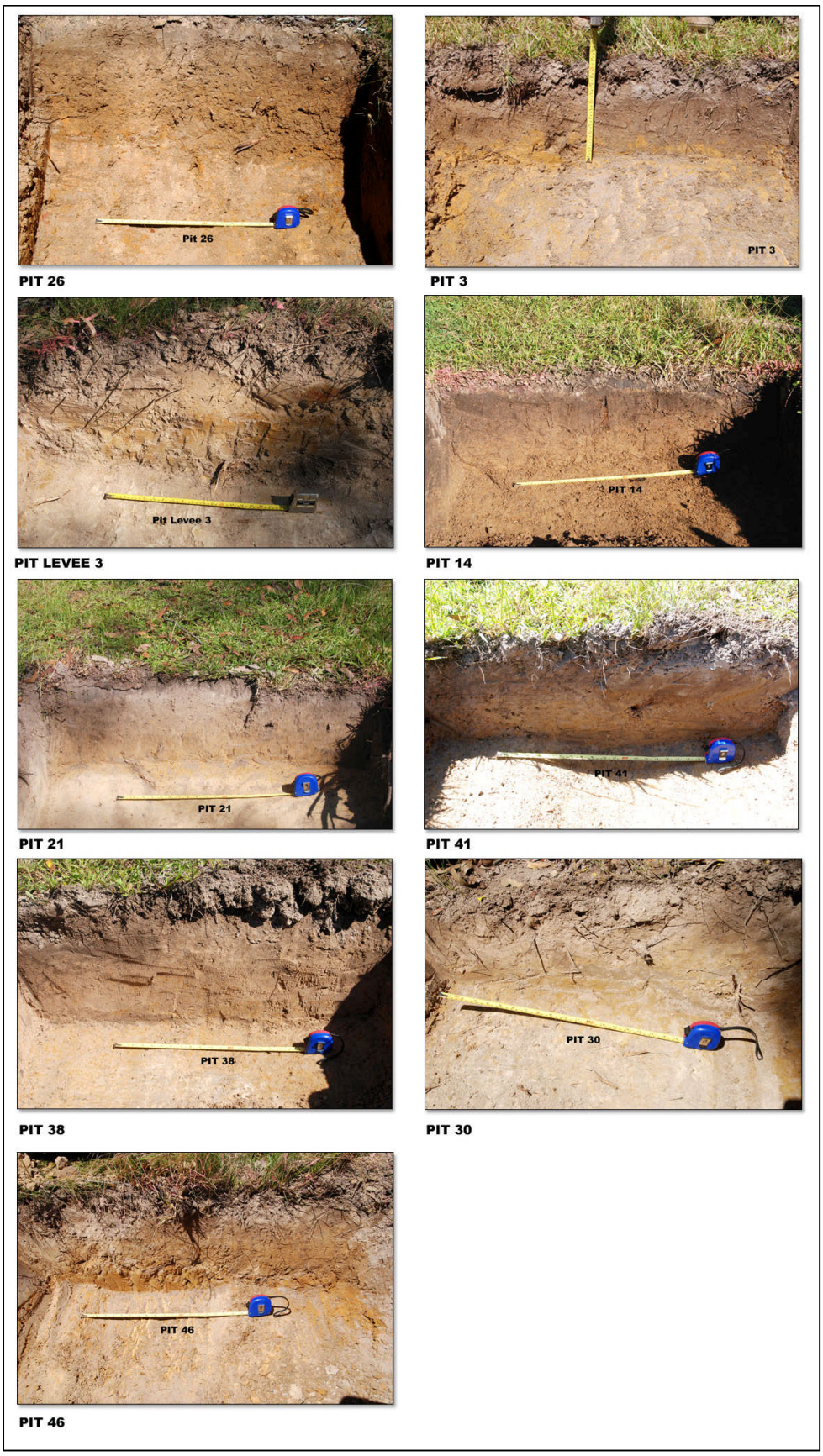
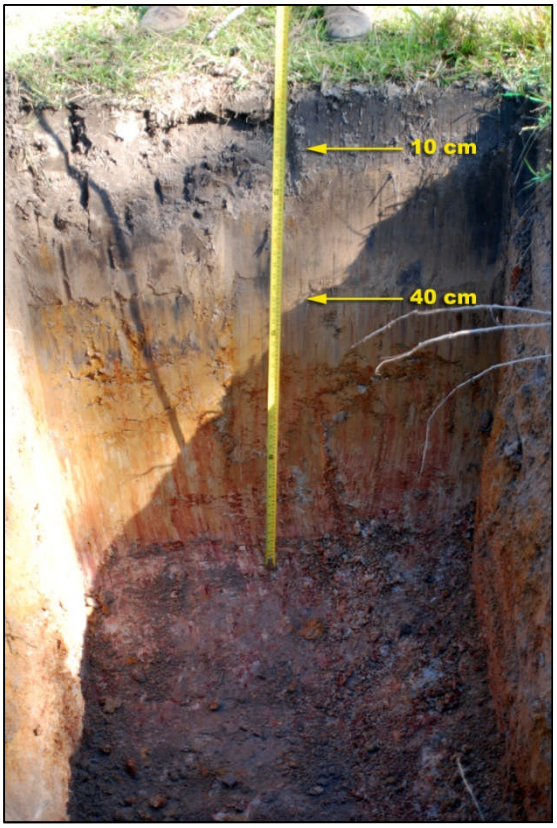


Figure 15: An aerial photograph of the Tooheys Road Study Area showing the location of pit profiles shown in Figure 14

.

Figure 16: Photograph showing the profile of pit 20C excavated well into the clay horizon to assess the depth of deposits.



Based on the results of all excavated pits, the following results are representative:

- Any artefacts recovered in the surface layer are probably disturbed and/or damaged;
- None of the locations are likely to be stratified in a chronologically useful sense;
- Because artefact burial is an ongoing process, surface visibility will be poor except where occasional flakes have been returned to the surface by surface disturbance or where erosion rates have been higher than average, and;
- The only means of dating any site will be from artefact cultural sequences or from the recovery of intact hearths or burials. All other dates, especially those based on detrital charcoal, including those based on thermo-luminescence, require clear archaeological stratigraphy because artefacts and charcoal can move through soil material of any age.

The following notes illustrate the soil profiles encountered at the Tooheys Road Study Area:

- The topsoil was generally thin across the study area, exhibiting discolouration due to leaf litter;
- The only pits displaying relatively thick topsoil were along Wallarah Creek and are probably recently deposited due to flooding;
- At most locations an orange clay layer formed the base of the A Horizon soils. There was no indication at any location of there being cultural material within this clay layer;
- Particularly to the north of Wallarah Creek, a very hard-packed, white clay delineated the top of culturally sterile deposits;
- Disturbance from plant roots and/or animal burrows (mostly insects) was noted at all locations. However, this disturbance was assessed as being relatively low as soil profiles remained generally intact, and;
- All locations had low levels of stone inclusions within the A horizon soils.

6.2 Artefact Analysis

6.2.1 Background considerations

Over the past 150 years archaeologists have endeavoured to research what can be learnt from the observed differences in lithic assemblages. The main points of the research can be summarised as follows:

Since the 1960s, archaeologists have discussed variation in the composition of artefact assemblages in terms of four key variables:

- the mechanical properties of the raw materials being worked;
- the techniques used to work those raw materials;
- the uses to which the tools in an assemblage were put; and
- cultural idiosyncrasies (or style).

For much of the twentieth century, artefact assemblages were interpreted as cultural markers. Bordes's study of variation in Middle Palaeolithic artefact assemblages is an example of the application of these ideas to the stone-age archaeological record.

The observation that contemporary hunting and gathering groups use different items of material culture for different purposes in different contexts led to the suggestion that the same structuring principles would have influenced the behaviour of prehistoric groups and, therefore, the composition of artefact assemblages. This idea was put forward most forcefully by Binford in the 1960s, to explain variation in Middle Palaeolithic artefact assemblages.

The properties of raw materials will influence the products of a particular stone-working technique, and experimental knapping studies can provide important information about the flaking properties and edge qualities of different raw materials. When applied to the interpretation of archaeological assemblages, this information – especially when used in conjunction with information about raw material distribution, tool use and edge resharpening – may help to explain differences in artefact morphology.

While different portions of the archaeological record can be characterized by different manufacturing techniques, it is also the case that each of these different techniques can be characterized by a different strategy of core reduction. The impact of different core reduction techniques on assemblage composition can be investigated through a combination of experimental knapping (seeking to identify debris diagnostic of a particular core reduction technique or stage of reduction), the analysis of flaking debris, and refitting studies.

Thus there is considerable debate about the sort of information that can be gained from the study of lithic assemblages. In the Australian context (and undoubtedly for stone-age societies around the world), it needs to be remembered that the stone tool was often a ‘means to an end’; namely that the tool itself was not as culturally important as the object it manufactured. Thus it was other artefact classes (which are largely missing from the archaeological record due to their organic nature) such as bark containers, wooden shields, boomerangs, spear throwers, body paint, clothing, temporary (sand) art etc., that were the artefacts that conveyed meaning and context for their users.

A further problem for Australian research into lithic assemblages is the lack of sites with secure archaeological contexts that enable studies of chronological variations to be examined. While some notable exceptions can be found in the region of the Study Area (see Section 4.2 and below), the majority of recorded sites in the region are surface scatters where artefacts have been removed from their archaeological context, most often by erosion. Unlike Europe and the Near East where secure archaeological contexts are more likely to be located, this has meant that the 30,000+ years of Aboriginal occupation in Australia have been reduced to two broad categories of lithic development: the earlier core and scraper tradition and the later small tool tradition.

