THE NORTHERN ROAD UPGRADE – STAGE 4

Aboriginal Archaeological Salvage Excavation

State Significant Infrastructure Approval (SSI 7127)

Prepared for Transport for NSW

Liverpool Local Government Area

December 2020

Ref. 1751

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Document Information

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Executive Summary

Transport for NSW, formerly Roads and Maritime Services, is undertaking works to upgrade about 16 kilometres of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park in south western Sydney, NSW (the project). The upgrade works are being undertaken in stages and are required to improve safety, increase road capacity and cater for expected future traffic growth. The project is designated as Critical State Significant Infrastructure (SSI 7127) and was assessed under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979*, requiring the approval of the Minister for Planning. In addition, the proposal was referred under the *Environment Protection and Biodiversity Conservation Act 1999* to the Minister for the Environment and Heritage. It was determined that an Environmental Impact Statement (EIS) was required. The Secretary of the NSW Department of Planning and Environment issued Secretary's Environmental Assessment requirements (SEARs) for the project on 28 July 2015 and amended SEARs were issued on 9 March 2016.

TfNSW engaged Kelleher Nightingale Consulting Pty Ltd (KNC) to undertake Aboriginal cultural heritage assessment for the project. Initial assessment included preparation of an Aboriginal archaeological assessment in accordance with Stage 2 of the Roads and Maritime NSW *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* and the requirements of the Office of Environment and Heritage [now Heritage NSW]. A full coverage survey of the project area was carried out in 2015 and 2016 by a team comprising representatives from the Deerubbin Local Aboriginal Land Council, Gandangara Local Aboriginal Land Council and archaeologists from KNC. Preparation of an Aboriginal Cultural Heritage Assessment Report (CHAR) was subsequently undertaken to inform the EIS. The CHAR assessment addressed the Aboriginal heritage requirements identified in the project SEARs. Following preparation of the EIS, the project was approved by the Minister on 30 May 2018.

CHAR recommendations included a salvage excavation program prior to construction works for the 20 Aboriginal sites within the project area exhibiting moderate significance. A management strategy (heritage management plan) was also developed to facilitate the preconstruction mitigation plan, enable the transition to construction and guide the ongoing construction program.

Following project approval, the project was divided into three stages. The southernmost section (named The Northern Road Upgrade Stage 4 or TNR4) is the subject of the current assessment and report. TNR4 was situated in the southern portion of the main project, from The Northern Road in Bringelly in the south, to Eaton Road Badgerys Creek in the north. TNR4 incorporated ten Aboriginal archaeological sites, eight of which required archaeological salvage excavation for the impacted portions:

- TNR AFT 22 (AHIMS 45-5-4793) (archaeological salvage required)
- TNR AFT 23 (AHIMS 45-5-4794) (no archaeological salvage required)
- TNR AFT 24 (AHIMS 45-5-4795) (archaeological salvage required)
- TNR AFT 25 (AHIMS 45-5-4791) (no archaeological salvage required)
- TNR AFT 26 (AHIMS 45-5-4798) (archaeological salvage required)
- TNR AFT 27 (AHIMS 45-5-4799) (archaeological salvage required)
- TNR AFT 29 (AHIMS 45-5-4801) (archaeological salvage required)
- TNR AFT 30 (AHIMS 45-5-4797 (archaeological salvage required)
- TNR AFT 31 (AHIMS 45-5-4802) (archaeological salvage required)
- B6 (AHIMS 45-5-2636) (archaeological salvage required).

One additional site within the Western Sydney Airport lands (B54 – AHIMS 45-5-2790) was also to be partially impacted by activities associated with TNR4. This was included in the current salvage program and was salvaged in accordance with the methodology outlined in the Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan.

This report documents the findings of the salvage program for these nine archaeological sites.

Site boundaries were determined by landscape context. Six sites were situated on ridgetops/crests (TNR AFT 22, TNR AFT 23, TNR AFT 24, TNR AFT 29, TNR AFT 30 and TNR AFT 31), two sites on crests to mid-slope (TNR AFT 26 and TNR AFT 27), and two on lower slopes/alluvial terraces (B6 and B54). The salvage program often covered more than one landform type within each site, particularly during Phase 1 dispersed salvage excavation.

A total of 5,204 Aboriginal stone artefacts were recovered during the excavation programme with 89.9% recovered from the Phase 2/3 contiguous open area excavations (n=4,676), and 10.1% from the Phase 1 excavations (n=528). A total of 583m^2 was excavated during the program, incorporating 228m^2 from the Phase 1 excavations and 355m^2 from Phase 2/3. The two sites located on the lower slopes and benches contained the highest number of artefacts with B6 found to contain 59% of the entire project assemblage (n=3,070) and B54 containing 20.8% of the project assemblage (n=1,085). Only one other site, TNR AFT 27, had a moderately high count of artefacts (n=696), comprising 13.4% of the project assemblage.

The highest mean artefact density per square metre was 19.3/m² at site B6, closely followed by site B54 with 19/m². Most other sites, primarily ridgetop and crest sites, had low numbers of artefacts and correspondingly low mean artefact densities. Four of the ridgetop/crest sites had less than one artefact per square meter.

A variety of lithic raw materials were identified within the assemblage, consistent with other known Aboriginal sites in the Cumberland Plain. However, there was a slightly elevated proportion of chert in the project assemblage, more than is common for similar assemblages from the region. This is likely due to the relative proximity of the Nepean River and Blue Mountain foothills to the west of the project area where chert sources are known to occur. Silcrete was the most common raw material in all but one site, comprising 66.1% of the project assemblage, followed by quartz (16%), silicified tuff (12.6%) and chert (4.2%). Other materials found in small numbers included petrified wood, quartzite, mudstone, fine-grained siliceous material (FGS) and a number of igneous artefacts.

The majority of the assemblage comprised complete flakes or flaked debitage (flake fragments and angular fragments) with cores and core fragments comprising 2.6% of the total assemblage. Variation between sites was apparent, with a higher ratio of cores to flaked debitage located in the lower density sites on crests and ridgetops. Evidence of tool manufacturing and use was also apparent, particularly at the higher density occupation sites, where the presence of the tools themselves along with particular core reduction types indicated the manufacture of backed blades. Backed artefacts comprised 1.7% of the entire assemblage and were primarily represented by backed blade fragments (n=45) and complete blades (n=21), with a significant number of geometric microliths (n=18). The number of retouched artefacts was lower, and these represented only 0.8% of the entire assemblage (n=43). The majority were non-formal retouched types with a small number of scrapers (n=10) and one Tula Adze. The Tula Adze is a specific type of retouched artefact and is usually associated with wood working. One small hammerstone and an axe/hatchet fragment was also identified. Most tools were located within the silcrete assemblage, although backed and retouched artefacts of tuff, quartz and chert were also identified.

Allowing for land use disturbance and differing excavation methodologies, there is a pattern of artefact discard within the study area that reflects differences in human behaviour. These differences most likely relate to the way Aboriginal people were accessing and using different resources across the individual landform types and the wider landscape bisected by the Northern Road corridor.

Sites within the TNR 4 study area showed a distinct difference in past landscape usage. Elevated sites, situated on ridgetops and crests, display low artefact densities and a more mixed assemblage, with little indication of long-term occupation. Sites situated on lower landform types such as lower slopes and alluvial terraces, in this case sites B6 and B54, show a more complex pattern of occupation. These two high density sites have assemblage characteristics which indicate domestic use and include: moderate to high numbers of backed artefacts and exhausted microblade cores, the use of a variety of lithic materials, multiple knapping floors and a high percentage of flaked debitage. Easy access to reliable water sources and the various economic resources associated with such areas, added to a relatively flat stable physical environment, appears to be a necessary basis for sites within this area. The absence of these indicators at sites TNR AFT 22, TNR AFT 24, TNR AFT 26, TNR AFT 29, TNR AFT 30 and TNR AFT 31 suggests that these sites were not occupation areas but were likely intermittently used locations along corridors for movement across the landscape and/or short-term hunting camps. In general, easy access to lithic resources does not appear to be a principal factor in the location of longer-term occupation for sites within the project area, with the characteristics of the salvage assemblage suggesting the importation of most lithic material from outside the area.

The archaeological sites associated with the project represent an important extended type of connectivity, where all of the sites are located on or near the spine of a low north-south ridge (The Northern Road) stretching over 16 kilometres. The reason The Northern Road was built on the ridgeline was the same reason the Aboriginal sites are located on the ridge – the landform itself facilitates intrinsic transitory movements suitable for cultural activity. This naturally formed cultural highway enables an assessment of past behaviour through the study of Aboriginal sites (representing past movements on the ridgeline over several thousand years). Moreover, the collection of archaeological sites has a greater scientific and socio-cultural assessment value than piecemealed assessments. In effect the en masse archaeological information represents a higher information value than each individual site – the group is more valuable than any individual part. In this regard the project's collection of impacted archaeological sites are a valuable assessment group, because the group offers a statistically significant level of information about an area (the south west Cumberland Plain) where little large scale, connectable or representative information exists.

The salvage program completed for The Northern Road Upgrade Stage 4 contributes to the baseline for understanding, interpreting and conserving the region's Aboriginal cultural heritage and illuminating the complexity and richness of the Aboriginal archaeological story.

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1 Introduction

1.1 Project background

Transport for NSW ('TfNSW'), formerly Roads and Maritime Services, is undertaking works to upgrade about 16 kilometres of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park in south western Sydney, NSW (the project). The upgrade works are being undertaken in stages and are required to improve safety, increase road capacity and cater for expected future traffic growth. The project is part of the Western Sydney Infrastructure Plan (WSIP). WSIP involves major road and transport linkages that will capitalise on the economic gains from developing the western Sydney airport site at Badgerys Creek whilst boosting the local economy and liveability of Western Sydney. Additionally, the project would provide better connections for the South West Priority Land Release Area and Western Sydney Priority Growth Area by enhancing the transport corridor through completing the upgrade of The Northern Road. The overall project corridor is shown in Figure 1.

The project is designated as Critical State Significant Infrastructure (SSI 7127) and was assessed under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), requiring the approval of the Minister for Planning. In addition, the proposal was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to the Minister for the Environment and Heritage. It was determined that an Environmental Impact Statement (EIS) was required. The Secretary of the NSW Department of Planning and Environment issued Secretary's Environmental Assessment requirements (SEARs) for the project on 28 July 2015 and amended SEARs were issued on 9 March 2016. Following preparation of the EIS, the project was approved by the Minister on 30 May 2018.

1.2 Assessment context

TfNSW engaged Kelleher Nightingale Consulting Pty Ltd (KNC) to undertake Aboriginal cultural heritage assessment for the project. Initial assessment included preparation of an Aboriginal archaeological assessment (KNC 2016) in accordance with Stage 2 of the Roads and Maritime *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime 2011) and the requirements of the Office of Environment and Heritage (OEH) [now Heritage NSW]. A full coverage survey of the project area was carried out in 2015 and 2016 by a team comprising representatives from the Deerubbin Local Aboriginal Land Council, Gandangara Local Aboriginal Land Council and archaeologists from KNC.

Preparation of an Aboriginal Cultural Heritage Assessment Report (CHAR) was subsequently undertaken to inform the EIS (KNC 2017). The CHAR assessment addressed the Aboriginal heritage requirements identified in the project SEARs. The objectives of the CHAR combined Aboriginal community consultation with an archaeological investigation in accordance with:

- Secretary's requirements;
- EPBC Act assessment requirements;
- Roads and Maritime PACHCI;
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (OEH 2010a);
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011); and
- *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH 2010b).

Aboriginal cultural heritage assessment for the project was designed to meet the SEARs and the EPBC Act. This included:

- assessment of impacts to Aboriginal heritage (both cultural and archaeological significance);
- consultation with Aboriginal communities, including Deerubbin Local Aboriginal Land Council, Gandangara Local Aboriginal Land Council and registered Aboriginal stakeholders for the project, to assess impacts and develop mitigation measures;
- preparation and consultation on the archaeological assessment methodology. The methodology of assessment was distributed to registered Aboriginal stakeholders, discussed at an Aboriginal focus group meeting resulting in agreement by the stakeholders;
- evaluation of landscape features and potential archaeological significance;
- detailed archaeological assessment of the project to fully identify spatial extent and impacts;
- identification of mitigation and management measures;
- distribution of draft CHAR to Aboriginal stakeholders and an Aboriginal focus group meeting to discuss the CHAR results and agree on appropriate mitigation measures.

Aboriginal archaeological assessment of the project area found 28 Aboriginal archaeological sites within the project boundary. The sites comprised 23 artefact scatters and five isolated artefacts. The spatial extent of Aboriginal archaeology of the project area was topographically well defined and within scientifically well understood soil matrices, which enabled a clear establishment of the presence and significance of archaeological sites within the project boundaries.

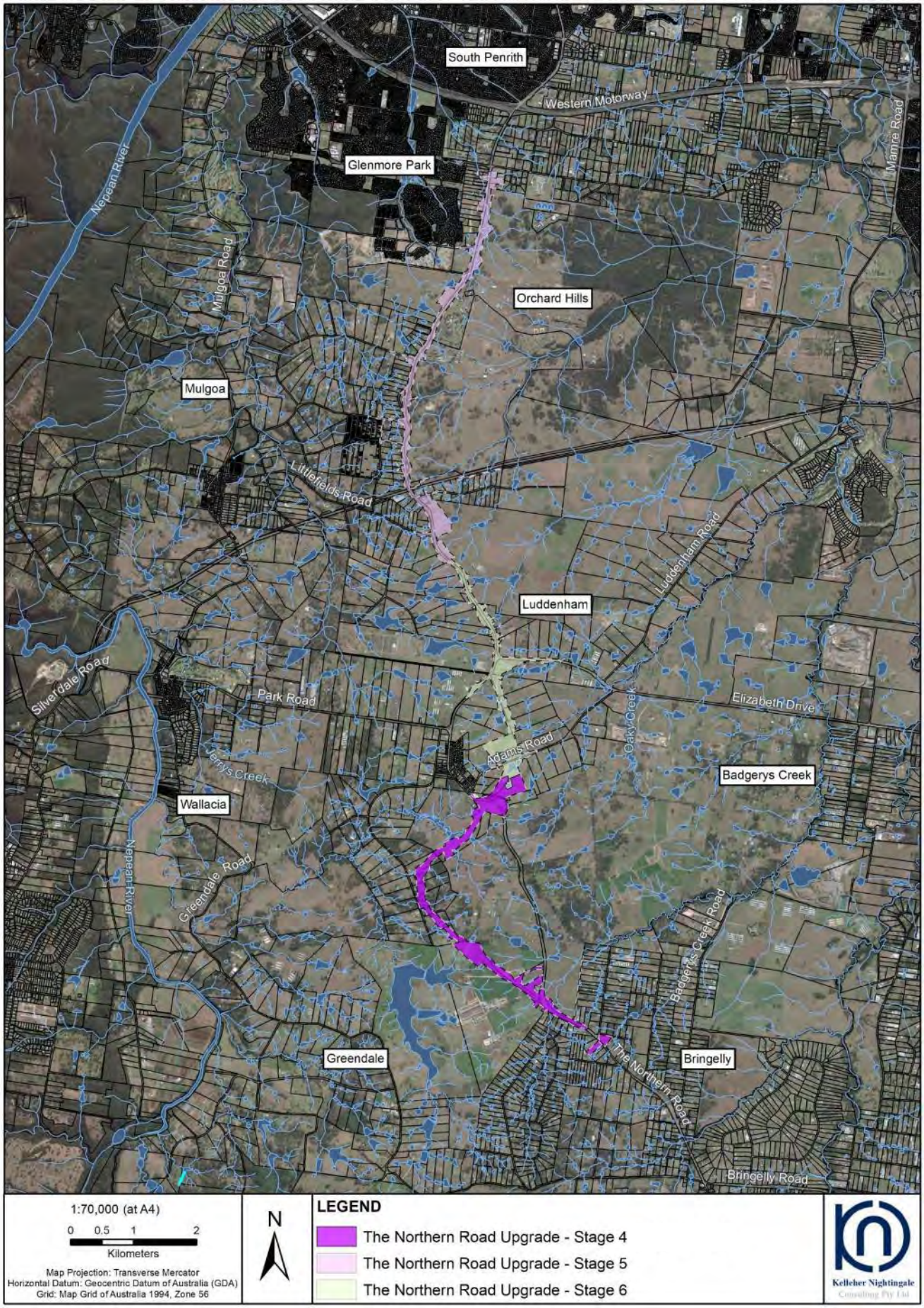

Figure 1.The Northern Road Upgrade (SSI 7127) project area showing staging

Of the 28 Aboriginal archaeological sites affected, it was identified 12 sites would be totally impacted by the proposed works. Design refinement partially reduced the impact to the remaining 16 archaeological sites. All identified sites were to be at least be partially impacted by the project.