Clearly this is unsatisfactory for such a long period of occupation where that occupation extended from ice-age occupation of Tasmania to Holocene occupation of the continent’s most harsh deserts. One would naturally assume that, presented with such a variety of environments, over such a long period of time, with exposure to a variety of raw material types that a more regional and chronological lithic development would be noted.

However, this has not yet been possible in Australia except in the broadest of terms. The lack of securely dated data is the greatest inhibitor, although the author suspects, given the less-than-ideal nature of raw materials for lithic manufacture in Australia, that less importance was placed on lithic manufacture than the product that was manufactured by the lithic. In Australia’s case we are fortunate to have either archival records or recent ethnographical studies that enable us to appreciate the richly carved shields, the elaborate body paint and body scarring, the beautifully woven or knotted string bags and the range of expertly designed spear throwers, boomerangs and spears that filled the traditional Aboriginal world. It was these pieces that showed the viewer the cultural affiliations of the

user, far more than the standard flake which could be used to do everything from wood carving to body scarring.

Stone artefacts are probably the most resilient physical evidence of Aboriginal occupation in Australia and for many parts of the country form the most abundant archaeological evidence of Aboriginal occupation. Stone artefacts are important because they are tangible evidence of Aboriginal use of an area and can potentially contain information about lithic activities, the organisation of stone technologies, and potentially information about larger-scale issues of settlement organisation across regions and even social change over time.

6.2.2 Four primary issues

The kinds of information which can be obtained from stone artefacts may vary considerably, depending in part on:

- The numbers of artefacts which can be examined and recorded – generally, the larger the number of artefacts the more reliable will be statistical statements about them;
- The presence of other assemblages with which the artefacts can be compared;
- The condition of sites in which they occur – generally undisturbed sites have more information potential than disturbed sites, depending on the scale at which research is carried out, and;
- The theory which underlies the artefact recording and analysis.

1. Statistically useful sample sizes

A large enough number of artefacts need to be recorded so that analyses can be based on statistically sound data (Leonard & Jones 1989). The numbers of artefacts which are needed in a sample will depend on how common or rare certain kinds of artefacts are. If a summary of most common raw material types is required then a random sample of 20 or 30 artefacts might suffice. On the other hand if no backed artefacts were found, and this type normally makes up 1% of an assemblage, then several hundred artefacts would need to be recorded to indicate whether or not backed artefacts are present on a site or in a certain landscape setting.

Some site recorders may not detail artefacts on small sites, or think that small sites are unimportant because they have few artefacts. However, depending on the kind of question that is asked, it may be possible to group several small sites to give a large enough sample of artefacts to be statistically useful. For example, if many small sites with 10 artefacts each were found on ridge tops then it might be possible to group all the sites together to study Aboriginal use of ridge tops within a larger landscape. Ideally, sample sizes should be large enough to be able to carry out statistical tests of significance (Clegg 1990).

2. Comparable assemblages

One way to understand an assemblage is to have another to compare it to. It then becomes possible to investigate similarities and differences, and to discuss reasons for them. If artefact assemblages come from different landscape settings then it may be possible to discuss Aboriginal use of a landscape. For example, one site might be close to a stone quarry and another site might be far away. One site might be close to a big river and another associated with a minor creek in the hinterland. On a stratified site it may be possible to compare an older assemblage from lower deposits with a younger assemblage from upper deposits.

If there are no other assemblages for comparison it may still be possible to make behavioural interpretations of the artefacts but it may be difficult to assess the results.

3. Condition

As a general rule artefacts from undisturbed sites may be able to provide more information than artefacts from disturbed sites. On sites in good physical condition it may be possible to identify artefacts relating to individual lithic activities, such as knapping floors (Hiscock & Mitchell 1993). It may be possible to refit or conjoin artefacts, and analyse the evidence from those activities (White 1999). For example, a person may have obtained some stone, taken it to a camp site, flaked it in a particular way, made some tools, left a lot of debris behind, and perhaps took some of the stone with them when they went to another camp. Other people might have obtained different kinds of stone from other quarries and flaked it in other ways, or just picked up a bit of stone that someone had left behind when they camped there once before.

On very heavily disturbed sites the artefacts themselves may be very broken, making it harder to analyse them.

However, some disturbed sites may still be able to provide good information, if comparisons are made between sites. If 100 artefacts from one site are compared with 100 artefacts from another site, it might not particularly matter if the two sites have been disturbed or not.

4. Theory and recording

Stone artefacts can be recorded and analysed in different ways to give different kinds of information about different topics. The variables that are recorded and the interpretations which are made will depend in part on the theory which underlies the analysis. If someone wants to know what stone tools were used for, then artefacts should be examined under a microscope for use-wear and residues. If someone wants to know how stone was flaked and tools were made then a technological analysis may record data on stone flaking such as patterns of scarring on cores or flakes. If someone wants to know about how stone materials were obtained (procured), transported and discarded then recording might focus on stone raw materials – information about raw material types and where they occur naturally in the landscape will be critical, and raw material type and size of artefacts may be recorded. Someone might be interested in the distributions of certain artefact types, so recording might focus on retouched or backed artefacts, rather than debitage. In the future, Aboriginal people might want information about topics or issues that have not yet even been thought about.

Consulting projects may seek to provide a basic description of an assemblage, recording just a few variables to give information about general topics. The present analysis records provenance information (where each artefact was found) and five other variables, with some additional information for modified artefacts and cores. This level of recording should not be regarded as a definitive record of the assemblage. If artefacts are kept in a safe place they can be reanalysed in the future to provide new information and address new questions.

With microscopic use-wear and residue analysis it may be possible to identify the kinds of things that stone tools were used for. It is now known that many backed artefacts have plant residues on them, indicating that they were not always used – if at all – as spear points or barbs (e.g. Barton 1992a, 1992b, 1994; Fullagar 1992, Fullagar *et al*. 1994).

If different sites in different kinds of landscape settings were studied it may be possible to say something of peoples' activities in different parts of a region. Some sites may have been occupied as general camps; other sites may have been used for dinner-time camps, or lookout sites for watching

kangaroos. People may have used stone in different ways at different kinds of sites, e.g. intensive stone flaking to make stone tools may have been carried out at camp sites, with lots of artefacts left behind. But prepared stone or made tools might have been taken to dinner-time sites and few artefacts left behind. Different numbers of artefacts, and different kinds of artefacts, may have been left at different kinds of sites (e.g. Bamforth 1986, 1991; Binford 1979, 1980; Kelly 1992; Kuhn 1989, 1994; McNiven 1991).

Some sites contain stratified deposits, deeper soils having older artefacts, and upper soils having younger (more recent) artefacts. Such stratified assemblages are found most often at stone shelter sites, but sometimes open sites might also have stratified assemblages. From excavations at shelter sites in and around the Blue Mountains, we know that there have been changes over time in the appearance of stone artefact assemblages. Most notable are changes in raw material use (use of different rock types), changes in artefact size, changes in the kinds of stone tools that were made (particularly backed artefacts, but also edge-ground axes), and changes in the way stone was flaked (especially asymmetric alternating and bipolar flaking). There have also been changes in the numbers of sites that were occupied at different times and in the numbers of artefacts that were left behind (e.g. Attenbrow 1987; Johnson 1979; McDonald 1994; White 1999).

Such changes in stone artefact assemblages have probably resulted from changes in how people lived. How many people there were, what group affiliations there were (who they knew, who they visited), the size of territories, how they organised their occupation of their territories, perhaps too, there may have been changes in which sites were significant. For example, if territories were very large then people could have occupied high colder mountain areas in summer, and in winter they could have moved down into lower country, or occupied more sheltered valleys. When population increased people may have had smaller territories, so they may have had to stay within smaller territories year round.

6.2.3 Results and Discussion of Artefacts

Of the 14 artefacts recovered from the excavation pits none were exceptional in any way. In general, the artefacts retrieved from the excavations can be characterised as small in dimension, largely devoid of secondary retouch, often broken and predominantly made from milk quartz, quartzites and mudstones.

Table 1 records the artefacts retrieved during the test excavation programme.

This table demonstrates:

- The majority of the recovered artefacts were located in the lower level of the deposits (spits 2–3) while considerably fewer were recorded in spit 1 and only one in spit 4. This would indicate that there is a high probability that these artefacts are from disturbed deposits as it was in the upper soil layers that the greatest amount of bioturbation was recorded;
- Quartzite and mudstone artefacts predominate (**Figure 17**: mudstones at top, quartzites below);
- The recorded artefacts, in comparison to a normal range of artefacts, tend to have a small dimension (only one of the recorded artefacts has a maximum dimension larger than 3 cm) and are light (the average weight of the 14 recorded artefacts is 1.7 g);
- Many of the artefacts were broken;

- Overall percentages of cortex was low indicating that the majority of flakes were produced from reduced cores;
- No cores were recorded, although one core fragment was recovered. This indicates that intensive knapping episodes were not taking place in the excavation area. Debitage was recorded indicating that one-off lithic manufacture or tool sharpening took place within the Study Area;
- Pits 3 and 48 displayed the greatest density of artefacts at 2 artefacts per square metre. Many excavation pits recorded no artefacts. Artefact densities this low are representative of 'background noise' and do not indicate a complex, occupational sequence; and
- Only one of the 14 recorded artefacts demonstrated secondary retouch (

- Figure 18). The retouch was to one lateral edge of a flake and the retouch was steep, and unidirectional.