Archaeological and cultural significance of the identified Aboriginal sites was defined by the information exhibited by each site. The range of sites identified an Aboriginal cultural highway where various activities took place in the past (similar to contemporary roadway and occupation). Aboriginal sites with greater levels of significance offer detailed information about the Aboriginal highway along the ridge and specific meeting spots (like the junction of Elizabeth Drive and The Northern Road). Survey and consultation with Aboriginal stakeholders identified 20 Aboriginal archaeological sites of at least moderate significance. The remaining archaeological sites contained disturbed or low value deposits.

Recommendations included a salvage excavation program prior to construction works for the 20 Aboriginal sites exhibiting moderate significance. A management strategy (heritage management plan) was also developed to facilitate the preconstruction mitigation plan, enable the transition to construction and guide the ongoing construction program.

Following project approval, the project was divided into three stages. The southernmost section (named The Northern Road Upgrade Stage 4 or TNR4) is the subject of the current assessment and report (Figures 1 and 2). TNR4 was situated in the southern portion of the main project, from The Northern Road in Bringelly in the south, to Eaton Road Badgerys Creek in the north.

TNR4 incorporated ten Aboriginal archaeological sites, eight of which required archaeological salvage excavation for the impacted portions:

- TNR AFT 22 (AHIMS 45-5-4793) (archaeological salvage required)
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One additional site within the Western Sydney Airport (WSA) lands (B54 – AHIMS 45-5-2790) was also to be partially impacted by activities associated with TNR4. This was included in the current salvage program and was salvaged in accordance with the methodology outlined in the Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan (WSA ACH CEMP) (WSA Co 2018)

This report documents the findings of the salvage program carried out in accordance with the conditions of project approval, for the nine Aboriginal archaeological sites shown in Figure 2.

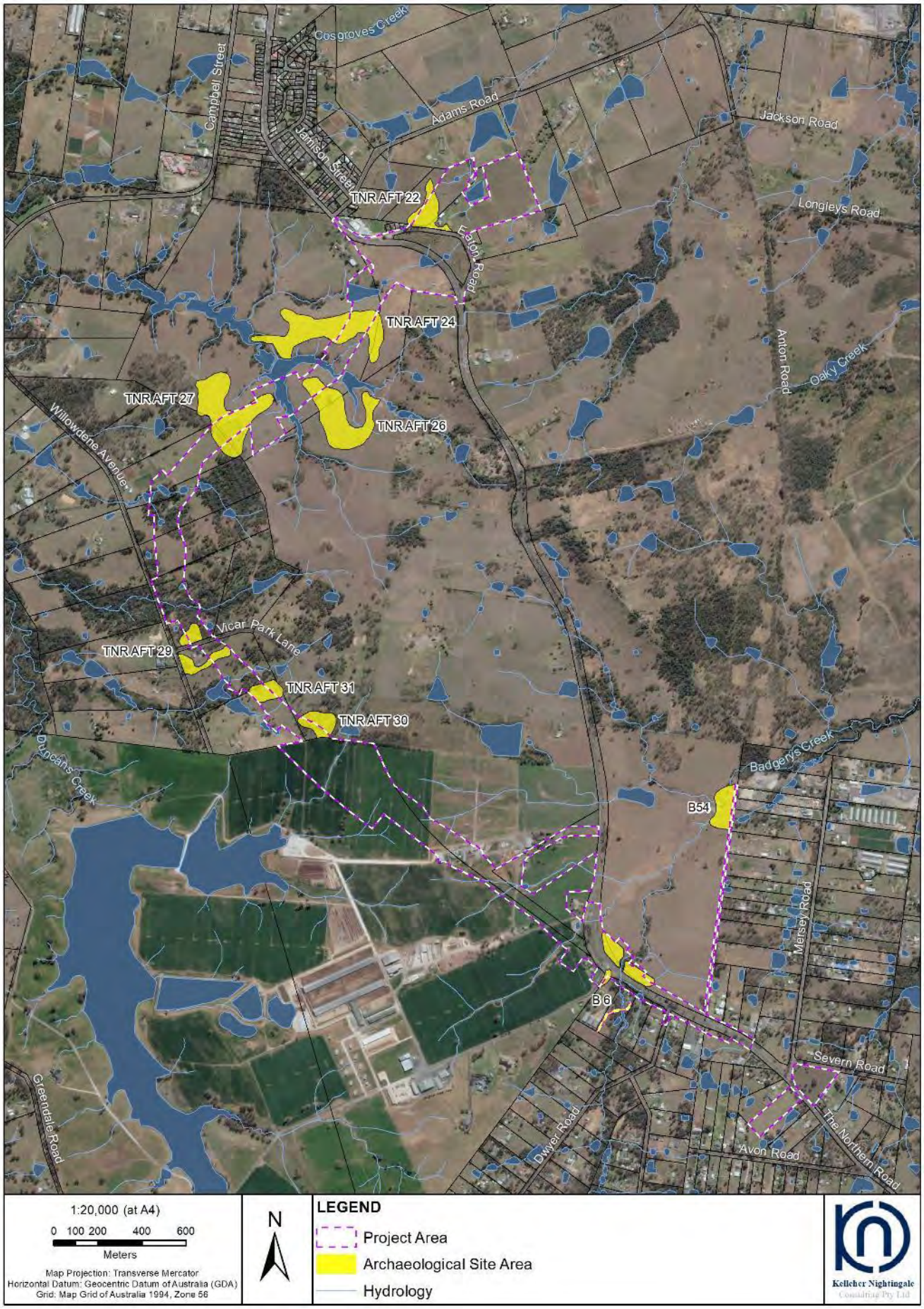


Figure 2. TNR4 project area and salvaged Aboriginal archaeological sites

2 Aboriginal Community Involvement

2.1 Stakeholder Consultation

TfNSW is committed to effective consultation with Aboriginal communities regarding activities which may impact on Aboriginal cultural heritage. The TfNSW PACHCI has been developed to provide a consistent means of effective consultation for TfNSW activities across NSW. The PACHCI is compliant with Heritage NSW requirements and guidelines.

Registered Aboriginal stakeholders have been involved in previous assessment of the project and preparation of the CHAR (KNC 2017). The stakeholder registration and consultation process followed the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH 2010b) and project SEARs and has been conducted in accordance with the requirements of the PACHCI. Salvage excavation fieldwork was undertaken in partnership with registered Aboriginal stakeholder representatives (site officers).

A full discussion and log of all Aboriginal community consultation is available in the CHAR (KNC 2017).

2.2 Registered Aboriginal Stakeholders

As listed in the CHAR, there are 61 Aboriginal stakeholder groups and individuals registered for consultation on the project. Registered Aboriginal stakeholders are listed in the table below.

Table 1. Registered Aboriginal stakeholders

REGISTERED STAKEHOLDER GROUPS AND INDIVIDUALS			
Group	**Representative / Contact**	**Group**	**Representative / Contact**
A1 Indigenous Services	Carolyn Hickey	Gunjewong Cultural Heritage Aboriginal Corporation	Cherie Carroll Turrise
Aboriginal Archaeology Services	Andrew Williams	Gunyuu	Darlene Hoskins-McKenzie
Amanda Hickey Cultural Services	Amanda Hickey	Kamilaroi-Yankuntjatjara Working Group	Phil Khan
Biamanga	Seli Stoer	Kullila Site Management	Paul Charles
Bidawal	Richard Andy	Liverpool City Councils Aboriginal Consultative Committee	Norma Burrows
Bilinga	Ms Wandai Kirkbright	Munyunga	Suzanne McKenzie
Bilinga	Simalene Carriage	Muragadi Heritage Indigenous Corporation	Jesse Johnson
Corroboree Aboriginal Corporation	Steve Johnson	Murramarang	Roxanne Smith
Cubbitch Barta Native Title Claimants Aboriginal Corporation	Glenda Chalker	Murri Bidgee Mullangari Aboriginal Corporation	Darleen Johnson
Cullendulla	Corey Smith	Murrin	Tarlarra Te-kowhai
Darug Aboriginal Cultural Heritage Assessments	Gordon Morton	Murrumbal	Levi McKenzie-Kirkbright
Darug Aboriginal Land Care	Des Dyer	Murrumbul	Levi McKenzie
Darug Custodian Aboriginal Corporation	Justine Coplin	National Koori Management	Ali Maher
Darug Land Observations	Gordon Workman	Ngarigo	Newton Bond
Darug Land Observations	Jamie Workman	Ngunawal	Dean Delponte
Darug Tribal Aboriginal Corporation	John Riley	Ngunawal	Edward Stewart
Deerubbin LALC	Kevin Cavanagh	Nundagurri	Newton Carriage
Djiringanji	Keith Nye	Rane	Tony Williams
Duncan Falk Consultancy	Duncan Falk	Tharawal LALC	Rebbeca Ede
Galaga	Wendy Smith	Thauaira	Shane Carriage
Gandangara LALC	Brad Maybury	Tocomwall	Danny Franks
Gangangarra	Kim Carriage	Walbunja	Hika Te Kowhai
Goobah Developments	Basil Smith	Walgalu	Ronald Stewart

REGISTERED STAKEHOLDER GROUPS AND INDIVIDUALS			
Group	**Representative / Contact**	**Group**	**Representative / Contact**
Gundungurra Tribal Technical Services	Peter Foster	Wandandian	William Bond
Gundungurra Tribal Technical Services	Christopher Payne	Warragil	Aaron Slater
Gundungurra Tribal Technical Services	Larry Hoskins	Warragil Cultural Services	Aaron Slater
Gundungurra Tribal Technical Services	David Bell	Widescope Indigenous Group	Steven Hickey
Gundungurra Tribal Technical Services	Pimmy Johnson Bell	Wingikara	Robert Brown
Gundungurra Tribal Technical Services	Teangi Mereki Foster	Wingikara	Hayley Bell
Gundungurra Tribal Technical Services	Sam Wickman		

*One additional Aboriginal group/individual registered for consultation on this project and has chosen to withhold their details in accordance with item 4.1.5 of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*

2.3 Participation in Archaeological Salvage Excavation Program

Fieldwork took place over two periods between August 2018 – June 2019. Representatives from the following registered Aboriginal stakeholder groups were involved in the salvage excavation activities:

- A1 Indigenous Services
- Kamilaroi Yankuntjatjara Working Group
- Murra Bidgee Mullangari Aboriginal Corporation
- Darug Custodian Aboriginal Corporation
- Gandangara Local Aboriginal Land Council
- Darug Aboriginal Cultural Heritage Assessments
- Kawul Cultural Services (registered for consultation on WSA)
- Butucarbin Aboriginal Corporation (registered for consultation on WSA)
- Yulay Cultural Services (registered for consultation on WSA)

3 Landscape Context

The following chapters provide environmental and landscape analysis from the CHAR (KNC 2017), and an ethnohistorical review and existing archaeological data for the region. As such they refer to the whole of The Northern Road upgrade project area. TNR4 comprises the southern portion of the project area.

3.1 Landform, geology and soils

The project area is located on the Cumberland Plain, a low lying and gently undulating subregion of the Sydney Basin. The Sydney Basin is a large geological feature stretching from Batemans Bay in the south to Newcastle in the north and Lithgow in the west. The formation of the basin began between 250 to 300 million years ago when river deltas gradually replaced the ocean that had extended as far west as Lithgow (Clark and Jones 1991).

The project area traverses a north-south oriented ridge that forms the watershed separating the catchment areas of South Creek in the east and the Nepean River in the west (Figure 3). The ridge is characterised by gentle to moderately inclined slopes with narrow to broad crests and drainage lines. The eastern side of the project area contains several north-east flowing creeks including Badgerys Creek, Cosgroves Creek and Oaky Creek which join South Creek approximately 7 kilometres to the east. On the western side of the project area, several creeks including Duncans Creek and Mulgoa Creek flow north-west to join the Nepean River approximately 4.5 kilometres to the west.

The basal geology of the project area is dominated by Bringelly Shale (Rwb), part of the Late Triassic Wiannamatta Group of shales common to the Cumberland Plain (Figure 4). Bringelly Shale (Rwb) is composed of shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff (Clark and Jones 1991) and underlies the crests, slopes and drainage lines of the majority of the project area. More recent Quaternary Alluvium (Qal) is present along the low lying areas adjacent to Badgerys Creek. Quaternary Alluvium (Qal) comprises fine-grained sand, silt and clay that deposited in association with fluvial activity along the various creek corridors. In the north of the project area, a small deposit of Cranebrook Formation geology (Qpc) is present adjacent to Surveyors Creek. Cranebrook Formation (Qpc) geology is characterised by a basal layer of pebble and cobble clast gravels below sand, silt and clay. The gravels comprise clasts of quartz, quartzite, chert, porphyry, granite, hornfels, sandstone and silcrete. Cranebrook Formation geology contains raw material types that were utilised by past Aboriginal people. Areas where these materials were exposed at the surface, such as within creek channels, are likely to have been exploited by past Aboriginal people.

Three principal soil landscapes are present within the project area. The basal geology is overlain by South Creek soils within the immediate vicinity of major creeks, transitioning to Blacktown soils on crests and low rises and Luddenham soils on hills and ridge slopes (Figure 5). The alluvial South Creek soil landscape is characterised by flat landforms with incised channels that are subject to frequent episodes of inundation, erosion and aggradation. The landscape contains deep structured loams and clays overlying bedrock or relict soils. The South Creek soil landscape may retain archaeological deposit but due to its location on active floodplains, integrity of deposit may be compromised due to repeated episodes of erosion and deposition caused by fluvial activity.

The residual Blacktown soil landscape is located on gently undulating rises with broad rounded ridges and crests with gently inclined concave slopes. The landscape is characterised by shallow to moderately deep red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and drainage lines. Erosional susceptibility of this soil landscape is relatively low, but is increased where surface vegetation is not maintained (Bannerman, Hazleton, and Tille 1990). Blacktown soils are conducive to artefact survivability, however their acid chemistry quickly removes organics and their deflationary tendency often results in a temporal collapse, where archaeological objects from multiple time periods accumulated within a single cultural soil layer.

The erosional Luddenham soil landscape is situated on low rolling to steep hills with narrow convex ridges and crests, moderately inclined slopes and narrow drainage lines. The landscape comprises shallow dark podzolic soils or massive earthy clays on crests, moderately deep red podzolic soils on upper slopes and moderately deep yellow podzolic soils and prairie soils on lower slopes and drainage lines. The Luddenham soil landscape has a high erosional susceptibility with moderate surface movement potential. The steeper hill slopes of the Luddenham Soil Landscapes are subject to minor gully erosion and moderate sheet erosion in areas that have been stripped of vegetation. Aboriginal sites within these areas are likely to be disturbed low density scatters exposed by the eroding landscape. However, landforms and vegetation that create stability for the soil landscape could have preserved Aboriginal sites. The landforms associated with this soil landscape are generally the furthest away from water sources and associated resources. It is therefore likely that these areas were utilised in a different way to other landforms in the project area.

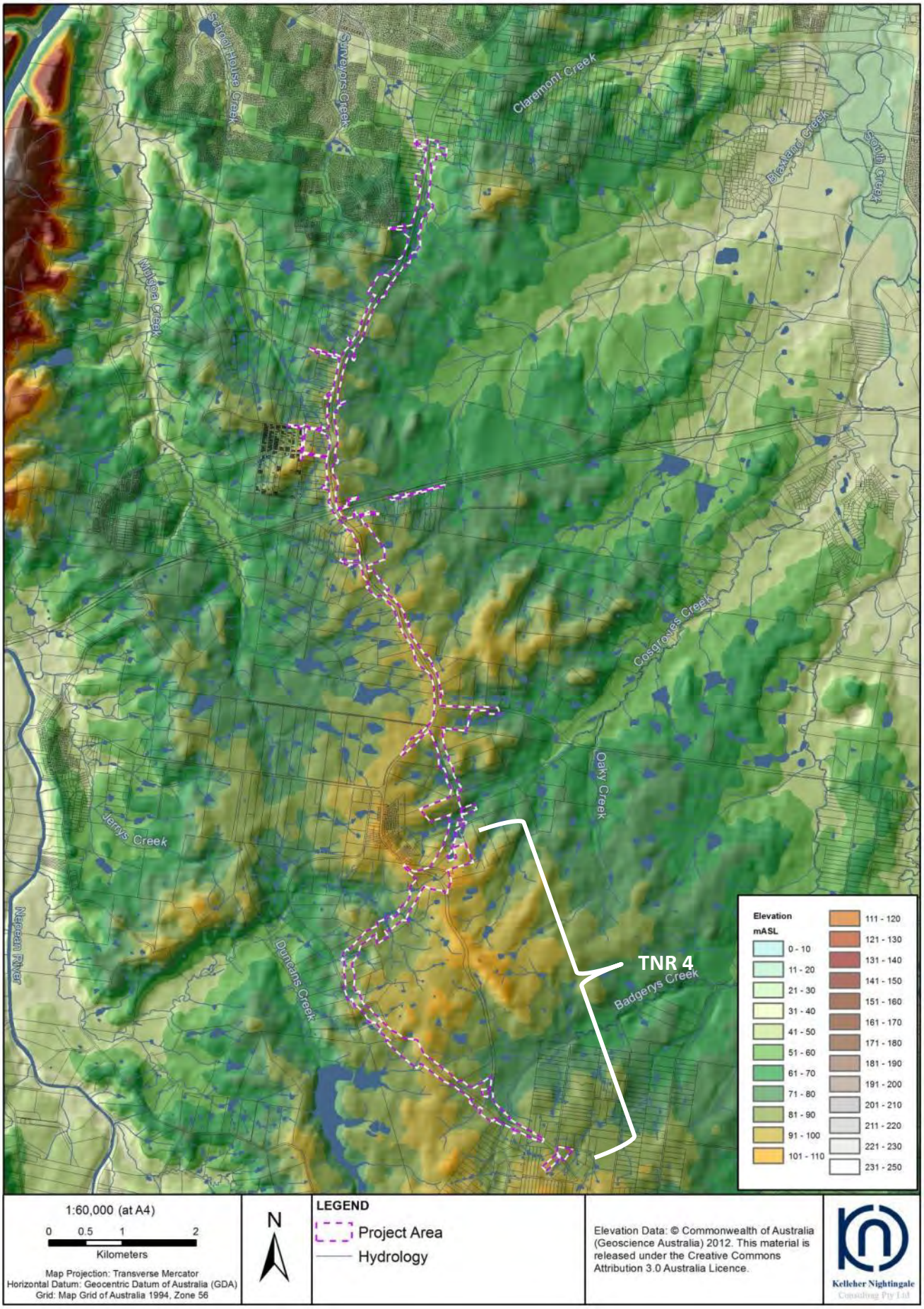


Figure 3. Landforms of the wider project area

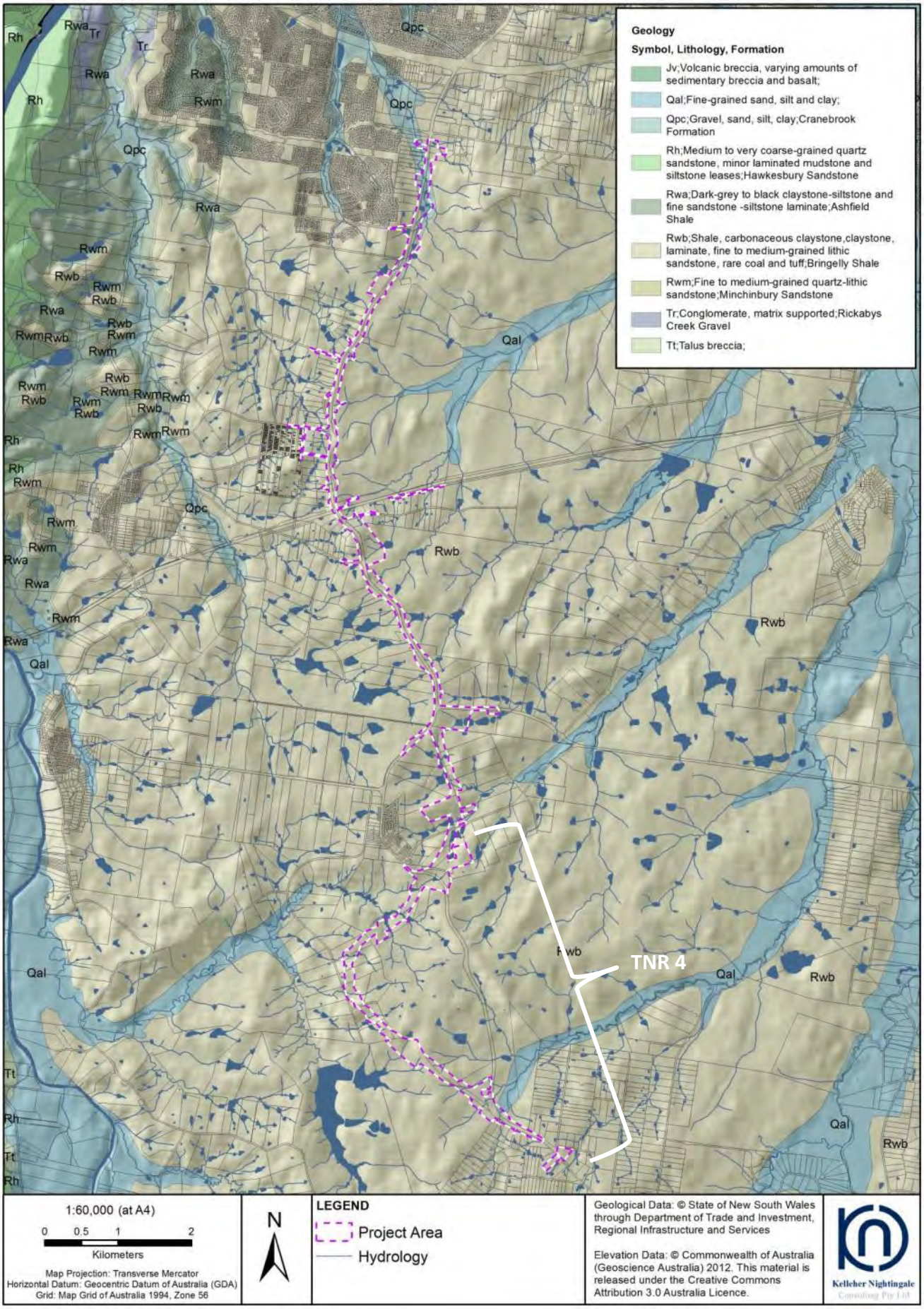


Figure 4. Geology of the wider project area

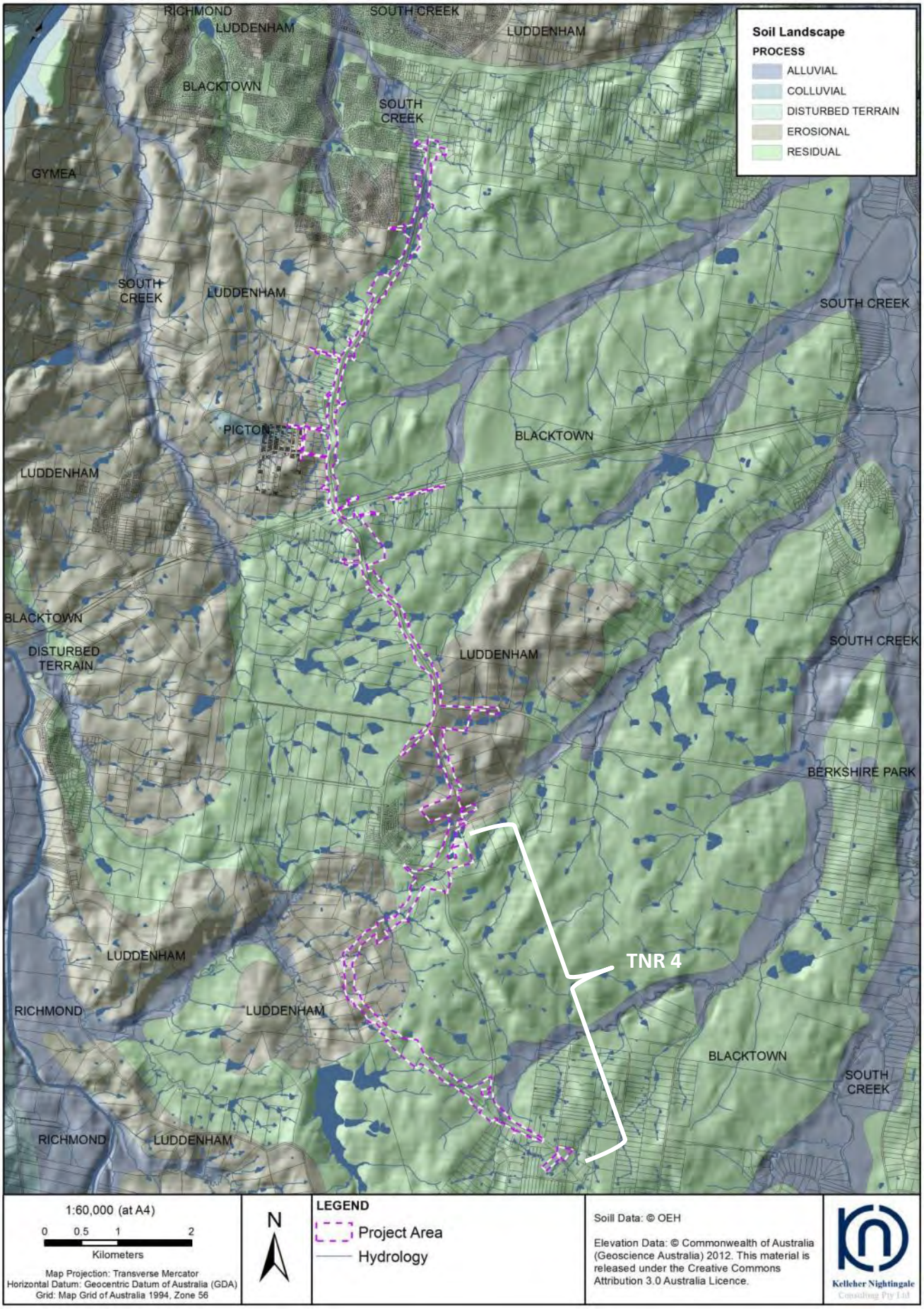


Figure 5. Soil landscapes of the wider project area

3.2 Vegetation and landuse history

The distribution of native vegetation within the project area has been affected by historic and contemporary European landuse practices in the region. Prior to 1788, a mixture of native vegetation communities would have extended across the entirety of the Cumberland Plain with distribution determined by a combination of factors including soil, terrain and climate. The clearance of native vegetation across the majority of the project area by European settlers has left only small areas of native vegetation. These areas are classified as Shale Plains Woodlands, Shale Hills Woodland and Alluvial Woodland.

Shale Plains Woodland is the most widely distributed native vegetation community on the Cumberland Plain and generally occurs on flat to gently sloping terrain and low elevation with soils derived from Wianamatta Shale or well drained Holocene Alluvium geology. Shale Plains Woodland is characterised by a canopy dominated by *Eucalyptus moluccana* (grey box) *and E. tereticornis* (forest red gum), a shrub stratum dominated by *Bursaria spinose* (blackthorn) and a ground stratum comprising a mixture of grasses.

Shale Hills Woodland generally occurs on higher elevations and steeper terrain than Shale Plains Woodland with soils derived from Wianamatta Shale geology. Shale Hills Woodland is characterised by a canopy dominated by *E. moluccana* (grey box and *E. tereticornis* (forest red gum), a small tree stratum of *Acacia implexa* (lightwood) and commonly occurring *Eucalyptus* species, a shrub stratum dominated by *Bursaria spinose* (blackthorn) and a ground stratum of grasses and herbs.