Figure 17: Selection of artefacts from the excavations.

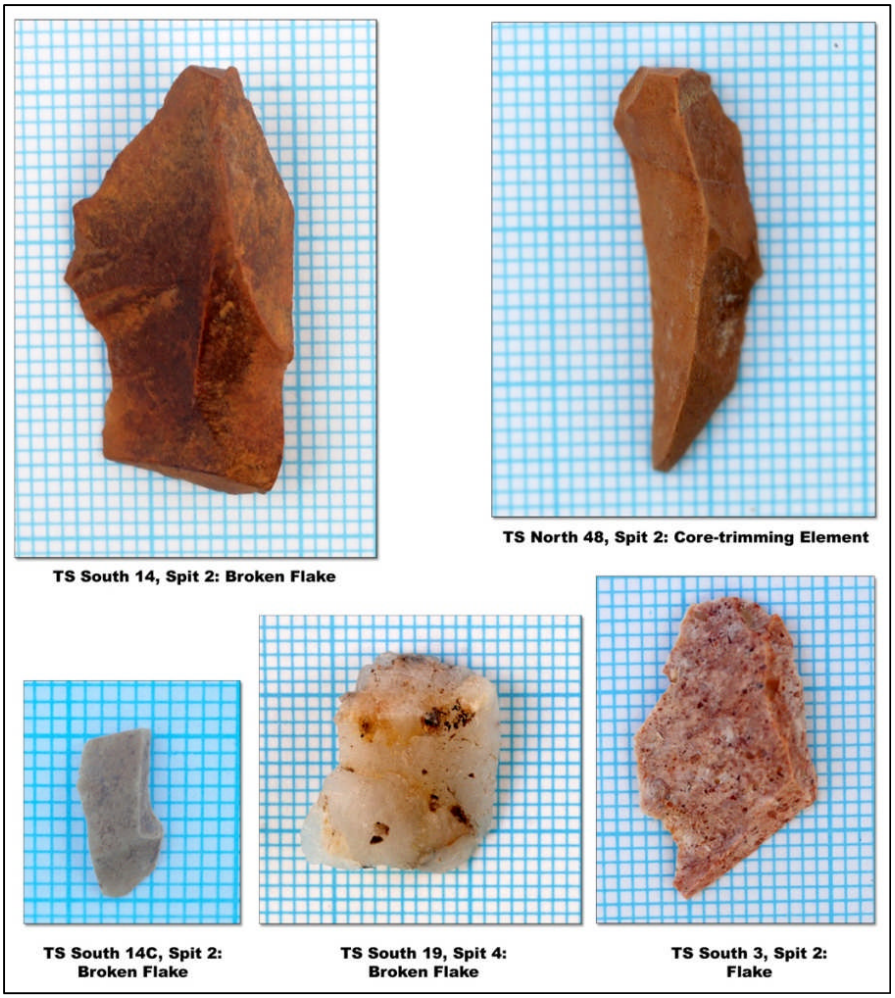


Figure 18: Retouched tool from pit 20, spit 3.

Table 1: Artefact Catalogue of excavated pits. Cells marked in blue denote artefacts. Cells marked in white denote possible artefacts/debitage.

Provenance	Artefact type	Raw Material	Break type	Platform	Termination	# Reverse Flakes	Cortex %	Dimensions	Weight	Notes
TS South 3 spit 2	Flake	Cream/Pink Quartzite	n/a	fine	feather	3	0	21.2 x 12.4 x 1.9	0.6	
TS South 3 spit 3	Broken Flake	Cream Quartzite, fine-grained	proximal	n/a	feather	?	0	13.6 x 5.9 x 1.4	0.2	
TS South 3 spit 3	Flake	Cream Quartzite	n/a	fine	feather	0	0	4.7 x 3.9 x 1.4	>0.1	Debitage
TS South 14 spit 2	Broken Flake	Pale orange mudstone	snap	n/a	feather	2	0	28.5 x 15.4 x 8	2.5	
TS South 19 spit 4	Broken Flake	Milk Quartz	proximal	n/a	feather	2	0	15.6 x 14.5 x 6.3	1.5	
TS South 18 spit 3	Chip	Milk Quartz	n/a	fine	feather	0	0	6.7 X 7.1 X 1.8	>0.1	Possible debitage No diagnostic features.
TS South 21 spit 3	Flake	Grey Quartzite, fine-grained	n/a	fine	feather	2	0	13 x 20 x 3.7	0.8	
TS South 12 spit 3	Flake	Mudstone	n/a	fine	feather	0	0	6.7 x 4.6	>0.1	Possible debitage No diagnostic features but an imported stone.

Provenance	Artefact type	Raw Material	Break type	Platform	Termination	# Reverse Flakes	Cortex %	Dimensions	Weight	Notes
TS South 20 spit 3	Retouched Flake	Light orange Quartzite	n/a	Moderate crushed	feather	4	0	42.9 x 32.9 x 11.2	16.6	Two large notches on one lateral edge
TS South 14C spit 2	Broken Flake	Orange mudstone	proximal	n/a	feather	3	0	10 x 4.4 x 1.3	>0.1	Probably debitage
TS South 3A spit 3	Chip	Pinkish Quartz	n/a	fine	feather	0	0	8.3 x 3.5 x 0.8	>0.1	Debitage
TS North 36 spit 2	Flake	Dark mudstone	n/a	Moderate Cortex	feather	2	12.5	14 x 10.1 x 3.6	0.4	
TS North 48 spit 2	Flake	Dark orange mudstone	n/a	fine	feather	0	50	15 x 9.8 x 2.3	0.3	
TS North 48 spit 2	Core-trimming Element	Orange mudstone	n/a	Moderate	steep	2	0	25.9 x 7.3 x 6.6	1.1	

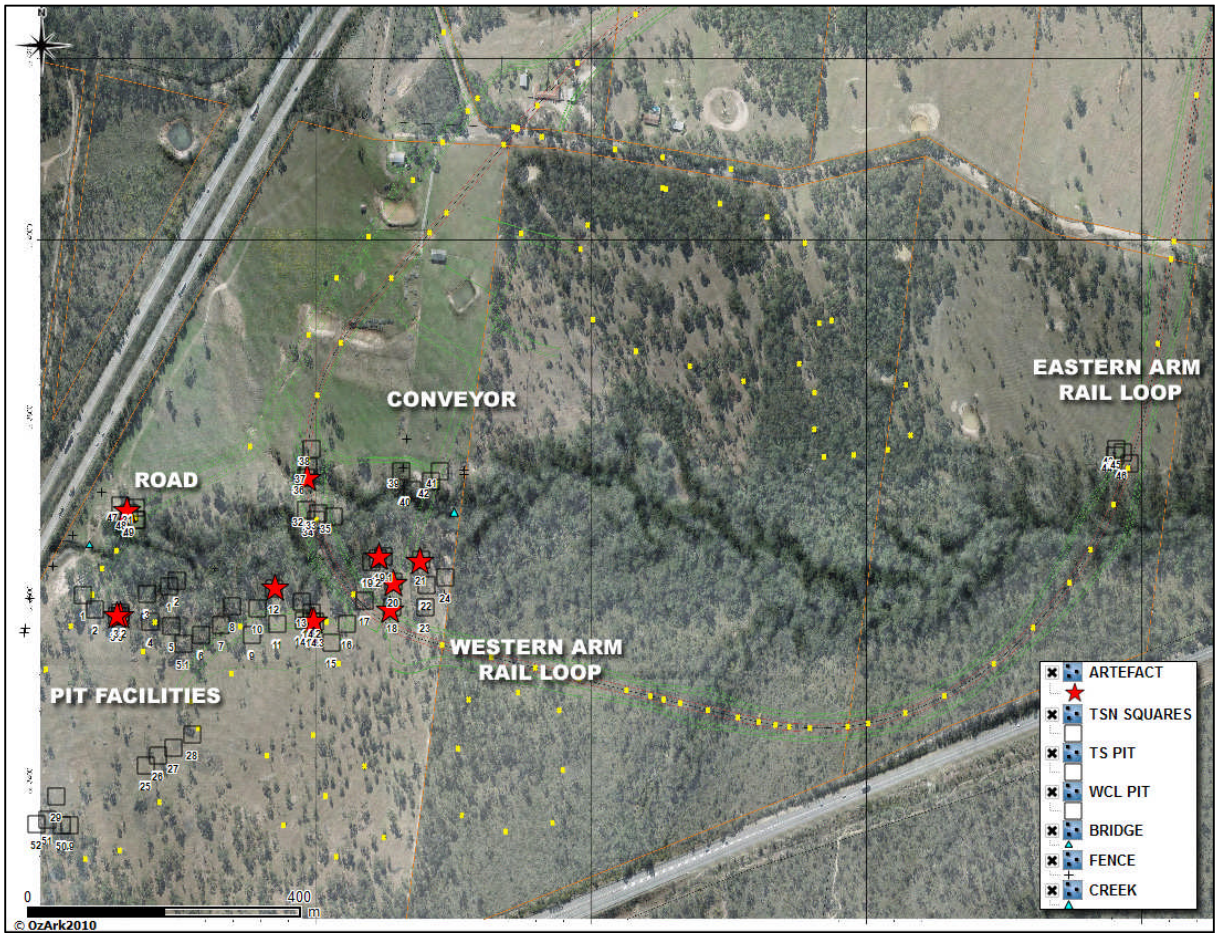
Artefact distribution

Artefact densities ranged across the Study Area in low frequencies. The maximum density of artefacts was two artefacts per square metre in pits 3 and 48, through to no artefacts per square metre in many other excavation pits.