Alluvial Woodland is found adjacent to or in close proximity to minor watercourses with draining soils derived from Wianamatta Shale geology. Alluvial Woodland commonly includes an upper tree stratum of *E. amplifolia* (cabbage gum) and *E. tereticornis* (forest red gum), a small tree stratum of *Acacia parramattensis* (Parramatta green wattle) and *Casuarina glauca* (swamp she-oak), an often sparse shrub stratum of dominated by *Bursaria spinose* (blackthorn) and an often dense ground stratum of grasses.

Landuse practices have had a variable impact on the landscape within the project area. The project area is predominantly cleared of native vegetation and utilised for grazing cattle and cultivating crops. A number of large dams have been constructed throughout the area within former creek channels, altering the area's hydrology and drainage patterns. Several residential and agricultural structures are also present. The landscape within the areas of urban expansion at Glenmore Park and the township of Luddenham contain low density residential and commercial structures with associated utilities and infrastructure.

A portion of the project area is located within Australian Department of Defence lands that contain several sealed and unsealed roads, a graded perimeter track, various buildings, dams and a landscaped golf course.

Construction activities within other (public and private) road corridors and the Warragamba-Prospect water pipeline easement have modified the landscape by creating cuttings and artificial embankments in addition to modifying the course of several waterways. The project area also contains several above and below ground utility corridors.

4 Ethnohistoric Context

The project area lies within a landscape which was important to, and intensively used by, past Aboriginal peoples (Attenbrow 2002). The arrival of European settlers began a cataclysmic series of events which radically changed the lifestyle of Aboriginal people on the Cumberland Plain. Contact with Europeans introduced diseases, such as smallpox, that drastically altered the size and structure of the Aboriginal population, whilst the expansion of settlements and establishment of farmland subsumed the traditional areas used to meet subsistence needs (Attenbrow 2002).

After their arrival in Sydney Cove in 1788, the British set about exploring the surrounding area. In the first three years of settlement many areas of the region were explored including Broken Bay, Botany Bay, Rose Hill (Parramatta), Prospect Hill and overland to the Nepean, Hawkesbury and Georges Rivers. During these explorations some of the British Officers, including Governor Phillip and Captain Watkin Tench, made a number of written observations regarding the local Aboriginal people that they met and travelled with (Attenbrow 2002:13).

Early historical observations described the Cumberland Plain as a mosaic of Aboriginal groups associated with particular areas of land. These groups were described as 'tribes' in many historical observations, when in fact they were more likely small territorial clans or local clans consisting of extended family groups, forming larger land-using bands linked through marriage and communal participation in subsistence gathering activities (Attenbrow 2002:22, Brook and Kohen 1991:2). The British noted a difference between the dialect of the Aboriginal people along the coast compared with those further inland on the Cumberland Plain. Captain Tench observed when two Aboriginal men from the coast conversed with an Aboriginal man further inland "they conversed on a par and understood each other perfectly, yet they spoke different dialects of the same language; many of the most common and necessary words used in life bearing no similitude, and others being slightly different" (Tench 1793:122).

None of the British observations from the late 18th and early 19th Century make reference to any name for the different dialects or wider language groups that they noted (Attenbrow 2002:33). It was only in the late 19th Century that the name Darug (also referred to as Daruk, Dharuk, Dharook, and Dharug) was used to refer to the language of the traditional inhabitants of the Cumberland Plain (Attenbrow 2002:33). In the early 20th Century, anthropologist/linguist R H Matthews noted that "the Dharuk speaking people adjoined the Thurrawal on the north, extending along the coast to the Hawkesbury River, and inland to what are now Windsor, Penrith, Campbelltown, and intervening towns" (Matthews 1901:155 [in Attenbrow 2002: 32]).

As well as differences in the dialect spoken between the coastal inhabitants and those further inland, the British also observed differences in subsistence activities. Brook and Kohen (1991:3) noted that "the Dharug people were apparently divided into two distinct sub-tribes: those along the coast, who lived on fish; those inland, who were frequently referred to as the 'woods tribes'". Tench recorded differences in the food eaten and methods used to acquire these resources between the inhabitants of the coast and those to the west of Rose Hill (Parramatta). On one occasion Tench observed a method of climbing trees for animals that involved cutting notches in the trunk and using these as toe-holds to climb the tree (Tench 1793:82).

Kohen (1986:77) explains that the Aboriginal people who lived between Parramatta and the Blue Mountains were not as dependant on fish and shellfish as groups closer to the coast, but relied on small animals and plant foods in addition to seasonally available freshwater mullet and eels. Tench (1793:230) observed that 'they depend but little on fish, as the river yields only millets and that their principal support is derived from small animals which they kill and some roots (a species of wild yam chiefly) which they dig out of the earth'. These wild yams were found in considerable quantities along the banks of the Nepean and Hawkesbury Rivers. Berries, Banksia flowers and wild honey were also recorded as foods of the local inhabitants (Collins 1798 [Kohen 1985:9]). A particularly important plant food was the Burrawong (*Macrozamia communis*), which provided a nutritious nut that was pounded and soaked in running water to leach out toxins before the flour-like extract was made into small cakes and baked over a fire (Kohen 1993:8).

Small animals provided the protein component of the Aboriginal diet on the Cumberland Plain, with hunting comprising a major economic role of the men. Along the river, traps and snares were set for bandicoots and wallabies, while decoys for snaring birds were also a commonly employed technique, 'these are formed of underwood and reeds, long and narrow, shaped like a mound raised over a grave, with a small aperture at one end for the admission of the prey' (Tench 1793 [Kohen 1985:9]). Possums and gliders were particularly common in the open woodland across the Cumberland Plain and probably formed the main sources of animal food. These were hunted in a number of ways, including smoking out the animal by lighting a fire in the base of a hollow tree, burning large tracts of land and gathering the stranded animals, as well as cutting toe-holds in trees mentioned above (Kohen 1993:10; Tench 1793:82).

5 Archaeological Context

Previous archaeological investigations have taken place within and on the immediate boundary of the wider project area. Investigations have primarily involved pedestrian survey and desktop assessment, although some excavation programs have been carried out. In general, these investigations have been concentrated to the south as part of preparation for the Western Sydney Airport at Badgerys Creek or in the north as part of the residential developments at Glenmore Park and Mulgoa. Archaeological assessment specific to the current project area was undertaken as part of the Stage 2 PACHCI assessment for the proposed Northern Road Upgrade and the subsequent CHAR. The results of investigations pertinent to the current assessment are presented below.

M4 Western Motorway

An archaeological survey for Aboriginal sites within the M4 Western Motorway corridor between Parramatta and Emu Plains was conducted in 1996 (Brayshaw and Haglund 1996). The archaeological survey identified 20 Aboriginal archaeological sites that were predominantly low density artefact scatters (less than five artefacts) and isolated artefacts. Much of the road corridor was found to be heavily disturbed, resulting in an archaeological record that was not considered to be reflective or representative of past Aboriginal occupation and use of this area; however, two artefact scatters located near South Creek were found to have relatively high artefact density and low disturbance. These sites were located in close proximity to major waterways on defined topography such as terraces or level hills/ridges with limited disturbance from modern landuse practices and protection from fluvial activity and erosion. Silcrete artefacts dominated the recorded assemblages, with lower numbers of indurated mudstone, quartz, quartzite and igneous materials also identified. The assemblage comprised 70% flakes or flake fragments and 30% cores or core fragments. The high proportion of broken or damaged artefacts was considered to be the result of disturbance and post-discard breakage.

An Aboriginal archaeological survey and subsequent cultural heritage assessment of the M4 Motorway corridor was undertaken by KNC as part of the M4 Managed Motorway (M4MM) project (KNC 2013; KNC 2015). The investigation, a follow-up from the 1996 Brayshaw and Haglund assessment, included a review of background information, including identification of previously recorded Aboriginal sites registered on the AHIMS register, sites known to the local Aboriginal community or others and any archaeologically sensitive landforms or areas or potential archaeological deposit in the M4MM project area. The survey identified 33 Aboriginal archaeological sites within the M4MM corridor including two previously unrecorded artefact scatters. The majority of sites were found to be highly disturbed with no intact archaeological deposit due to modern landuse practices and natural processes. The subsequent CHAR confirmed 30 sites would be at least partially impacted by the project, with salvage excavation recommended for sites of at least moderate significance (sites South Creek 1 (SC1), South Creek 2 (SC2), and Clyburn Avenue).

KNC subsequently undertook archaeological salvage works at these three sites, recovering a total of 8,410 artefacts from 350m^2 of excavation across SC1, SC2 and Clyburn Avenue (KNC 2019). SC1 and SC2 on the alluvial terraces near South Creek demonstrated higher artefact densities and greater artefact counts than Clyburn Ave, located on a more marginal upper slope/crest landform further from permanent water sources. At SC1, mean artefact density across the site was 27.6/m^2 (n=6478, 235m^2 sample). SC2 was slightly higher with 35.1/m^2 despite a smaller sample of 50m^2 (n=1756). A 51m^2 sample of Clyburn Avenue returned a total of 176 artefacts and a low mean site density of 3.5 artefacts/m^2. The majority of the excavated area yielded a low or moderate density of artefacts. Squares yielding high densities of artefacts (≥100 artefacts per square) were found at SC1, with nine squares containing over 100 artefacts and a peak density of 303/m^2. One square of over 100 artefacts was located at SC2. At Clyburn Ave, peak density was just 13.

Sites SC1 and SC2 were located next to a major creek system, while Clyburn Ave was located on upper slopes and a crest within the intermediate environmental zone. Assemblages at the South Creek sites represented primary activity areas, despite differences in artefact densities, and exhibited discrete spatial patterning of artefacts with overlapping events from activities such as knapping, tool maintenance, microblade production, specialised production and food preparation. Types of lithic material used, particularly the diverse silcrete assemblage, indicated access or procurement strategies for this important lithic resource may have changed over time. In turn, this suggested the sites were revisited and occupied periodically to exploit natural resources in the area, possibly over thousands of years.

The Clyburn Ave assemblage was representative of a secondary or even tertiary activity area, where very specific activities were being carried out, such as food preparation or hunting. There was little evidence of knapping or tool maintenance. The larger assemblages found at South Creek were predominantly silcrete, although there was a large variety of other materials being used, while the assemblage from Clyburn Ave was predominantly tuff with only a limited range of other materials, further highlighting the differing archaeological signature of selective activities on this more marginal landform.

Western Sydney Airport, Badgerys Creek

An archaeological assessment was undertaken for the Western Sydney Airport in 1985 (Kinhill Stearns 1985). The assessment included a survey that covered approximately 70 hectares and targeted areas where predictive modelling had suggested archaeological sites would be most likely to occur and areas where surface visibility would have revealed artefacts if present. The survey identified one artefact scatter of five silcrete flakes and flaked pieces adjacent to Badgerys Creek. The assessment noted that additional artefact scatters were likely to occur along the banks of larger creeks and that several landforms in the vicinity of Badgerys Creek appeared to be relatively intact. The remainder of the area was assessed as being heavily disturbed by extensive landuse.

Navin Officer conducted an Aboriginal cultural heritage study in 1997 of the then proposed airport area as part of an assessment of potential sites for a second major airport for Sydney. The study included a survey of a representative sample of the topographic variation within the proposed airport area. The survey identified 111 archaeological sites comprising 58 artefact scatters, eight scarred trees, 44 isolated artefacts and one potential archaeological deposit. Artefact density within the artefact scatters was generally low, with the majority containing five or less artefacts. Higher artefact numbers and densities were noted at sites located within the valley floor and fluvial corridors. Non-artefactual rounded silcrete gravels were identified across the northern portion of the survey area and were assessed as potentially representing the remnants of an eroded surface source (Navin Officer 1997: 5-7).

The survey identified two artefact sites (B6 and B54) which intersect the current TNR 4 project area. B6 was located on a lower slope with a northern aspect, adjacent to Badgerys Creek. Artefacts comprised one mudstone multiplatform core fragment, one chert flake and one quartz flake. The site was assessed as being in generally poor condition with disturbance from cattle and motorcycles. B54 was located on the eroded margin of a drainage gully adjacent to Badgerys Creek. Artefacts included one single-platform silcrete core and a chert flake. Site condition was poor due to erosion and stock trampling along the creek margin.

Navin Officer undertook an Aboriginal cultural heritage assessment of the Western Sydney Airport in 2015. The assessment included a test excavation program that targeted a representative selection of landform types within the area, to characterise the nature and extent of the subsurface archaeological resource. The test excavation pre-selected 38 potential test locations which were systematically surveyed and refined to a final 11 test locations where 114 test pits (1 x 0.5 metre) were excavated. A total of 91 stone artefacts were recovered during the test excavation program, resulting in the recording of 23 additional sites. The majority of test pits contained less than 10 artefacts. Artefacts recovered during the test excavation program were predominantly flakes with little to no dorsal cortex and which were generally small in size indicating a rationing of raw material.

The investigation found a direct correlation between landform and the presence of significant archaeological material, such that testing of the landscape was moot and reliability of artefact distribution on the Cumberland Plain can be established through landform assessment.

> It is now established that Aboriginal stone artefacts in subsurface contexts are distributed across the full spectrum of landscape variation. The areal incidence of this distribution is discontinuous and uneven, but broad and relative categories of artefact incidence can be reliably predicted according to landform types and variables. (Navin Officer 2015: 24)

The result show that a detailed survey combined with an archaeological landform assessment provided a true appreciation of the significance and extent of the archaeological resource.

The archaeological assessment for the Western Sydney Airport identified two general trends in the spatial distribution of artefacts recovered. Artefact density was generally low on ridgelines and crests. Relatively larger densities were generally found within 100 metres of a second order or greater streamline and lower order drainage lines were frequently sterile. Navin Officer concluded that data indicated that access to stable water sources were "the strongest deciding factor for Aboriginal groups in choosing where to focus their activities across the study location" (Navin Officer 2015: 129). Salvage recommendations and methodology were provided in Navin Officer 2017 and later incorporated into the WSA ACH CEMP (WSA Co 2018).

Glenmore Park/Mulgoa Rise

Dallas undertook an archaeological survey of the South Penrith Development Site (the future suburb of Glenmore Park) in 1981. The survey encompassed an area of approximately 800 hectares on the southern side of the Western Motorway between Mulgoa Creek and The Northern Road. The survey identified 20 surface artefact scatters and seven isolated artefacts. The sites were located on elevated locations or hills adjacent to School House Creek or an unnamed tributary of Surveyors Creek. Modern land-use practices such as ploughing were found to have disturbed many of the identified sites along Surveyors Creek while sites near School House Creek were found to be more intact. Low density artefact scatters with five or less artefacts constituted half the identified sites and most sites had less than 10 artefacts. Artefacts were predominantly flakes and flaked pieces made from chert and silcrete with some examples of mudstone and quartz. One basalt edge-ground hatchet was also identified.

Dallas and Steele conducted an Aboriginal archaeological survey and assessment of a portion of Lot 6800 DP 1013970, Glenmore Park (Dallas and Steele 2001a). No Aboriginal stone artefacts or culturally modified trees were identified during the survey. The slopes adjacent to Surveyors Creek were considered to have been disturbed by landuse practices and were assessed as having low archaeological potential; however, one area of potential archaeological sensitivity was identified within the Surveyors Creek corridor.