The distribution of artefacts seen in **Figure 19** shows two clusters of recorded material: one centring around pit 3 in the southwest and one around pits 18–21 in the southwest on the Western Arm Rail Loop route. Cluster 1 around pit 3 had four recorded artefacts namely: a quartzite flake, a quartzite broken flake and two small pieces of debitage. Cluster 2 around pits 18–21 also had four recorded artefacts, namely: a broken flake of milk quartz, a quartzite flake and a quartzite retouched tool. A small piece of milk quartz was also recorded and is possibly debitage. While these clusters are perhaps indicative of a former location for camps, the small numbers of artefacts involved, as well as the type of artefacts, would tend to indicate that their proximity could be nothing more than chance.

At most locations, the majority of artefacts were recorded from the middle-most spits (i.e. 10–30 cm). However, given that the excavation pits were dug by back-hoe, no fine points on the vertical distribution of artefacts can be made apart from the fact that land use disturbances at the Study Area have probably moved artefacts down through the soil profile until impervious clay layers are reached.

Figure 19: Distribution of artefacts across the Study Area.



Raw materials

The assemblage is dominated by quartz, with 57% of all excavated artefacts of this material (8 milk quartz and quartzite out of a total of 14 artefacts). The remainder of the artefacts (43 %) were of a fine-grained indurated mudstone (**Figure 17**). Neither stone is naturally present in the immediate landscape of the Study Area.

Artefact types

Most of the assemblage consists of small, unmodified flakes. Small flakes and chips of stone known to have been used to manufacture lithics were regarded as debitage — a side-effect of stone tool manufacture.

One unmodified yet more diagnostic flake was the core fragment or core trimming element. These flakes are a product of a core being reshaped for further flakes to be removed. They take the form of a ridged flake and indicate that core-shaping had taken place in the area.

The only modified artefact is a steeply-backed flake with two large notches taken from one lateral edge. While describing use to an artefact is always conjectural, the modification to this flake made it ideal as a hand-held vegetation cutting tool.

Artefact size

Data on the size of artefacts is given in **Table 1**.

In general, artefacts were small with only one recorded artefact having a maximum dimension larger than 3 cm.

Due to the few artefacts recorded, it is impossible to examine such attributes as changes of artefact size with time (depth).

Cortex

Data on the presence – or otherwise – of cortex on artefacts are given in **Table 1**.

In general, the majority of the artefacts recorded in the excavations had little, or no, cortex indicating that the artefacts had been struck from cores where the cortex had been largely removed. This would indicate that the cores had been prepared elsewhere – either at the quarry source or at other, more permanent camps beyond the excavated locations.

Indicative flaking quality

The majority of artefacts were of quartzite, a raw material that is plentiful in the general landscape, but varies in its grain size and suitability for knapping. The quartzites from the current excavation were fine-grained and more suitable for predictable knapping qualities.

The next most common raw material was mudstones. This raw material ranged in colour and the consistency of the grain but generally was of a fine texture that would have been appreciated by a knapper.

Reduction technology

Very little data to discuss this topic was recovered from the excavations. No cores were recorded and the range of flakes was limited in number making determinations on how they were manufactured difficult.

7.0 Discussion

7.1 Summary of results

The main findings of the present analysis can be summarised:

- The lithic assemblage of the excavations consists of a total of 14 artefacts. One retouched tool was recorded, along with several unmodified flakes and small pieces of debitage;
- The test excavation methodology was to sample widely and then concentrate around the find spot of an artefact by excavating further excavation pits in close proximity. This methodology was successful in demonstrating that the artefacts recorded were not part of a larger site;
- No archaeological stratification was noted in any of the excavation pits;
- Artefact densities ranged from nil to very low across the excavation area with maximum densities of two artefacts per square metre;
- The excavation assemblage is dominated by quartz and quartzites with 57% of all excavated artefacts of this material. The other dominant raw material used was indurated mudstone with the remaining 43% of the artefacts being from this material;
- In most cases, the artefacts recorded in the excavations came from Spits 2–3 (10–30 cm) and therefore it was hard to determine any chronological sequence in the lithic assemblage;
- No location within the Tooheys Road Study Area displayed evidence of a complex site features. No features were recorded from the excavations, and;
- The results from the excavations at the Tooheys Road Study Area demonstrate the low frequency of Aboriginal artefacts that exist as a ‘background scatter’ in many comparable environments without a site being present. This indicates the rate of probability of recording an Aboriginal artefact in similar environments, without a site concentration being present, as 0.45 artefacts per hectare (the total excavation area sampled some 20 hectares and the recorded artefacts numbered 9 – excluding debitage).

7.2 Discussion

The test excavation methodology and programme successfully completed their objectives.

The test excavation methodology was to sample as large an area as possible in order to determine the existence and integrity of any archaeological deposits. Over 60 excavation pits were excavated and wet-sieved with 45 excavation pits concentrating on the south bank of Wallarah Creek where the proposed impacts will be greater, 11 excavation pits were excavated on the northern bank in areas of direct potential impact and four excavation pits were excavated on the north bank of Wallarah Creek at the point where the Eastern Arm Rail Loop crosses the creek.

This array of excavation pits allowed a good assessment of the soil profiles and archaeological potential across the excavation area.

From the 60 excavation pits, only 14 artefacts were recorded with five of these being small chips of debitage without distinguishing flake-like features.

This very low frequency established that no discrete Aboriginal site exists within the excavation area. Further, inspection of the soil profiles showed disturbed soil horizons and thin top soils, and with knowledge of past land use disturbances, it was assessed that there is a very low probability of an Aboriginal site of any structural integrity remaining undetected within the excavation area.

The test excavation methodology allowed for further excavation pits to be placed around a pit that had recorded an artefact. This was to determine whether the artefact was part of a larger site, or if it was truly an 'isolated find'. This expansion occurred at four locations around pit 3, pit 14, pit 19 and pit 20. In all cases the expanded excavation pits did not record any further artefacts demonstrating that the artefacts recovered from the excavation were all isolated finds and were unassociated with a site.

This alone establishes a benchmark of how many isolated finds one could expect to locate in a comparable environment where no concentration of artefacts in a site exists. Given that the current test methodology dictated that the excavation squares be placed randomly and given that a consistent quantity from each spit was wet-sieved, this establishes a very good sampling regime over a relatively large area (20 hectares).

The excavations yielded 9 artefacts (excluding debitage) which, over the 20 hectares, give a frequency rate of 0.45 artefacts hectare. This provides us with a minimum quantifiable figure that represents the probable frequency of recording Aboriginal isolated finds in any given area in a comparable environment. Thus, in similar conditions, the minimum rate of frequency of isolated finds would be one isolated find in every two hectare area.

The types of artefacts recorded also give an indication of the types of artefacts one could expect to recover in any similar environment. Of the corpus of nine artefacts, only one (or 11%) was a modified tool and only one (the core fragment) was associated with lithic manufacture. The majority (or 78%) were unmodified flakes, either complete or broken. Thus, by extension, the most common isolated find in such areas would be unmodified flakes and only in rare instances would a modified flake or other specially prepared lithic be recorded.

While the excavation failed to record lithics in statistically relevant numbers or to locate areas of archaeological potential, the findings do, however, help illustrate the nature and frequency of the 'background scatter' of Aboriginal artefacts often found and designated as isolated finds.

From the results of this excavation programme, future researchers could assume, when assessing similar landforms that are without site concentrations, that, if excavated, an area would, at a minimum, yield 0.45 artefacts per hectare and that these artefacts would most likely to be unmodified flakes.

7.3 Further considerations

In Section 6.2.2, four considerations regarding lithic analysis were briefly discussed: sample size, comparative samples, physical condition and theoretical considerations.

With regard to the present excavation, too few artefacts were recorded so as to be statistically relevant. The sample size is thus too small to cast light on current research. However, the nature of the artefacts, all being essentially isolated finds, does have some interest and was discussed in Section 7.2.

Comparative samples are important as they allow investigation of similarities and differences. The current assemblage does not lend itself to discussions of change over time in raw material use due to the low frequency of recorded artefacts and the less-than-precise pit excavation (all excavation being done by machine).

The current excavations recovered one backed artefact from the excavations. While it would be dangerous to draw too many conclusions from this, it may indicate that, in general, the locations excavated during the current programme are more likely to be more recent in date (Late Bondaian, ca. 1000 BP).

With regard to site disturbance it can be noted that the current lithic assemblage shows a high degree of disturbance with all of the artefacts recorded being unassociated with sites.

The recording carried out for this project should be regarded as preliminary in nature, seeking to provide basic information about the nature of the assemblage to assist with an assessment of the site and its future management. The recording cannot be regarded as a definitive record of the assemblage. Aboriginal people of the future may require different kinds of information than that recorded here. If this assemblage (or indeed any other) is reburied, for example, and is not available for future research then the opportunity to ask new questions may be lost. If lithic assemblages are not to be cared for in a safe place (such as a museum or Aboriginal keeping place), and are to be reburied, then some consideration may need to be given to more comprehensive recordings, including, for example, microscopic investigation of artefacts with possible use-wear or measurements of the dimensions of individual artefacts.

7.4 Sampling Considerations

There are several sampling considerations that require discussion as a result of the methodology used during this excavation programme. These include:

- Sieve size;
- Sampling interval, and;
- Assemblage sample size.

Sieve Size

Throughout this excavation the smallest lower mesh size used was 3.2 mm (1/8 inch, circular aluminium sieves[7]). The nested upper sieve mesh was 6.25 mm. All excavated material was sieved through both these mesh sizes.

The use of varied mesh sizes has the potential to affect artefact retrieval rates and therefore sample size, artefact density and the structure of artefactual assemblages. This causes interference when trying to compare results at either an intra or inter-site level. It also can impact on the interpretation of the site due to the fact that small artefacts (which have the potential to be lost depending on mesh size) provide important data concerning the following:

- The presence of small flakes, particularly those less than 5 mm demonstrates on-site reduction;

[7] The actual size of the aperture in this type of sieve is in fact 3mm, with 0.2 mm comprising the mesh thickness itself.

- Also of very small size are the tiny flakes that are the result of blade backing, showing that this was occurring even if the tools are not recovered;
- Very small flakes within the profile indicate minimal disturbance to the site from wind and water prior to the site being buried.

It is considered that consistent use of the nested sieves throughout the excavation programme has minimised the adverse affects that mesh size can have on intra-site interpretation

Pit size and Sampling interval

The pit dimensions used for the current project were usually 1 x 1 m. Most recent test excavations in Western Sydney, the Blue Mountains and the Lithgow area have used test pits measuring 1 x 1 m[8].

At sites where there is no surface indication of artefact location, it has been assessed that a pit with greater intersection margins (i.e. the number of metres that comprise the pit edges), such as that achieved by a 2 x 0.5 m pit (= 5 m), will be more likely to intercept a 'feature' than a pit with only 4 m of intersection (i.e. a 1 x 1 m). In the current circumstance, however, the large area to be sampled provided an alternative to this methodology whereby extra excavation pits were placed around an excavation pit that recorded an artefact. In this way it could be tested to see if a site was even present before moving to finer excavation techniques.

In the current programme, the nature of the proposed works and area of land under investigation necessitated a limited number of pits at each location, albeit widely scattered across the landscape. Thus the minimum 1 x 1 metre pit was employed as the test excavation methodology dictated that the area of archaeological sensitivity be 'tested' in order to inform future management recommendations. Obviously this methodology may limit the ability of the archaeologist to locate concentrations of artefacts and/or features. It also limits our ability to comment definitively on the nature of the assemblage, site size or artefact distribution. However, a discussion of the results of the test excavation methodology upholds that the area was suitably sampled and that had an Aboriginal site of any scientific significance existed at the Tooheys Road Study Area that it would have been intersected by one of the 60 excavation pits.

Assemblage sample size

Over the past fifteen years, research has turned to the issue of what size artefact assemblage is required to undertake detailed technological analysis. It has been argued that flake sample sizes need to be between 30 and 150 for a valid analysis to be achievable (Baker 1992: 33, Haglund 1992, Hiscock 1993, 1994, Koettig 1992).

A more realistic view is that the number of artefacts required to form a statistically valid sample will depend on what analyses are to be carried out. Commonly occurring artefact types and raw materials will be easier to investigate and will require a smaller sample size than those that are rarer.

Compared to the other excavations conducted by OzArk (OzArk 2004b) – Lidsdale (417 artefacts over 28 pits), or Yamble Bridge (2,542 artefacts over 30 pits: OzArk 2004a), the current excavation yielded a low sample size (14 artefacts over 60 pits).

[8] Although test excavations at Lidsdale utilised 0.5 x 2 m test pits.

Although no discreet knapping features were recorded, there is evidence that stone reduction was occurring due to the presence of a core fragment and debitage. Variability in the location of the various stages of stone tool production within the one knapping event has been noted by Koettig in the Hunter Valley (1992). As a result, the flakes retrieved in the current sample may not be representative of those present within any entire knapping floor. An issue such as this can only really be solved by open area excavation where a more complete assemblage can be retrieved, indicated by conjoining.

The identified characteristics of the current assemblage as described in Section 6.2.2 must remain somewhat vague due to the nature and size of the assemblage.

Site boundaries

Definitive site boundaries were not defined during the excavation programme as no site was recorded.

8.0 Assessment significance

8.1 Site Assessment

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Scientific, cultural and public significance are currently identified as baseline elements of this assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

Cultural significance

This area of assessment concerns the importance of a site or features to the relevant cultural group — in this case the Aboriginal community. Aspects of cultural significance include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of significance may not be in accord with interpretations made by the archaeologist — a site may have low scientific significance but high Aboriginal significance (or *vice versa*).

Scientific significance

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of significance relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness' (Sullivan & Bowdler 1984). Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region?

Public significance

Sites that have public significance do so because they can educate people about the past. By reducing ignorance about why sites are important to the Aboriginal and scientific community, important sites can be protected from ignorant or inadvertent destruction. Educating the public to understand the need for site preservation should increase the likelihood of maintaining an archaeological resource into the future. For a site to have high public significance it should contain easily identifiable and interpretable elements, and be relatively easily accessed.

8.2 Significance assessment of the excavated locations

Scientific

Of the locations assessed during the current excavation programme, the following scientific assessments can be made:

- Due to the disturbed nature of the deposits such as the evidence of bioturbation within the pits and disturbed soil horizons from actions such as ploughing, the scientific significance is diminished;
- The low overall artefact density suggests a less-complex occupation by traditional Aboriginal groups, again diminishing the scientific significance, and;
- No artefacts recorded during the excavations were unique or rare. As other examples of such types of sites exist throughout the immediate region the scientific significance is again diminished.

As a result, the Tooheys Road Study Area is assessed as holding **low scientific significance**.

Aboriginal

The Aboriginal significance of all locations was discussed during the days of excavation with the community representatives present. In general, the Aboriginal community see all artefacts as having cultural significance as they represent the past occupation and use of the land. In particular, however, none of the locations investigated here represented high cultural significance for the Aboriginal community as similar sites are to be found throughout the region. However, it is in the Aboriginal community's interest that *all* cultural material be treated with respect and due process.

Discussions with the Aboriginal representatives at the conclusion of the excavation revealed that the finds were important to them as it demonstrated the past occupation of the land by their ancestors. When asked to assess the cultural significance of the Tooheys Road Study Area the Aboriginal representatives were mindful to not over-assign significance as this diminished the interpretation of sites that hold truly high cultural significance.

As a result, the Tooheys Road Study Area is assessed as holding **moderate cultural significance**.

Public

The public significance of buried occupation sites such as those discussed here are usually assessed as low due to the fact that lay persons do not often to recognise stone artefacts.

As a general rule, isolated finds are very difficult for the non-specialist to appreciate, due to the 'invisibility' of the evidence present. Artefacts are difficult for the lay person to identify, and it is usually only when these sites are associated with other types of sites that they can be appreciated as a "site complex".

As a result, the Tooheys Road Study Area is assessed as holding **low public significance**.

8.3 Relevant legislation

Base line principles for the conservation of heritage places and relics can be found in the Burra Charter[9], which recognizes that there are places worth keeping because they can enrich our lives on many levels. The significance of such places may be embodied in fabric (physical material), environmental setting, contents, use or its meaning to people, and should be assessed through

[9] The Burra Charter defines the basic principles and procedures to be followed in the conservation of all kinds of places such as monuments, buildings, Aboriginal sites, roads, archaeological sites, whole districts or even regions. It was first adopted in 1979, based on the Australian ICOMOS (International Council on Monuments and Sites) review (1977) of the 1966 Venice Charter (ICOMOS 1998).

methodical data collection. Since its adoption in 1979, The Burra Charter has become the standard of best practice in the conservation of heritage places in Australia, and heritage organisations and local government authorities have incorporated the inherent principles and logic into guidelines and other conservation planning documents. The Burra Charter generally advocates a cautious approach to changing places of heritage significance. This conservative notion embodies the basic premise behind legislation designed to protect our heritage, which operates primarily at a State level.

A number of Acts of parliament provide for the protection of Aboriginal heritage at various levels of government[10]. The three most important statutes in New South Wales are:

- The Environmental Planning and Assessment Act (EP & A Act) 1979 as amended
- The National Parks and Wildlife Act 1974
- The Heritage Act 1977

The Environmental Planning and Assessment Act 1979 required that environmental impacts, including cultural heritage, are considered at a land-use planning and decision making level. Amendments were made to this Act by the Planning Reform Bill of 2005. Essentially this provides a new method for project assessment that places major infrastructure projects, or those deemed to be of state significance as defined in Schedule 1 of the *State Environmental Planning Policy (Major Projects) 2005*, under Part 3A of the Act.

Under Section 75U of *The Environmental Planning and Assessment Act 2005* (EP&A Act), if the current project is granted project approval under Part 3A of the EP&A Act, the following approvals, which may have otherwise been relevant, will not be required to carry out the Project:

- *Heritage Act 1977*: Disturbance to an item listed on the State Heritage Register or Interim Heritage Order – Excavation Permit; and
- *National Parks and Wildlife Act 1974*: A section 87 preliminary research/collection permit; or section 90 consent to destroy relics.