A subsurface testing program of the area of potential archaeological sensitivity was undertaken by Dallas and Steele in 2001 (Dallas and Steele 2001b). The program comprised 18 test trenches (1 x 1 metre) that were excavated in successive 10 centimetre spits using a backhoe fitted with a flat (batter) bucket and five 1 x 1 metre test squares which were manually excavated in 5 centimetre spits using hand tools. Soil profiles were found to be relatively uniform across the area with a depth between 20 centimetres and 40 centimetres.

A total of 73 stone artefacts were recovered during the program. The artefacts were predominantly made from silcrete with smaller quantities of tuff and quartz also recovered. Artefacts recovered during the excavation were predominantly flakes and flake fragments whilst backed artefacts, cores, broken hatchet head fragments, retouched fragments and a scraper were also found. Artefacts were distributed in low densities across the tested area; however, one area contained a relatively higher artefact density and was interpreted as a knapping location.

The recovered stone material included a large volume of fragments which likely represented the remains of flaked material but could not be attributed to a formal artefact type. These fragments represented a stone type that did not naturally occur within the soil profile. The low density spatial distribution of artefacts and large quantities of stone fragments outside the knapping location were interpreted as reflecting the effect of natural process such as inundation from floodwaters and possible redeposition of material from upstream (Dallas and Steele 2001b: 47-48).

The Glenmore Park Southern Release Area, an area encompassing approximately 225 hectares west of the Northern Road, south of Ridgetop Drive and Mulgoa Nature Reserve, was assessed by Navin Officer in 2003. The assessment included a review of background information and a field survey. The survey identified eight archaeological sites and two areas of potential archaeological deposit. The sites were generally low density artefact scatters or isolated artefacts located on low hills or elevated positions adjacent to creeks. The artefacts were predominantly made from silcrete with minor quantities of chert, tuff and volcanic material also identified. Artefact types were primarily flakes and flaked pieces. A single backed artefact, scraper, core, grindstone and ground edge hatchet were also found.

Much of the original landscape of Glenmore Park was considered to have been drastically altered from past landuse. The central portion of Glenmore Park was disturbed through the quarrying operations and subsequent regeneration of the Mulgoa Quarry. Historical landuse for agricultural and pastoral purposes had resulted in widespread vegetation clearance of much of the land, with some remnant vegetation in the south and isolated possible old growth trees across the landscape.

Lot 1 DP109697, Luddenham

A number of archaeological sites were recorded on the AHIMS database within Lot 1 DP109697, Luddenham, during an archaeological field survey for an unknown project. The recorded sites comprise three artefact scatters and three isolated artefacts. The sites were predominantly situated on creek flats or low lying slopes in close proximity to two north east flowing creek systems, while one isolated artefact was located on the crest of a small knoll. The artefacts found at the sites were mainly flakes and flaked pieces with one blade core and one flake with retouch also noted. The artefacts were made from silcrete, chert and tuff.

The sites were considered to be in poor condition and in most cases it was considered that the areas around the identified sites displayed low likelihood of retaining archaeological deposit, due to factors including historical disturbance and the location of the sites along a watercourse that would have been regularly waterlogged and retained standing water for long periods of time. The sites located on the more elevated locations near the watercourse were considered to have better archaeological potential.

The Northern Road Upgrade - Old Northern Road Narellan to Mersey Road Bringelly

In 2012, Artefact Heritage conducted an Aboriginal archaeological survey and cultural heritage assessment of The Northern Road between Old Northern Road at Narellan and Mersey Road at Bringelly as part of the planning for the future road upgrade.

The survey identified 23 Aboriginal archaeological sites within the survey area that consisted of 10 artefact scatters, 11 isolated artefacts, one scarred tree and one possible scarred tree. The majority of artefact scatters and isolated artefacts were found on lower hillslopes; however, sites were also identified in smaller quantities on flat, hillslope, upper hillslope, lower ridgeline, terrace and creek flat landforms. The scarred tree and possible scarred tree were identified on flat landforms. Ground visibility was very low due to thick grass cover and sections of the survey area were disturbed by modern landuse practices such as road corridors, around structures and dams. Stone artefacts were primarily made

from silcrete, with small quantities of artefacts of silicified tuff, chert, mudstone, quartz and quartzite. The majority of stone artefacts were flakes, flake pieces and broken flakes; however, other stone artefact types were noted including cores, backed blades and a scraper.

5.1 The Northern Road Upgrade: Aboriginal archaeological survey report and CHAR

An Aboriginal archaeological survey assessment of the wider project area was undertaken as part of the Stage 2 PACHCI assessment for The Northern Road Upgrade between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (KNC 2016). A full coverage survey of the project area was carried out in 2015 and 2016 by a team comprising representatives from the Deerubbin Local Aboriginal Land Council, Gandangara Local Aboriginal Land Council and archaeologists from KNC.

Digital and printed maps of the project area were used for reference. Handheld GPS receivers were used to register archaeological sites. The team closely inspected exposed ground, such as unsealed tracks or eroded surfaces, for artefacts and any old growth trees for evidence of Aboriginal bark removal. The survey also focused on establishing a detailed appreciation of archaeologically sensitive landforms to assist in identifying the full spatial extent of identified archaeological sites.

As a result of the survey, 28 Aboriginal archaeological sites were identified within the wider project area. The sites comprised 23 artefact scatters and five isolated artefacts. The sites were predominantly found on the crests and upper slopes of a north-south ridgeline or on lower slopes and elevated locations adjacent to creeks. Artefacts were predominantly silcrete and silicified tuff with smaller quantities of quartz, medium grained siliceous material, chert and mudstone. The majority of recorded artefact types were flakes or flake fragments with small numbers of cores, utilised flakes and retouched flakes.

The spatial extent of Aboriginal archaeology of the project area was topographically well defined and within scientifically well understood soil matrices, which enabled a clear establishment of the presence and significance of archaeological sites within the project boundaries. Ground surface visibility was variable across the project area. The majority of the project area had moderate ground surface visibility with intermittent vegetation cover of the immediate ground surface. In areas where the ground cover had been disturbed by modern landuse practices such as excavated drainage channels, damming, vehicle and cattle tracks or natural process such as erosion and fluvial activity, ground surface visibility was generally high.

A CHAR was subsequently prepared for the project (KNC 2017) to inform the EIS. Impact assessment found that of the 28 Aboriginal archaeological sites affected, 12 sites would be totally impacted by the proposed works. Design refinement partially reduced the impact to the remaining 16 archaeological sites. All identified sites would be at least partially impacted by the project. Archaeological and cultural significance of the identified Aboriginal sites was defined by the information exhibited by each site. The range of sites identified an Aboriginal cultural highway where various activities took place in the past (similar to contemporary roadway and occupation). Aboriginal sites with greater levels of significance had the potential to offer further detailed information about the Aboriginal highway along the ridge and specific meeting spots (like the junction of Elizabeth Drive and The Northern Road).

Survey and consultation with Aboriginal stakeholders identified 20 Aboriginal archaeological sites of at least moderate significance. The remaining archaeological sites contained disturbed or low value deposits. Mitigative salvage excavation was recommended for the 20 archaeological sites exhibiting moderate significance, while the remaining eight archaeological sites, exhibiting low levels of significance, required no mitigative action. A salvage methodology was prepared as part of the CHAR. Within the current study area, from The Northern Road at Bringelly in the south to Eaton Road Badgerys Creek in the north, TNR4 incorporates ten Aboriginal archaeological sites, eight of which required archaeological salvage excavation for the impacted portions:

- TNR AFT 22 (AHIMS 45-5-4793) (archaeological salvage required)
- TNR AFT 23 (AHIMS 45-5-4794) (no archaeological salvage required)
- TNR AFT 24 (AHIMS 45-5-4795) (archaeological salvage required)
- TNR AFT 25 (AHIMS 45-5-4791) (no archaeological salvage required)
- TNR AFT 26 (AHIMS 45-5-4798) (archaeological salvage required)
- TNR AFT 27 (AHIMS 45-5-4799) (archaeological salvage required)
- TNR AFT 29 (AHIMS 45-5-4801) (archaeological salvage required)
- TNR AFT 30 (AHIMS 45-5-4797 (archaeological salvage required)
- TNR AFT 31 (AHIMS 45-5-4802) (archaeological salvage required)
- B6 (AHIMS 45-5-2636) (archaeological salvage required).

Project Approval (SSI-7127) was granted by the Minister in May 2018, and the project was split into three stages. The following chapters present the methodology, results and findings of the salvage work conducted for TNR 4 in accordance with the Project Approval.

6 Salvage Methodology

The archaeological salvage methodology prepared for the wider project as part of the CHAR assessment process is reproduced below (KNC 2017). Salvage excavation for TNR 4 was conducted in accordance with this methodology.

6.1 Research Aims

The main aims of the proposed salvage excavation program are:

- To salvage a representative sample of the identified archaeological sites prior to construction impact.
- To analyse the salvaged archaeological material to gain and conserve knowledge and understanding of the scientific and cultural information exhibited by the activities associated with landforms within the project area.
- Analysis of the geomorphological history of the project area, specifically examining the impacts of fluvial and erosional forces on the archaeological record.
- Retrieve a suitable quantity of artefacts for a regional analysis.

The further scientific aim of the salvage excavation program would be to determine the subsurface integrity, extent, spatial distribution and nature of the cultural deposit and the specific types of associated archaeological/cultural activities.

- Determining the integrity of the deposit involves assessing the degree of disturbance which is present.
- Determining the statistical extent of the sites and/or activity areas involves identifying the boundaries associated with the identified archaeological deposit.
- Assessing the spatial distribution involves identifying the presence/absence of archaeological material across the identified archaeological sites.
- The nature of the sites refers to the type of activities indicated by the artefactual material (e.g. primary production, domestic knapping, hunting camps). The goal would be to retrieve entire assemblages from specific activities if such activities were present.
- Retrieved assemblages would be compared with the results from other relevant archaeological projects in order to assess significance.

6.2 Research Questions

The results of the proposed salvage excavation would increase our understanding of subsurface archaeology of the project area, specifically related to the large scale connectivity between sites along and near the ridge associated with The Northern Road. Research will focus on identifying a range of activity areas, which characterised the larger landscape of the ridge. In particular, research would be conducted at archaeological sites across the range of landforms present within the project area addressing questions about past activity events and survivability of the deposit. In addition, assessment techniques will address how natural processes and modern landuse practices impact on archaeological sites within the local area. This information is of critical importance for determining empirical scientific value.

> **Question 1**: What cultural activities are archaeologically identifiable across the project area and what is the effect of natural and human disturbance on the preservation of these Aboriginal archaeological sites?

What can we expect?

It is anticipated that differences in stone tool assemblages may be related to different cultural activities (e.g. primary reduction vs maintenance flaking). The science of archaeology is paramount to any research question and it is important to stress that the goal for the salvage program for all excavated sites is straight forward: to retrieve a viable sample for comparative analysis using established techniques (see Field Methods below). In this regard interpretation would not precede data collection. The proposed archaeological program would systematically sample the relevant areas using standard techniques with the outcome being a viable, robust and comparable sample. Analysis of the sample would follow and interpretations would be made distinctly separate from the results.

> **Question 2**: Based on a statistical suitable sample - do variations in the lithic assemblage represent cultural activities, raw material sourcing or combinations of cultural and environmental factors?

6.3 Geoarchaeology

The archaeological program proposed in this research design will salvage the significant archaeology, but equally important is the aim to assess the geoarchaeological context. Archaeological investigations in the Cumberland Plain have often encountered quantities of archaeological objects but generally not placed these objects into a geomorphic context. Specifically the geomorphic integrity of archaeological deposit needs to be further investigated in such potentially fluctuating environments especially where artefacts are retrieved using bulk excavation techniques. A research study by Dr. Anthony Barham and Dr. Matthew Kelleher suggests that the archaeological significance is degraded in these fluctuating environments because poor depositional integrity undermines the potential cultural information (Kelleher and Barham 2006).

Area of undeveloped land on the Cumberland Plain continues to decline, and archaeological survey and salvage continue to rapidly acquire more data, a methodological "tipping point" has been reached in archaeological resource management. Acquiring more data by long-established methods will not represent best practice. Available information shows that the data already gathered through archaeological mitigation (survey, subsurface sampling and salvage excavations) need to be better contextualized. New 'best practice' protocols for acquiring archaeological information need to be developed. A key of the proposed excavation program therefore is to work towards the "nesting" of archaeological and geomorphic information into enhanced and better integrated research and conservation frameworks.

Likewise new methods of calibrating soil loss rates, soil mixing, and cosmogenic and radiometric dating of soils and rock surfaces (Nishiizumi et al. 1986, 1993) have yet to be applied systematically to archaeological contexts despite the very real potential for now solving long standing issues over the age of lithic assemblages. These methods cannot be easily applied after salvage has been completed. Use of such techniques has to be planned into research designs. It is possible that we can begin to address some resource and knowledge gaps by implementing more advanced excavation protocols.

The Cumberland Plain, like much of south east Australia, has been subject to dramatic fluctuations in aridity and rainfall, river discharge (including a long-term trend of declining river flows) and associated episodes of vegetation and soil regolith instability over the last 120,000 years (ka). These oscillations would have caused substantial changes in sediment storage both on hillslopes and in floodplains. Cycles of soil stripping on hillslopes, alternating with episodes of stability and soil development, were first identified in Eastern Australia over 50 years ago at sites on the Cumberland Plain. In floodplains, periods of sediment storage and alluvial sediment accumulation have probably alternated with incision and evacuation of previous floodplain sediments. These cycles, and their frequency, may have had profound effects on the present spatial distribution, visibility and nature of open landscape archaeological sites. When interpreting the depositional record archaeologists need to take on board these important controlling factors on site age, site preservation and site patterning across the landscape. The substantial transect that is the project area represents an opportunity to begin addressing these questions within a single assessment. The single assessment represents value over multiple small scale approaches, because it offers an eminently comparable sample.

At present the archaeological methods being used for mitigation have become preoccupied with recovering lithic artefact assemblages and analysing these important sources of evidence independent of the environmental and stratigraphic contexts from which the lithic artefacts derive. Many research questions asked of lithic assemblages cannot be answered without ancillary data and evidence e.g. the effects of past geomorphic and soil process on the taphonomy of artefact scatters, and the age of the deposits from which they derive. In this light, field methods used for salvage excavation will aim to establish the relationship between object and deposit, a crucial and basic part of any excavation.

6.4 Archaeological Salvage Areas

Salvage excavation would be undertaken at impacted archaeological sites with at least moderate archaeological significance. Salvage excavation of these sites would focus on the extraction of collections of artefacts related to activity areas and geomorphic information.

The current document includes the salvage reporting for eight archaeological sites contained within the TNR 4 section of the overall The Northern Road Upgrade project, where the CHAR recommended salvage mitigation. The archaeological salvage areas comprise the locations of these eight sites within the approved EIS assessment boundary and approval corridor.

It was also identified that works associated with the project would have a partial impact on site B54 within the WSA lands. This was included in the TNR 4 salvage program and was salvaged in accordance with the approved methodology prepared by Navin Officer (2017) in the WSA ACH CEMP (WSA Co 2018: Appendix D).

6.5 Field Methods and Excavation Techniques

The goal of the field excavation program was to recover significant assemblages of artefacts and investigate the geomorphic processes that contribute to site taphonomy.

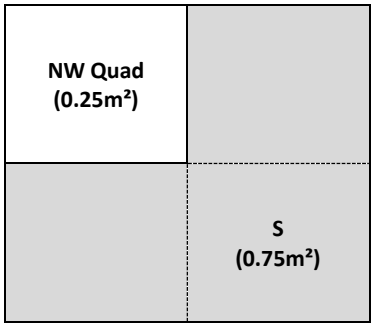
Salvage Program
In order to achieve the most robust and comparable result, KNC advocates open area salvage excavation. The first phase in open area salvage is to establish the statistical boundaries of the previously identified archaeological deposit. This approach is designed to salvage the spatial properties of the site as shown in the lithic continuum. In other words, recording the spread of activities across the site/landscape.

6.5.1 Phase 1

A series of 1 x 1 metre squares are excavated on a transect grid overlain on each site to mark the spread of lithics and related geomorphic activity. Geocentric Datum of Australia 1994 (GDA94) coordinates would be recorded for each square to enable three dimensional modelling. Statistical salvage following this method is highly beneficial because it creates a robust inter-site sample, sufficiently random, critical for regional comparative analysis. No other method is as efficient or effective.

Each Phase 1 square location was given a unique numeric identifier (S1, S2, S3 etc).

First Quadrant
The initial excavation unit at each 1 m^2 Phase 1 square location will involve the excavation of a 50 cm x 50 cm test unit in the northwest quadrant of the 1 m^2. The remaining three quadrants will be excavated in accordance with general salvage excavation methodology (below). The results of the first quadrant will be used to investigate the effectiveness of a 50cm x 50cm 0.25m^2 sample size vs. a standard 1m x 1m square.



Together, the quad unit and extension S-square make up a 1 m^2 Phase 1 square. Unless specifically referring to the NW Quad Unit, completed squares are generally referred to as Phase 1 within the analysis.

Phase 1 squares would be hand excavated in stratigraphic units (Unit A, Unit B, etc.). Squares would be excavated until the basal layer or culturally sterile deposit is reached (usually 25-35 centimetres). All excavated deposit would be wet sieved using nested 5.0 millimetre sieves and 2.5 millimetre meshes.

The location of each excavated square would be identified on a surveyed plan of the site. Stratigraphic sections detailing the stratigraphy and features within the excavated deposit would be drawn and all squares would be photographed. The stratigraphy of all excavated areas would be fully documented and appropriate records archived.

6.5.2 Phase 2/3 open areas

Phase 2 expansion
Where information bearing deposits are identified at Phase 1, a series of 9 x 1 m^2 expansion squares (3 x 3 metre area, including original Phase 1 square) would be excavated around those deposits. Information bearing deposits are identified by triggers such as:

- significant quantities of artefacts
- objects exhibiting a range of diagnostic characteristics
- variations in raw material
- unusual artefacts
- soils horizons with good condition and integrity
- chronological material and/or taphonomic indicators.

In this context chronologic material is anything that can be used to date artefacts or deposit: charcoal or charcoal bearing deposit (e.g. hearth ash), sandy deposit, gravels (e.g. aluminium feldspar). It is anticipated that approximately two 9 m^2 excavation areas would be undertaken at each of the salvaged sites. 9 m^2 excavations would only be undertaken where Phase 2 excavations are required (based on triggers above). A full 9 m^2 area would be excavated in all instances where Phase 2 investigations are undertaken.

Phase 3 expansion
Open area salvage of significant deposit follows the Phase 2 expansion squares and would expand to encompass entire activity areas. Phase 3 excavations are required where the Phase 2 triggers are found to extend beyond the 3 x 3 metre Phase 2 excavation area. The location of Phase 3 open area investigations would be based on Phase 1 and 2 results. An additional 25-50 m^2 (combination of Phase 2 and Phase 3) would be excavated for each salvage location, where required.

Phase 2/3 open area expansions are considered together in the analysis of the salvage results.

6.6 Analysis

The location of each excavated square was identified on a surveyed plan of the site. Drawings detailing the stratigraphy and features within the excavated deposit were created and sample squares were photographed. The stratigraphy of all excavated areas was fully documented.

The subsequent analysis aimed to compare the assemblages from each salvage area. The identification of artefact types and raw material, their distributions and associations, were used to inform the interpretation of site use, antiquity and significance. The current excavation program yielded a large artefact collection (known as an 'assemblage') and provides a powerful and definitive sample of the Aboriginal archaeology of the region. However, the real value lies in the information that these artefacts contain and the story they can tell.

There are several different ways to 'count' an assemblage, depending on what sort of questions trends observed in the data. For example, counting the number of artefacts of each raw material might suggest differences in how these materials were used, both within an individual site and when sites across the landscape are compared. Similarly, by looking at how many tools were recovered versus the quantity of waste material (i.e. 'debitage') we may gain insights into the sort of activities taking place across a landscape. Looking at where artefacts occur can also take place on several levels and this information is important when interpreting what a site was used for and why.

Detailed (laboratory) analysis entailed recording several characteristics for each individual artefact. Stone artefact raw materials were examined through a hand lens (x 10 magnification). Artefact attributes were chosen in accordance with the research aims and were derived from Andrevsky (1998), Hiscock (1993), and Holdaway and Stern (2004. Each artefact was recorded in database form, suitable for comparative analysis on a local and regional basis.

The salvage involved excavation of large open areas of connecting squares. Within these open areas, we could identify specific artefact concentrations known as knapping floors. Several clear knapping floors were recorded during the current program. Artefact distribution plots have been used to illustrate the distribution of artefacts on a knapping floor within an excavation area. By examining how these relate to each other we can shed light on how Aboriginal people organised their activities at a camp site or work area. Consequently, we can look at differences in assemblage size between different sites to examine how Aboriginal people used their landscape.

6.6.1 Lithics

Artefacts would be analysed on a comparable level with previous analyses of excavated assemblages. Information derived from this analysis; in particular the identification of specific artefact types and their distributions and associations; would be used to put together interpretations about how sites were used, where sites were located across the landscape, the age of sites and to assess cultural heritage values. By comparing different areas it would be possible to determine whether there were differences in the kinds of activities carried out and if different activities were related to different landforms.

A range of stone artefacts may be present across the salvage areas and the analysis would expand accordingly to account for artefact variability. All information would be recorded in database form (MS Excel). Various types of evidence would be used to determine the kinds of activities that were carried out. A short description of the proposed analysis is outlined below.

- Field analysis would record basic data, such as material type, number and any significant technological characteristics, such as backing or bipolar techniques; added to this would be any provenance data such as pit ID and spit number.

- The purpose of the field recording is twofold: 1) establish a basic recording of artefacts retrieved and 2) to allow on-going assessment of the excavation regime (e.g. whether higher stratigraphic resolution is required while digging).
- Detailed (laboratory) analysis would entail recording a larger number of characteristics for each individual artefact. These details would be recorded in matrices suitable for comparative analysis (e.g. multivariate and univariate) of the excavated assemblage on a local and regional basis.
- Lithic characteristics to be recorded cover a range of basic information but are not limited to these categories (see example below). For transparency, terms and category types would in large part be derived from Holdaway and Stern (2004).

Table 2. Artefact characteristics recorded

Attributes recorded	Whole flakes	Broken flakes	Angular fragments	Backed artefacts	Retouched artefacts	Ground artefacts	Cores
Record number	✓	✓	✓	✓	✓	✓	✓
Site code & square	✓	✓	✓	✓	✓	✓	✓
Spit number	✓	✓	✓	✓	✓	✓	✓
Raw material	✓	✓	✓	✓	✓	✓	✓
Cortex	✓	✓	✓	✓	✓	✓	✓
Size range & weight	✓	✓	✓	✓	✓	✓	✓
Length, width, thickness	✓			✓	✓	✓	✓
Flake shape, platform & termination	✓	✓			✓		
Retouch or use-wear	✓	✓	✓	✓	✓	✓	✓

The analysis of artefacts recovered during the excavation program would be undertaken in a transparent and replicable fashion so as to permit the comparison of the entire excavated assemblage with data from other areas. This would also allow for an interpretation of the project area's archaeological significance.

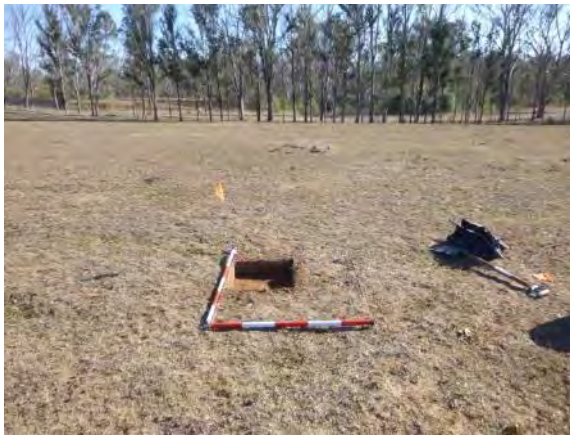


Plate 1. TNR AFT 29, completed quad (0.25m^2) and surrounding S-extension ready for excavation

Plate 2. TNR AFT 24, view along Phase 1 transect with sieve station at left

Plate 3. TNR AFT 27, open area Phase 2/3 excavation in progress

Plate 4. Site B6, open area Phase 2/3 excavation in progress

7 Salvage Excavation Results

TNR 4 Quick Reference	
Creek system	**Landforms**
Badgerys Creek Duncans Creek	Ridgecrest to alluvial terrace
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
218 squares Total 218 m²	16 open areas Total 308 m²
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
483 total artefacts Mean density 2.2/m²	3,636 total artefacts Mean density 11.8/m²
Phase 1 & 2 combined	
Total sample: 526 m², 4,119 artefacts Mean density 7.8/m²	

The TNR 4 series of excavations were located in the southern section of the greater The Northern Road project extending from The Northern Road in Bringelly in the south to Eaton Road, Badgerys Creek in the north. Eight sites were excavated in this section ranging primarily along ridge crests and their lower slopes adjacent to both permanent and ephemeral water sources. One further site (B54) within the WSA lands is also reported in the results chapter although is not included in the following summary due to the different methodology used during excavation.

Site disturbances varied but were primarily due to removal of native bush and grasslands for historic pastoral uses, which have subsequently exposed soils to erosion and deflation. These disturbances directly influenced the in situ archaeological landscape, with artefact bearing deposits found to commonly be either removed or redeposited, particularly along the higher elevation ridge crests. More intact deposits were found along the lower slopes and in areas adjacent to water courses, although in these cases flooding events may have also had an impact on the cultural deposits within the soil profiles. Other disturbances included construction of buildings, transport routes (roads) and underground utilities.

A total of 218m² was excavated during the Phase 1 excavations with a total of 483 artefacts recovered. The subsequent Phase 2/3 open area excavations covered a total area of 308m² with 3,636 artefacts retrieved. In total, 4,119 artefacts were recovered from 526m² of excavation, yielding a mean artefact density across the TNR 4 salvage program of 7.8/m². The number of artefacts recovered per site differed significantly, with most sites yielding very low numbers of artefacts with subsequently low artefact densities, often below 1/m² (Table 4). Raw materials recovered during the excavation were consistent with lithic assemblages found at Aboriginal sites across the Cumberland Plain in western Sydney (Table 5). The most common raw material recovered was silcrete, followed by quartz and silicified tuff (Tuff). Chert was reasonably well represented within the assemblage (5.1%), with small numbers of petrified wood (P. wood), quartzite, mudstone, fine-grained siliceous (FGS) , medium-grained siliceous (MGS) and igneous material.

Table 3. TNR 4 salvage artefact count summary

n artefacts (%)	Phase 1	Phase 2/3	No. Open Areas	Total Artefacts	% of TNR4 total
B6	316 (10.3%)	2,754 (89.7%)	5 (3 & 13-16)	3,070	74.5%
TNR AFT 22	6	-	-	6	0.1%
TNR AFT 24	18 (56%)	14 (44%)	3 (4, 5 & 9)	32	0.8%
TNR AFT 26	40 (22%)	139 (78%)	2 (1 & 2)	179	4.3%
TNR AFT 27	66 (9.5%)	630 (90.5%)	3 (6, 7 & 8)	696	16.9%
TNR AFT 29	10	-	-	10	0.2%
TNR AFT 30	7 (37%)	12 (63%)	2 (11 & 12)	19	0.5%
TNR AFT 31	20 (18.5%)	87 (81.5%)	1 (10)	107	2.6%
Totals	483 (11.7%)	3,636 (88.3%)	16 open areas	4,119	

Table 4. TNR 4 Phase 1 and Phase 2/3 results

	Phase 1			Phase 2/3			Site total		
Site	**m²**	**n**	**Density**	**m²**	**n**	**Density**	**m²**	**n**	**Density**
B6	42	316	7.5/m²	117	2,754	23.5/m²	159	3,070	19.3/m²
TNR AFT 22	31	6	0.2/m²	-	-	-	31	6	0.2/m²
TNR AFT 24	35	18	0.5/m²	24	14	0.6/m²	59	32	0.5/m²
TNR AFT 26	25	40	1.6/m²	50	139	2.8/m²	75	179	2.4/m²
TNR AFT 27	25	66	2.6/m²	51	630	12.3/m²	76	696	9.1/m²
TNR AFT 29	15	10	0.7/m²	-	-	-	15	10	0.7/m²
TNR AFT 30	20	7	0.3/m²	16	12	0.7/m²	36	19	0.5/m²
TNR AFT 31	25	20	0.8/m²	50	87	1.7/m²	75	107	1.4/m²
Totals	**218**	**483**	**2.2/m²**	**308**	**3,636**	**11.8/m²**	**526**	**4,119**	**7.8/m²**

Table 5. TNR 4 salvage Raw material summary

Raw Material	Silcrete	Tuff	Quartz	Chert	P. Wood	Quartzite	Mudstone	FGS	MGS	Igneous
B6	1964	332	587	154	13	10	3	4	1	2
TNR AFT 22	3	2	1							
TNR AFT 24	12	14	3	1	1					1
TNR AFT 26	136	13	24	4	1					1
TNR AFT 27	433	179	30	49	3	1		1		
TNR AFT 29	7	1	1	1						
TNR AFT 30	17	1	1							
TNR AFT 31	79	7	21							
Totals	**2651 (64.4%)**	**549 (13.3%)**	**668 (16.2%)**	**209 (5.1%)**	**18 (0.4%)**	**11 (0.3%)**	**3 (0.07%)**	**5 (0.1%)**	**1 (0.02%)**	**4 (0.1%)**

Plate 5. Excavating S32 on crest at TNR AFT 30

Plate 6. Completed Open Area 2 at TNR AFT 26, view to west

7.1 TNR AFT 22 (AHIMS 45-5-4793)

Site TNR AFT 22 was located on the crest and upper slopes of a northern spur adjacent to two north flowing tributaries of Cosgrove Creek (Figure 6). The site was situated on the northern side of Eaton Road within Lot 1 DP250030, Lot 1 DP90157, Lot 1 DP215715 and Lot 2 DP250030.