Although the provisions of other relevant Acts, including the *National Parkes and Wildlife Act 1974,* do not apply for developments assessed under Part 3A of the EP&A Act, their intent has been considered and remains part of the assessment requirements, with independent expert panels being utilised to assess the veracity of environmental assessment reports. Under Part 3A, the Section 87 and 90 permits that are required for impacts to Indigenous heritage under the NP&W Act, are not required for projects assessed under Part 3A. Instead, a Statement of Commitments in terms of heritage is presented within 3A applications, which then form the basis for the Minister's approval which will usually contain a series of Conditions, including a requirement for the preparation of an Indigenous Heritage Management Sub Plan as part of the Construction Environment Management Plan for the Project. These conditions include similar checks and balances as required by the NP&W Act, such as test excavation programmes or site destruction mitigation development etc. as is currently required under the permitting process, however, without the need to obtain permits.

- Application to the Study Area: As the current Wallarah 2 Coal Project is a mining project and falls into the criteria defined in Schedule 1 *State Environmental Planning Policy (Major Projects) 2005*, it is being assessed under Part 3A of the EP&A Act and

[10] NSW Heritage Office 1998: *Living with Aboriginal Culture*, p. 3

will be determined by the Minster for Planning. As the project approval process is not as yet complete, permission to proceed with the test excavation programme ahead of project approval and in the absence of a DECCW AHIP was requested directly from the Department Planning. Permission was received and Attachment 2 presents the documentation relating to this approval.

8.4 Impact of the proposed works

The proposed works will have a severe impact within specific areas with the Tooheys Road Study Area

Figure 20 shows the location of recorded artefacts superimposed on a plan of the proposed works in the western portion of the Tooheys Road Study Area.

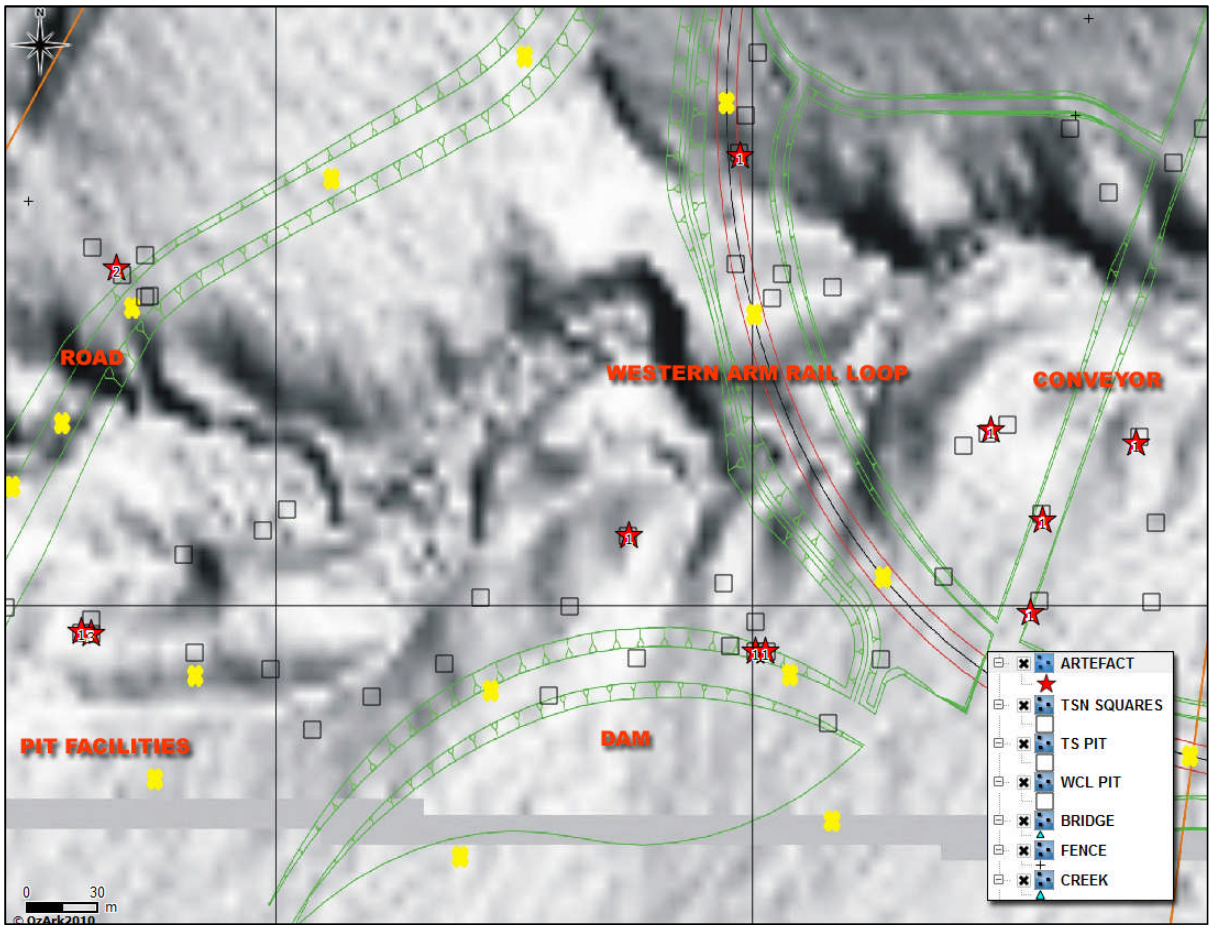
As can be seen, some artefacts were recorded within the immediate impact footprint of the proposed works.

While the artefacts from the excavation have been removed to safety, there is every chance that further, undetected Aboriginal artefacts may be located within the Study Area, particularly on the southern bank of Wallarah Creek, although their frequency is likely to be low.

These undetected artefacts are likely to be isolated finds and will mostly consist of unmodified flakes. While they have low scientific significance, they may hold cultural significance and therefore the recommendations listed in Section 9.1 should be followed in relation to construction work along Wallarah Creek.

While further archaeological investigation at the Tooheys Road Study Area is unwarranted due to the results of the test excavation programme, impact to undetected artefacts may occur and, as such, individual finds of Aboriginal artefacts should be looked out for during the early site clearing and site preparation of the construction phase. Removed topsoils should be retained on site for revegetation after construction is complete such that any potential artefacts contained within the soil will remain in the general vicinity.

Figure 20: Recorded artefacts in relation to the proposed works.



9.0 Recommendations

The following recommendations are made regarding the Tooheys Road Study Area. These are made on the basis of:

- legal requirements under the terms of the National Parks and Wildlife Act of 1974 (as amended) whereby it is illegal to damage, deface or destroy an Aboriginal relic/object without the prior written consent of the Director, DECCW, or in this case, approval of the Department of Planning under Part 3A of the EP&A Act 2005 as amended.
- the results of the current test excavations;
- the analysis and assessment of the archaeological site material and physical site characteristics found within the current study area, and a projection of these findings into the broader regional and landscape context;
- The interests of the Darkinjung Local Aboriginal Land Council and Guringai Tribal Link Aboriginal Corporation, other local Aboriginal groups and the broader community, and;
- The likely impacts resulting from the construction of the Wallarah 2 Coal Project at select, previously determined locations.

9.1 Specific Management Recommendations

Due to the results of previous surveys and the current test excavation programme, management recommendations for the areas investigated are as follows:

South Bank of Wallarah Creek within the presently cleared field (from the F3 Freeway to c. 600 m east). From the creek line to the Motorway Link Rd c. 600 m south:

- Due to the likelihood of artefacts being present at a low frequency, crews involved with the initial clearing and preparation of the site, including all crews involved with earth moving, should be appropriately inducted to inform them:
  a) That no identifiable Aboriginal site has been recorded in the area;
  b) That there may, nonetheless, be isolated Aboriginal artefacts present in the landscape (a printed copy showing typical artefacts should be distributed. Section 5.2.2 of this report could form the basis of such printed information);
  c) That should a noticeable concentration of items work crews suspect may be Aboriginal in origin be encountered, then work should cease in that area and DECCW consulted on how to best proceed;
  d) That should a suspected isolated Aboriginal artefact be noticed, it should be removed to a safe location and DECCW informed; and
  e) All crews involved with the initial clearing and site preparation work should read and sign the induction.
- If the induction is undertaken, there is no constraint to the proposed construction as outlined in this report on cultural heritage grounds.

- Removed topsoils should be retained on site for revegetation after construction is complete such that any potential artefacts contained within the soil will remain in the general vicinity.

North Bank Wallarah Creek from the F3 freeway to c. 600 m east. From the creek line to a distance of 100 m from its banks.

- The final Works Design should attempt to limit ground disturbing works in this area to the impact footprint of each piece of infrastructure: the conveyor, Western Arm Rail Loop and the road to the pit top facilities.
- Removed topsoils should be retained on site for revegetation after construction is complete such that any potential artefacts contained within the soil will remain in the general vicinity.
- Due to the likelihood of artefacts being present at a very low frequency, crews involved with the initial clearing and preparation of the site, including all crews involved with earth moving, should be appropriately inducted to inform them of points a–e as documented above.
- If the induction is undertaken, there is no constraint to the proposed construction as outlined in this report on cultural heritage grounds.

Eastern Arm Rail Loop

- The final Works Design should attempt to limit ground disturbing works in this area to the impact footprint of the Eastern Arm Rail Loop, particularly within 100 m of the creek's banks on both sides.
- No induction of workers is necessary if only working in this area.
- There is no constraint to the proposed construction as outlined in this report on cultural heritage grounds.