The area had been cleared of most native vegetation and consisted primarily of grass cover and had been used historically for grazing. Previous assessment indicated the hill-top soil structure was a closed system of erosion where soils deflate and erode *in situ,* making the hill archaeologically valuable. A moderate depth of soil was recorded during the initial survey with the site assessed as having at least moderate archaeological value.

Four silcrete artefacts were located during the survey, visible in the cutting along Eaton Road. The artefacts included two complete flakes and two flake fragments.

TNR AFT 22 Quick Reference	
Creek system	**Landforms**
Cosgroves Creek	Crest and upper slopes
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
31 squares Total 201 m^2	N/A
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
6 total artefacts Mean density 0.2/m^2	N/A
Phase 1 & 2/3 combined	
Total sample: 31 m^2, 6 artefacts Mean density 0.2/m^2	

Plate 7. (Main picture) Facing north, view across site area (Top right) Expansion of NW quad unit to a 1x1m Phase 1 square. (Lower right). S79 completed, facing south east.

7.1.1 Soils, landform and disturbance

Soils across the crest proper were shallow (averaging 9-12cm depth) and comprised a mixed, homogenous A unit of greyish to yellowish brown sandy clay loam. The B unit comprised compact yellow clay. Soils contained small ironstone gravels <5mm 2% and contemporary inclusions including small glass and brick fragments down to the basal clay. The uniform, mixed nature of the deposit and presence of modern contaminants throughout suggests previous ploughing across this part of the landform.

Squares located across the edge of the crest and upper slope displayed deeper profiles (averaging 15-20cm depth) and a redder basal sandy clay. The A unit comprised the same mixed deposit as squares on the crest, with a slightly higher sand content, and with greater bioturbation evident due to ant and earthworm activity. Some mixing of basal clay into the lower level of the A unit was also apparent at several locations, again likely due to previous ploughing.

Squares lower down the slope varied more in excavated depth likely due to microtopographic factors affecting the accumulation of sediment from higher up the slope, ranging up to a maximum of 31cm and averaging around 20cm depth. Ironstone content was slightly higher, approaching 5% and scattered charcoal flecking was also observed. Mixing between the base of the A unit and the underlying clay was also evident, likely due to both previous ploughing and bioturbation. Plate 7 shows representative soil section profiles from the site.

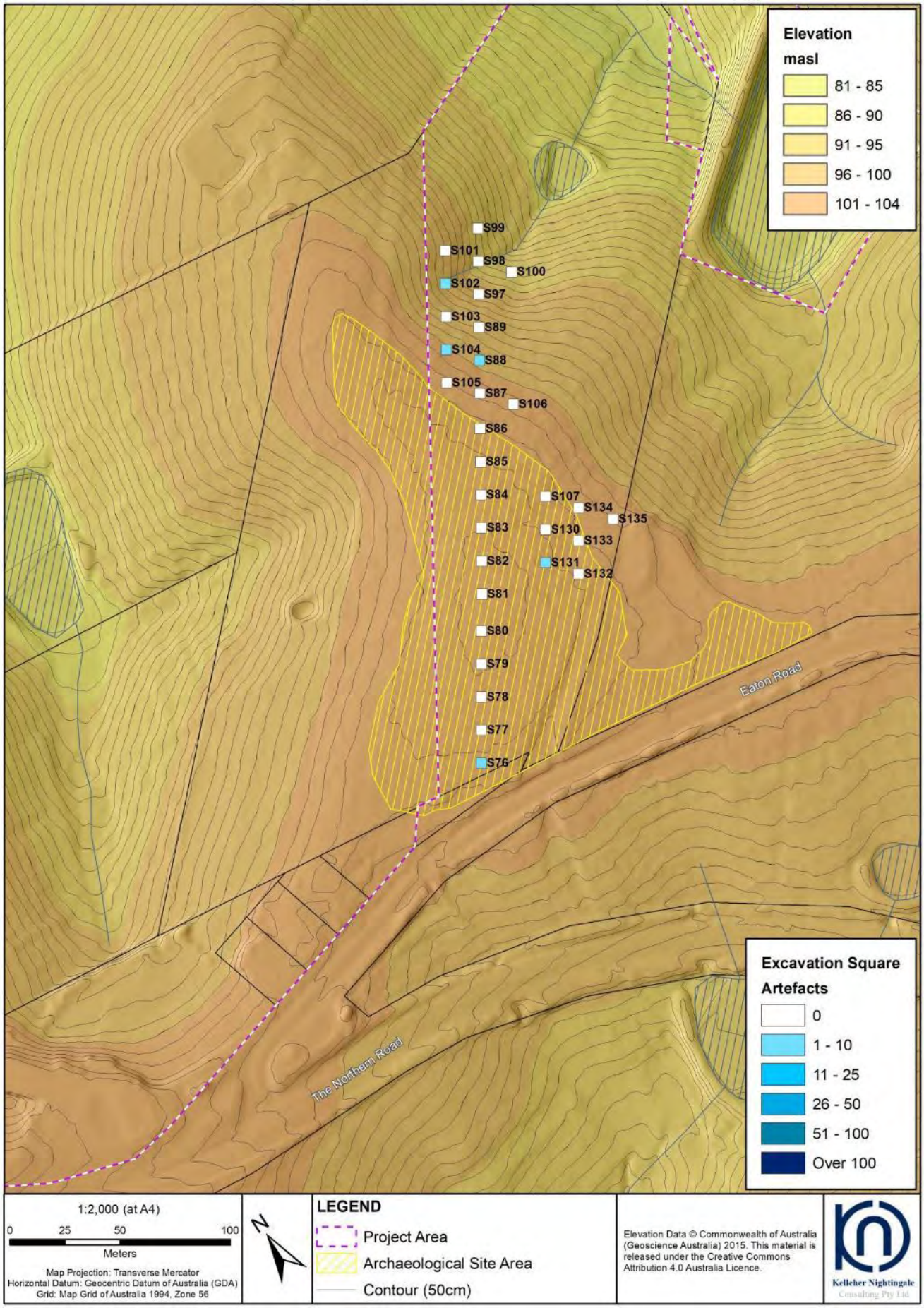


Figure 6. TNR AFT 22 excavation results

S77 east section

S82 east section

S102 east section

S136 south section

Plate 8. Representative section profiles, TNR AFT 22

7.1.2 Phase 1 Results

A total of 31 1x1m Phase 1 squares were excavated during the initial stage of salvage. These were made up of 31 quad units (each 0.25m^2) and their 31 accompanying 0.75m^2 S square extensions. Phase 1 squares were aligned along one central transect running north-east to south west across the site area and adjoining slope, with shorter satellite transects either side and a second cluster of short transects to the south east.

A total of 6 artefacts were recovered, giving an average (mean) artefact density across the site of just 0.2/m^2. Artefacts were identified in five squares (16% of squares) dispersed across the salvage area, with no evident patterning in artefact distribution. The highest density was present at S76 which contained two artefacts which were conjoinable fragments of a single flake. S76 was also the only Phase 1 square which contained artefacts in both the quad unit and the S extension sections of the square. In total, 27 of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive).

Table 6. TNR AFT 22 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S76	1	1	**2**	S99	0	0	0
S77	0	0	0	S100	0	0	0
S78	0	0	0	S101	0	0	0
S79	0	0	0	S102	0	1	**1**
S80	0	0	0	S103	0	0	0
S81	0	0	0	S104	0	1	**1**
S82	0	0	0	S105	0	0	0
S83	0	0	0	S106	0	0	0
S84	0	0	0	S107	0	0	0
S85	0	0	0	S130	0	0	0

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S86	0	0	0	S131	0	1	**1**
S87	0	0	0	S132	0	0	0
S88	1	0	**1**	S133	0	0	0
S89	0	0	0	S134	0	0	0
S97	0	0	0	S135	0	0	0
S98	0	0	0	**Site Total**	**2**	**4**	**6**

Table 7. TNR AFT 22 Raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Total
Phase 1	3 (50%)	2 (33.3%)	1 (16.7%)	6
Cortical Artefacts	1 (33.3%)	0	0	1 (16.7%)

The artefacts recovered consisted of three silcrete flake fragments, two tuff flake fragments, and one quartz flake fragment. One of the silcrete distal fragments (Artefact #24) had steep retouch on the distal margin and an elongate shape, and was identified as an end-scraper.

No triggers for Phase 2/3 salvage were identified at the site and due to the very low artefact density, open area excavations were not undertaken.

Table 8. TNR AFT 22 Artefact characteristics

Artefact ID	TU/TS No.	Material	Reduction Type	Size Range mm	Weight (g)	Cortex	Comments
#19	S 76	Tuff	Distal	16-20mm	0.82g	0%	Conjoined #20 old break
#20	Q 76	Tuff	Medial	21-25mm	2.97g	0%	Conjoined #19 old break
#21	Q 88	Silcrete	Distal	11-15mm	0.32g	0%	
#22	S 102	Silcrete	Medial	11-15mm	0.44g	0%	
#23	S 104	Quartz	Distal	11-15mm	0.3g	0%	
#24	S 131	Silcrete	Distal	26-30mm	2.81g	31-69%	Retouched – End Scraper

7.2 TNR AFT 24 (AHIMS 45-5-4795)

Site TNR AFT 24 was located on the crest and slope of a western spur overlooking the junction of two west flowing creeks (Figure 7). The site was situated approximately 360 metres south-west of the southern junction of The Northern Road and Eaton Road within Lot 2 DP854626 and Lot 1 DP851626.

The site extends over a hill slope with high gradients to the north and south with a more gradual descent west to the east bank of the Duncans Creek system. The site was in close proximity to several other sites (TNR AFT 25, TNR AFT 26 and TNR AFT 27), identified on crests and slopes adjacent to the north-west flowing creek system.

The area had been cleared of native vegetation due to historic pastoralist practises, although overall the area was assessed as displaying low levels of disturbance with the soils appearing moderately intact. The site was assessed as having moderate archaeological value due to its proximity to resources and the generally low levels of disturbance.

TNR AFT 24 Quick Reference	
Creek system	**Landforms**
Duncans Creek	Crest
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
35 squares Total 35 m^2	3 open areas Total 24m^2
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
18 total artefacts Mean density 0.5/m^2	14 total artefacts Mean density 0.6/m^2
Phase 1 & 2/3 combined	
Total sample: 59 m^2, 32 artefacts Mean density 0.5/m^2	

The survey identified three silcrete artefacts on exposed surfaces such as walking/animal tracks and patches of sheet erosion near the creek tributary. The artefacts consisted of one small unifacial core with two negative scars and two flake fragments.

Plate 9. (Main picture) Facing south, view across site area (Top right) View south west towards lower slope and drainage line, S19 in foreground. (Lower right). S15 completed, view north to crest.

7.2.1 Soils, landform and disturbance

The majority of the soil profiles across the crest and adjoining slope were found to be relatively shallow and eroded. Squares excavated on the more elevated crest landform averaged 15cm in depth and comprised reddish brown to grey brown sandy clay loam with little to no topsoil above an undulating red blocky clay B horizon with visible sand grains. Some glass and plastic fragments within the A horizon indicated contemporary disturbance. Squares excavated across the upper slope were shallower, averaging 10cm depth but as shallow as 2cm and displayed a homogenous, dry reddish-brown sandy clay loam above sandy clay. Undulations across the landform surface suggest previous ploughing.

Squares on the midslopes also tended to be shallow (around 10cm depth) but had a reduced sand content, comprising light brown clay loam to silty clay loam above brown to orange basal clay. The A unit had some scattered Fe/Mn flecking and occasional mixed basal clay lumps within the deposit. Squares positioned along the margins of the drainage gully running south west down the slope were also disturbed due to cattle trampling. Squares excavated across the lower slope and on the treed bench above the creek were deeper, ranging from 25-45cm, with a greater depth of humic topsoil. These squares also displayed greater bioturbation due to tree root and insect activity.

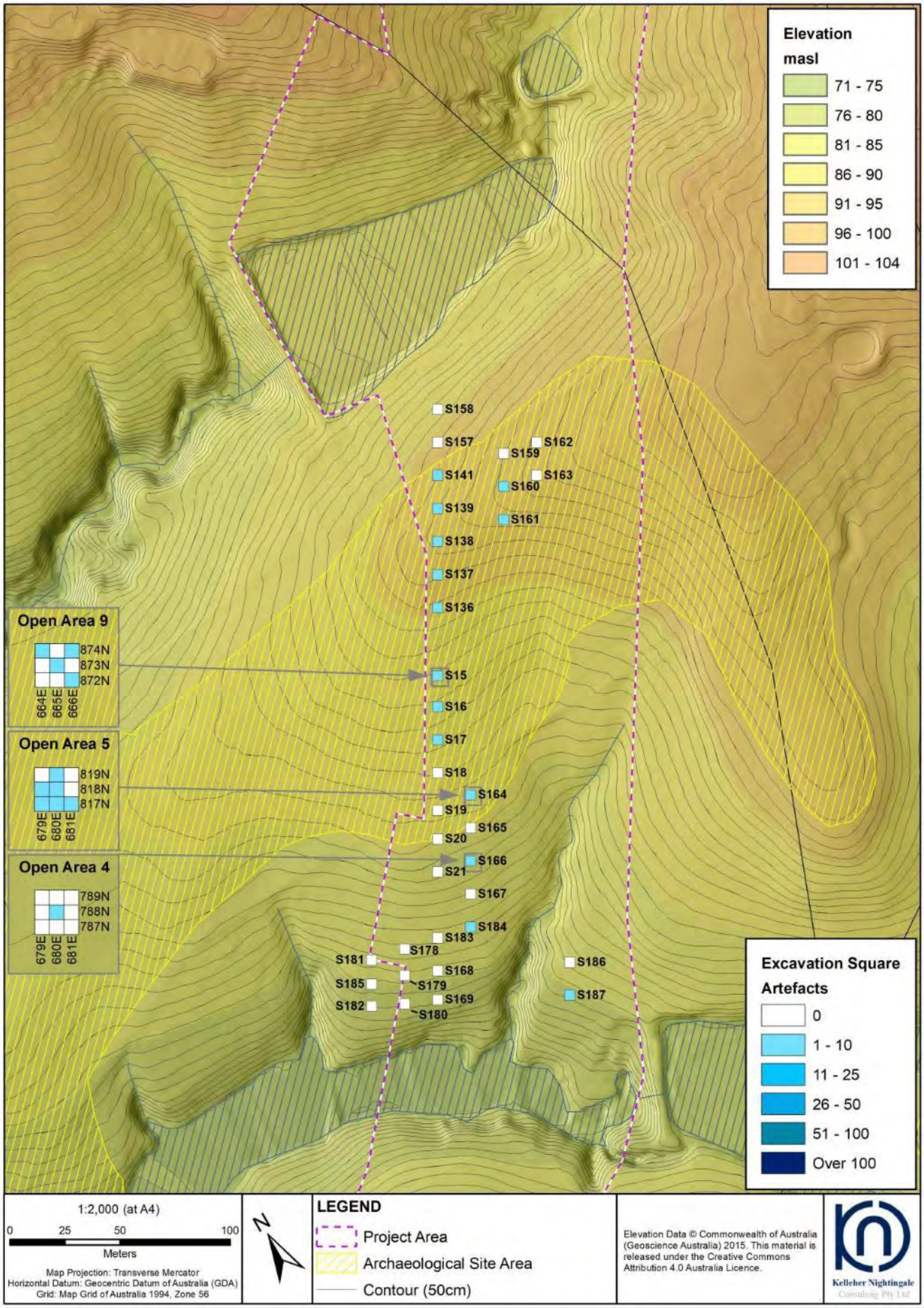
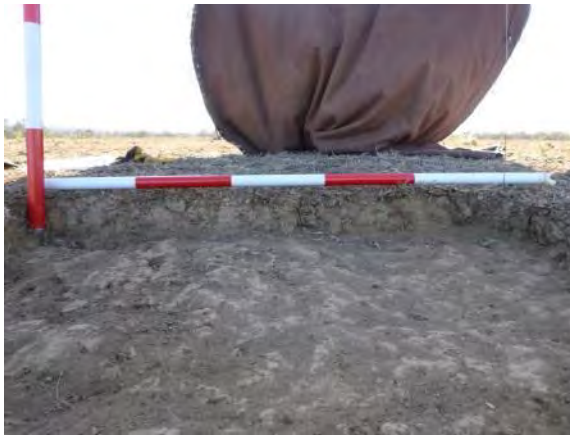


Figure 7. TNR AFT 24 excavation results

The A unit was silty clay loam with a higher proportion of Fe/Mn than squares at a higher elevation and frequent charcoal. The B unit comprised a mixed orange-brown clay with occasional mottles. The higher proportion of silt in the deposit bordering the creek is likely a function of fluvial activity.