9.2 General

One copy of this report should be sent to the Members of:

Darkinjung Local Aboriginal Land Council
Attn: Suzanne Naden
Operations Manager
168 Pacific Highway (PO Box 401)
Wyong NSW 2259

Guringai Tribal Link Aboriginal Corporation
Attn: Tracey-lee Howie
Chairperson
PO Box 4061
Wyongah NSW 4061

One hard copy of this report should be sent to:

Cheryl Brown
AHIMS Registrar, Cultural Heritage Unit
DECCW
PO Box 1967
Hurstville, NSW, 1481

10 References

Attenbrow 1987 — Attenbrow, V. 1987 *The Upper Mangrove Creek catchment: a study of quantitative changes in the archaeological record*. Ph.D. thesis, Department of Anthropology, University of Sydney.

Attenbrow 2004a — Attenbrow, V., 2004 Potential Archaeological Deposits in the Storage Area of the Mangrove Creek Dam in the NSW Central Coast, *Newsletter, Australian Association of Consulting Archaeologists*, 94: 17-18.

Attenbrow 2004b — Attenbrow, V., 2004 *What's Changing: Population Size or Land-use Patterns? The archaeology of Upper Mangrove Creek, Sydney Basin*, Pandanus Books, Sydney.

ICOMOS 1998 — Australian ICOMOS Inc. 1998 *Understanding the Burra Charter: A guide to the principles of heritage conservation in Australia*. Brochure produced for Australia ICOMOS.

Baker 1992 — Baker, N. 1992 *New South Wales National Parks and Wildlife Service Hunter Valley Aboriginal sites assessment project*. Stone artefact recording & analysis — recording techniques and methodology. Unpublished report to the NSW National Parks and Wildlife Service.

Baker 1996 — Baker, N. 1996 *Archaeological test excavations at Plumpton Ridge. Proposed Sydney Orbital road route EIS*. Excavation and analysis report to Robynne Mills, archaeological consultant, for Sinclair Knight Pty Ltd. Prepared by Australian Museum Business Services.

Bamforth 1986 — Bamforth, D. B. 1986. Technological efficiency and tool curation *American Antiquity* 51(1): 38–50.

Bamforth 1991 — Bamforth, D. B. 1991. Technological organisation and hunter-gatherer land use: a California example, *American Antiquity* 56(2): 216–234.

Barton 1992a — Barton, H. 1992. Warkworth site salvage: residue and use-wear analysis of stone artefacts from Warkworth in the Hunter Valley. Appendix E (In) L. Haglund 1992 *Archaeological investigations at Doctors Creek, Warkworth, NSW: salvage excavation and surface collection in compliance with NPWS salvage requirements. Vol.5*. Report prepared by Haglund and Associates for Warkworth Mining Ltd.

Barton 1992b — Barton, H. 1992. Artefacts from Doctors Creek, Warkworth, Sites H & L - collected by Prof. L. K. Dyall, September 1979. Appendix H (In) L. Haglund 1992 *Archaeological investigations at Doctors Creek, Warkworth, NSW: salvage excavation and surface collection in compliance with NPWS salvage requirements. Vol.6*. Report prepared by Haglund and Associates for Warkworth Mining Ltd.

Barton 1994 — Barton, H. 1994. Analysis of residues on selected artefacts from site #37-6-299 Mt Thorley, Hunter Valley. Appendix E (In) H. Brayshaw

1994 *Salvage excavation of site #37-6-299 Mt Thorley - Hunter Valley, NSW*. Report to Mt Thorley Co-Venture R W Miller & Co Pty Limited.

Bennett 1968 — Bennett, F.C., 1968. *The Story of the Aboriginal People of the Central Coast of New South Wales*, Wyong, Brisbane Water Historical Society.

Binford 1979 — Binford, L. R. 1979. Organization and formation processes: looking at curated technologies, *Journal of Anthropological Research* 35(3): 255–272.

Binford 1980 — Binford, L. R. 1980. Willow smoke and dogs' tails: hunter-gatherer settlement systems and their archaeological site formation, *American Antiquity* 45(1): 4–20.

Bowdler 1983 — Bowdler, S. 1983 *Aboriginal sites on the Crown timber lands of NSW*. Report to the Forestry Commission of NSW.

Clegg 1990 — Clegg, F. 1990 *Simple statistics: a course book for the social sciences* Cambridge University Press, Cambridge.

Close 1978 — Close, A. 1978 The identification of style in lithic artefacts. *World Archaeology* 10: 223–237.

Coombs 1994 — Coombs, H.C., 1994 *Aboriginal Autonomy: Issues and Strategies*, Melbourne, Cambridge University Press.

Cotterell & Kamminga1987 — Cotterell, B. and Kamminga, J. 1987 The formation of flakes, *American Antiquity* 52(4): 675–708.

Dallas 1986 — Dallas, M., 1986 *Archaeological survey along Hue Hue Road, Wyong*, NSW Unpublished report to NSW NPWS.

Dallas *et al* 1987 — Dallas, M., Menses, P., Rola-Wojciechowski, C, 1987. *Aboriginal Resources Planning Study for the Wyong Shire Council, NSW*. Report to Wyong Shire Council.

Dyall 1981 — Dyall, L.K., 1981. *Report On Aboriginal Relics At Proposed Site For Power Station At Chittaway Point, N.S.W*. Report for a the Electricity Commission of NSW.

ERM 2001 — Environmental Resources Management Australia Pty Ltd. 2001. *Wyong Project - Indigenous Cultural Heritage assessment – preliminary field survey of the Bushells ridge site*. Report for Coal Operations Australia Limited.

Flood 1995 — Flood, J. 1995. *Archaeology of the Dreamtime*. Angus & Robertson: Sydney.

Fullagar 1992 — Fullagar, R. 1992. Stone artefacts from Camberwell, Hunter Valley. Appendix II (In) M. Koettig 1992 *Salvage excavations of Aboriginal sites of the Camberwell lease. Vol. 2*. Report to Camberwell Coal Pty Ltd.

Fullagar *et al*. 1994 — Fullagar, R., Furby, J. and Brass, L. 1994. Usewear and residue analysis of stone tools from Bulga. (In) M. Koettig 1994 *Bulga lease*

Authorisation 219 salvage excavations. Vol.5. Report to Saxonvale Coal Pty Ltd.

Haglund 1992 — Haglund, L. 1992 *Archaeological investigations at Doctors Creek, Warkworth, NSW: salvage excavation and surface collection in compliance with NPWS salvage requirements. Vol.6*. Report prepared by Haglund and Associates for Warkworth Mining Ltd.

Haglund 1996 — Haglund, L. 1996 *Salvage Excavation completed for Ulan Coal Mines limited: NPWS site 36-3-177.* Report to Ulan Coal Mines.

Hamm & Tickle 2006 — Hamm, G. (Ed) and Tickle, R. 2006 *Moolarben Coal Project non-Aboriginal Assessment*. Report to Moolarben Coal Mines Pty Limited.

Hiscock 1993 — Hiscock, P. 1993 Bondaian technology in the Hunter Valley, New South Wales. *Archaeology in Oceania* 28: 65–76.

Hiscock 1994 — Hiscock, P. 1994 Technological responses to risk in Holocene Australia, *Journal of World Prehistory* 8: 267–299.

Hiscock & Attenbrow 2004 — Hiscock, P. and Attenbrow, V. 2004 A revised sequence of backed artefact production at Capertee 3, New South Wales, *Archaeology in Oceania* 39 (2): 94–99.

Hiscock & Mitchell1993 — Hiscock, P. and Mitchell, S. 1993 Stone artefact quarries and reduction sites in Australia: towards a type profile Australian Heritage Commission Technical Publications Series No.4, Australian Government Publishing Service, Canberra.

Johnson 1979 — Johnson, I. 1979 *The getting of data: a case study from the recent industries of Australia*. Ph.D. thesis, Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra.

Kelly 1992 — Kelly, R. L. 1992. Mobility/sedentism: concepts, archaeological measures and effects, *Annual Review of Anthropology* 21: 43–66.

Kinhill 1995 — Kinhill Engineers Pty Ltd 1995. *An Archaeological Survey and Assessment of Compartments 182, 183 and 184, McPherson State Forest, NSW*. Prepared for State Forests NSW.

Koettig 1992 — Koettig, M. 1992 *Salvage excavations of Aboriginal sites of the Camberwell lease. Vol. 1–2*. Report to Camberwell Coal Pty Ltd.

Kuhn 1989 — Kuhn, S. L. 1989. Hunter-gatherer foraging organization and strategies of artifact replacement and discard, pp. 33–47. (In) S. S. Amick and R. P. Mauldin (eds) *Experiments in lithic technology* BAR International Series 528, Oxford.

Kuhn 1994 — Kuhn, S. L. 1994. A formal approach to the design and assembly of mobile toolkits, *American Antiquity* 59(3): 426–442.

Leonard & Jones 1989 — Leonard, R. D. and Jones, G. T. 1989 (eds). *Quantifying diversity in archaeology*, Cambridge University Press, Cambridge.

McDonald 1994 — McDonald, J. 1994 *Dreamtime superhighway: an analysis of the Sydney Basin rock art and prehistoric information exchange*. Ph.D. thesis, Department of Prehistory and Anthropology, The Faculties, Australian National University, Canberra.

McDonald 1997 — Jo McDonald CHM 1997 *Interim Heritage Management report: ADI Site St Marys. Volume 1*. Report to Lend Lease.

McNiven 1991 — McNiven, I. 1991 "Teewah Beach: new evidence for Holocene coastal occupation in southeast Queensland" *Australian Archaeology* 33: 14–27.

Moore 1970 — Moore, D.R. 1970 "Results of an archaeological survey of the Hunter River, New South Wales, Australia. Part I: the Bondaian industry of the upper Hunter and Goulburn River valleys" *Records of the Australian Museum* 28(2): 25–64.

Moore 1981 — Moore, D. R. 1981 Results of an archaeological survey of the Hunter River, New South Wales, Australia. Part II: Problems of the lower Hunter and contacts with the Hawkesbury Valley, *Records of the Australian Museum* 33(9): 388–442.

Nelson 1991 — Nelson, M. 1991 The study of technological organization. *Method and Theory in Archaeology* 3: 57–100.

OzArk 2004a — OzArk 2004 (OzArk EHM P/L) *Archaeological test excavation of site # 36-2-106 and PAD # 36-2-105, Yamble Bridge, MR 233, 22.5 kms west of Gulgong, NSW*. Report for RTA.

OzArk 2004b — OzArk 2004 (OzArk EHM P/L) *Salvage Excavations of site L2 (#45-1-2574), proposed corridor of the new Castlereagh Hwy (86), Lidsdale, NSW*. Report prepared for RTA.

OzArk 2008 — OzArk 2008 (OzArk EHM P/L) *Test/salvage Excavation Programme: Wollar to Wellington 330 Kv Electricity Transmission Line, NSW.* Report to IEC for TransGrid

OzArk 2009 — OzArk Environmental and Heritage Management Pty Ltd. 2009. *Indigenous and non-Indigenous Heritage Assessment: Surface Facilities – Wallarah 2 Coal Project, Wyong NSW*. Report to IEC on behalf of WACJV

Pearson 1981 — Pearson, M. 1981 *Seen through different eyes: changing land use and settlement patterns in the Upper Macquarie River region of NSW from prehistoric times to 1860*. PhD Thesis, Department of Prehistory and Anthropology, Australian National University, Canberra.

Silcox 1996 — Silcox, R. 1996. *Archaeological survey and assessment of Compartment 128, Ourimbah State Forest, Mangrove Mountain, NSW*. Prepared for State Forests of NSW.

Speth 1972 — Speth, P. 1972 Mechanical basis of percussion flaking, *American Antiquity* 37(1): 34–60.

Stinson 1979 — Stinson, E., 1979. *A Pictorial History of the Wyong Shire*, Wyong, Wyong Shire Council.

Stockton 1977 — Stockton, E.D., 1977. Middens of the Central Coast, New South Wales. *Australian Archaeology*, 7: 20-31.

Vinnicombe 1980 — Vinnicombe, P. 1980. *Predilection and Prediction: A Study of Aboriginal Sites in the Gosford–Wyong Region*. Unpublished report to NSW National Parks & Wildlife Service.

White 1999 — White, E. 1999 *Artefact analysis: site SG5, Ulan, NSW*. Report prepared for Haglund and Associates and Ulan Coal Mine.

Plates

Plate 1: Aboriginal community representatives (and OzArk staff) assisting with the wet-sieving of deposits.

Plate 2: Excavation of excavation pits by back-hoe. The marked out pit can be seen, as well as the plastic sheeting on which the deposits will be placed.

Plate 3: Cleaning out a pit following machine excavation. The separated piles represent each spit as it was excavated.

Appendix 1

Aboriginal Community Correspondence

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

168 PACIFIC HIGHWAY,
WATANOBBI NSW 2259
POSTAL ADDRESS:
P.O. BOX 401, WYONG NSW 2259

A.B.N. 99 583 297 167
TELEPHONE: (02) 4351 2930
FAX: (02) 4351 2946
EMAIL: darkinjung@dlalc.org.au
www.darkinjung.com.au

OzArk Environmental & Heritage Management
145 Wingewarra St
DUBBO NSW 2830

23rd March 2010

Dear Cheryl

This letter confirms that as a representative of Darkinjung Local Aboriginal Land Council (DLALC), I was involved in the test excavation programme conducted from 15th to 19th March 2010 located at Wallarah Creek, south of Tooheys Road Bushells Ridge. This was carried out on behalf of OzArk Environmental & Heritage Management & Wallarah 2 Coal Project. Also involved from DLALC was Darren Carney on the 18th & 19th March 2010.

The method used for artefact retrieval required a number of 1 metre x 1 metre test excavation pits (in excess of 40) which were dug by an excavator over an area of approximately 600m². These were located in several zones on the northern and southern banks and terraces of the creek line and also approximately 400 metres further up the southern slope of the site, towards the sites boundary and the Motorway Link Road. The pits were divided into spits and from each spit 10 buckets of soil were retrieved as a representative sample (2-3 spits per pit), and then hand sieved using the wet sieving method.

Considering the area sampled, very few artefacts were retrieved. The artefacts found were a confirmation of Aboriginal people's occupation and use of the site in the past. The low density of finds was possibly because of the past use and disturbance of the site due to vegetation clearing and subsequent soil erosion.

Taking into account the methodology and results of the test sampling, DLALC was satisfied in the manner in which the testing was achieved.

Yours Sincerely

S. Hodgetts

Sharon Hodgetts
Consultant for DLALC

Suzanne Naden
Operations Manager

Appendix 2

Approvals

Wallarah 2
COAL PROJECT

25 Bryant Drive
Tuggerah, NSW 2259

PO Box 3039
Tuggerah, NSW 2259

Phone. 02 4352 7500
Fax. 02 4353 5699
Email. info@wallarah.com.au

6 January 2010

Department of Planning
33 Bridge St
Sydney NSW 2000

Attention: Mr Howard Reed *by email: Howard.Reed@planning.nsw.gov.au*
C.C.: Mr Colin Phillips *by email: Colin.Phillips@planning.nsw.gov.au*

Dear Colin & Howard

Wallarah 2 Coal Project Archaeological Investigation Work

Following our recent meeting to discuss the request by the Department of Environment Climate Change and Water (DECCW) to undertake a test excavation along nominated creek lines within the Tooheys Road site, our archaeologist Dr Jodie Benton (OzArkEHM) has contacted Ms Kylie Seretis of your department to discuss the required work.

We understand that an approval under Section 87 of the National Parks and Wildlife (NPW) Act is not required as the Wallarah 2 Coal Project comes under Part 3A of the EP&A Act and therefore has an exemption pursuant to s75U(4) from the need to get the s87 approval (or s90) under the NPW Act. However, prior to undertaking the work we consider that it would be necessary to receive an instruction in writing from DOP outlining that the investigation work can process under Section 75U (1) and (4) of the EP&A Act.

Accordingly, we would appreciate your written confirmation that the proposed test work as described in the W2CP EA lodged for adequacy review can proceed. Subject to promptly receiving your written instruction, it is intended to undertake the excavation work in January to allow the results of the work to be known prior to project determination. We also intend to further the archaeological investigations within Wyong State Forest, Jilliby State Conservation Area and a sample area of Jilliby Jilliby Creek, the results of which should also be available prior to determination.

We will advise DECCW that the additional work requested will be carried out and seek their input into the design the additional surveys. Given that our original surveys and investigations have not revealed any subsidence-sensitive land features, it is unlikely that the conclusions of the assessment contained in the current EA document will be altered as a result of this work. We do intend however, to strengthen the commitment to undertake additional archaeological investigations in the first 10 years of mining prior to extracting coal beneath Wyong State Forest.

Should you require any additional information please contact me.

Yours sincerely

Peter Smith
Environment and Community Manager

From: Howard Reed [Howard.Reed@planning.nsw.gov.au]

Sent: Friday, 8 January 2010 12:03 PM

To: Peter Smith

Cc: robert.byrnes; Jodie; Colin Phillips; David Kitto; Kylie Seretis

Subject: Re: Wallarah 2 Coal Archaeological survey work

Dear Peter,

I refer to your email below and attached letter dated 6 January.

I confirm that s.75U(4) EPAA operates so as to exempt a proponent from the need to obtain a permit or consent under s. 87 and s. 90 NPWA, providing that the proposed activity relates to investigative or other activities required to be carried out for the purpose of complying with the Director-General's environmental assessment requirements.

I note that the published DGRs for the project include (inter alia) the requirement that:

The environmental assessment of the project must include

- a detailed assessment of [Aboriginal Heritage, including Aboriginal rock art sites], which includes:
  - a description of the existing environment and its values, using sufficient baseline data;
  - an assessment of the potential impacts of all stages of the project on this environment, including any cumulative impacts;
  - a description of the measures that would be implemented to avoid, minimise and, if necessary, offset the potential impacts of the project, and ensure that the project is in the public interest and meets the net benefit test;
  - a description of the measures that would be implemented to manage and monitor the potential impacts of the project, paying particular attention to emerging best practice within the mining industry in the field of adaptive management;

Consequently, the Department agrees with your view that the DGRs require the undertaking of appropriate subsurface investigations of Aboriginal heritage values at key sites of proposed surface disturbance, such as at the Tooheys Rd site.

S. 75U(4) does not require any approval or endorsement by the Department, but this email serves to confirm that the Department agrees with the company's interpretation regarding its exemption from the requirements of s. 87 and s. 90 NPWA.

Kind regards,

Howard Reed
A/Director Industry and Mining