The general trend for decreased depth of A horizon up the slope towards the crest was evident at the Phase 2/3 open areas, where deposit was generally shallow, averaging 15-18cm at OA4, 12-14cm at OA5 and 8-10cm at OA9. Soils were weakly structured yellow clay loams and some mixing of clay into the deposit was evident, likely due to former ploughing. Basal clays comprised compact reddish brown to brown undulating clay. The B horizon was very dry, blocky and bioturbated by thick pasture grass roots.

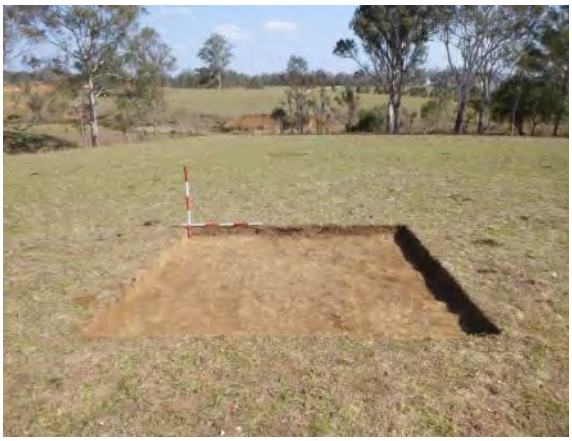
Overall, soils across the crest and adjoining slope were found to comprise a moderately shallow deposit of poorly structured clay loam to sandy clay loam. Sand content was higher towards the crest, while the silty alluvial influence was evident in the deeper squares closer to the creek. Mixing of the A horizon was evident due to previous ploughing and bioturbation.



S16 west section

S180 north section

S187 north section



OA4 view to south

OA5 view to north

OA9 view to west

Plate 10. Representative section profiles and open areas, TNR AFT 24

7.2.2 Phase 1 results

A total of 35 1x1m Phase 1 squares were excavated during the initial stage of salvage. These were made up of 35 quad units (each 0.25m^2) and their 35 accompanying 0.75m^2 S square extensions. Phase 1 squares were aligned along several transects spaced 15 metres apart across the project corridor from the crest down to the lower slope adjoining the creek line to the south. A short transect containing two squares was also placed on the opposite side of the erosion gully running to the creek which cut across the slope.

Squares were placed at 15 metre intervals and staggered by 5 metres between transects. Several squares were offset to avoid areas of high disturbance such as the farm track, or to better target microtopographic variation in the landform (particularly on the bench in the slope overlooking the creek at S169, 179, 180 and 182).

A total of 18 artefacts were recovered during the Phase 1 program, giving a mean artefact density across the Phase 1 sample of 0.5/m^2. Artefacts were present in 14 of the 35 excavated squares (40% of squares), mostly concentrated around the upper to mid slope. Squares on the lower slope and bench adjoining the creek were negative, as were those on the highest part of the spur crest. The majority of positive squares contained a single artefact, with S15, 16, 141 and 164 each containing two.

Table 9. TNR AFT 24 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S15	0	2	**2**	S163	0	0	**0**
S16	0	2	**2**	S164	0	2	**2**
S17	0	1	**1**	S165	0	0	**0**
S18	0	0	**0**	S166	0	1	**1**
S19	0	0	**0**	S167	0	0	**0**
S20	0	0	**0**	S168	0	0	**0**
S21	0	0	**0**	S169	0	0	**0**
S136	0	1	**1**	S178	0	0	**0**
S137	0	1	**1**	S179	0	0	**0**
S138	0	1	**1**	S180	0	0	**0**
S139	0	1	**1**	S181	0	0	**0**
S141	1	1	**2**	S182	0	0	**0**
S157	0	0	**0**	S183	0	0	**0**
S158	0	0	**0**	S184	1	0	**1**
S159	0	0	**0**	S185	0	0	**0**
S160	0	1	**1**	S186	0	0	**0**
S161	0	1	**1**	S187	1	0	**1**
S162	0	0	**0**	**Site Total**	**3**	**15**	**18**

From the 14 positive test squares, only three contained (single) artefacts in the initial 0.25m^2 quad unit, and only one of these went on to also contain an artefact in the expansion S unit (S141). In the other 11 squares, the initial quad unit was empty and artefacts were only identified when this was expanded to a full 1m x 1m squares. The remaining 21 squares contained no artefacts in either the quad unit or S square extension. In total, 21 of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive).

Despite the low artefact numbers, Phase 1 excavations recovered a broad range of raw materials, with silcrete (n=7) and Tuff (n=6) dominating the assemblage. Small numbers of quartz, chert, petrified wood and igneous materials were also recovered (Table 10). The most common artefact type was flake fragments (medial and distal) comprising 66.7% of the assemblage (n=12). Only two complete flakes were recovered (11.1% of the Phase 1 assemblage), both of silcrete. A fragment of a backed blade was found at S141. Angular fragments comprised 22.2% of the assemblage, included in this number was an igneous axe/hatchet fragment located in TS 166.

Table 10. TNR AFT 24 Phase 1 Reduction and material summary

Reduction Types	Whole flakes	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	2	1	4	0	7 (38.9%)
Tuff	0	1	2	3	6 (33.3%)
Quartz	0	0	2	0	2 (11.1%)
Chert	0	0	1	0	1 (5.6%)
Other	0	0	1 (P. Wood)	1 (Igneous)	2 (11.1%)
Total	**2 (11.1%)**	**2 (11.1%)**	**10 (55.6%)**	**4 (22.2%)**	**18**

Three of the Phase 1 squares were subsequently selected for Phase 2/3 open area expansion.

Open Area 4 (OA4) was expanded around S166 which contained the hatchet fragment. Open Area 5 (OA5) was expanded around S164 which contained two conjoining angular fragments of tuff. Open Area 9 (OA9) was expanded around S15 which contained two silcrete artefacts including one of the complete flakes. The open areas were positioned from the midslopes (OA9) down to the midslopes/lower slope transition (OA4 and OA 5).

7.2.3 Phase 2/3 results

Three areas of Phase 2/3 excavation were undertaken across the site: Open Areas 4, 5 and 9. Each comprised an 8m^2 extension to the selected Phase 1 squares to create three 3m x 3m (9m^2) open areas (Figure 8). In total, 24 additional 1m^2 squares were excavated as part of the Phase 2/3 program.

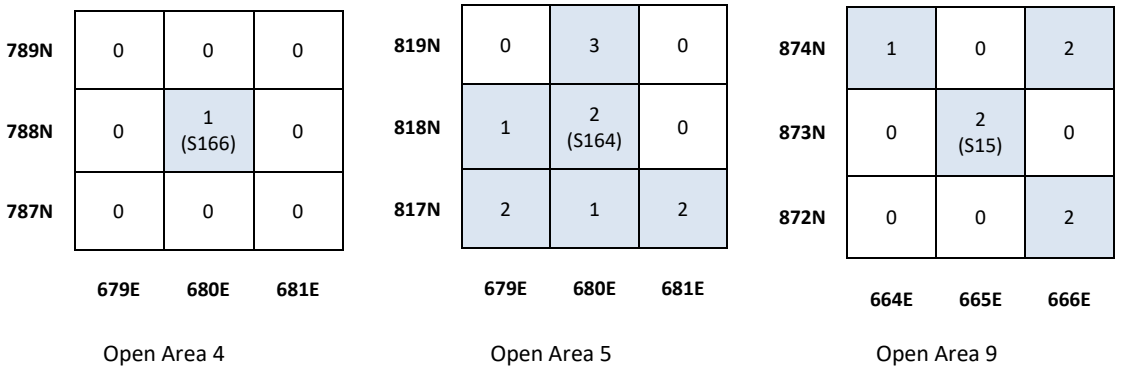


Figure 8. TNR AFT 24 artefact distribution in open areas

A total of 14 artefacts were recovered from the Phase 2/3 program, giving a comparably very low mean artefact density as was encountered during Phase 1 (0.6 artefacts/m^2). Of the 24 squares excavated, eight contained artefacts (33.3% of squares), similar to the 40% of positive squares located during Phase 1 salvage.

No additional artefacts were recovered from OA4. Nine artefacts were recovered from the expansion of S164 at OA5 (accounting for 64.3% of the Phase 2/3 assemblage), giving a mean density for this open area of 1.2/m^2 (inclusive of Phase 1 square). The three artefacts recovered from 680E 819N was the highest single square artefact count for the site. Five additional artefacts were recovered from OA9. The results of the Phase 2/3 salvage confirmed the Phase 1 findings of a very low density and relatively dispersed deposit, with no concentrations of artefacts or higher density activity areas identified during either dispersed Phase 1 or contiguous Phase 2/3 excavation.

Raw material was limited compared to the Phase 1 excavation, with Tuff being the most common (n=8), comprising 57.1% of the assemblage, followed by silcrete (35.7%) and a single quartz artefact (7.1%) (Table 11).

Table 11. TNR AFT 24 Phase 2/3 Raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Total
OA4	0	0	0	0
OA5	1 (11.1%)	7 (77.8%)	1 (11.1%)	9 (64.3%)
OA9	4 (80%)	1 (20%)	0	5 (35.7%)
Total	**5 (35.7%)**	**8 (57.1%)**	**1 (7.1%)**	**14**

Table 12. TNR AFT 24 Phase 2/3 Reduction Types

Reduction Types	Whole flakes	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	0	1 (20%)	2 (40%)	2 (40%)	5
Tuff	2 (25%)	2 (25%)	1 (12.5%)	3 (37.5%)	8
Quartz	0	0	0	1 (100%)	1
Total	**2 (14.3%)**	**3 (21.4%)**	**3 (21.4%)**	**6 (42.9%)**	**14**

A small number of complete flakes (n=2) were found within the Tuff assemblage, one each found in OA5 and OA9. The majority of artefacts were either flake fragments or angular fragments, with the single quartz artefact being an angular fragment. Former ploughing of the paddock may have contributed to the high level of fragmentation in the assemblage.

No cores were identified in either the Phase 1 or Phase 2/3 excavation. The amount of cortex was generally low throughout the entire site assemblage, with 16.7% of the silcrete assemblage and 14.3% of the Tuff assemblage retaining some level of cortex (Table 13).

Only two modified artefacts or tools were identified at the site, both within the Phase 1 excavations. One was a backed quartz artefact, a distal fragment of a backed blade in S141. The second was the igneous fragment of an axe/hammerstone located in S166. No further fragments of the tool were identified in the subsequent OA4.

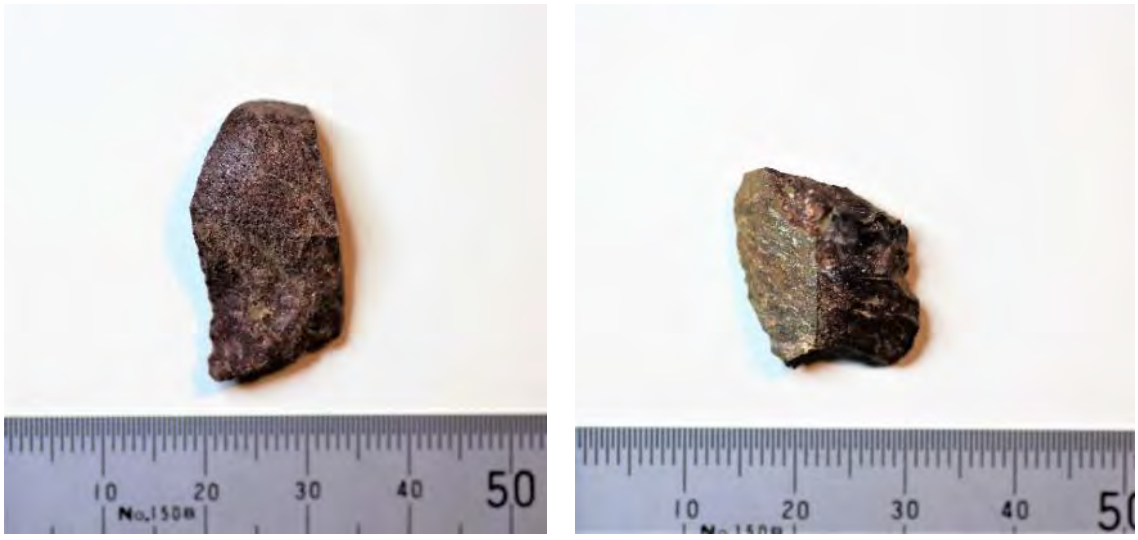


Plate 11. TNR AFT 24: (L) #1 Silcrete Flake, (R) #5 Petrified Wood distal fragment

Table 13. TNR AFT 24 Cortical Artefacts Phase 1 & 2/3

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	Igneous	Total
TNR AFT 24 all artefacts	12	14	3	1	1	1	32
Artefacts with cortex	2 (16.7%)	2 (14.3%)	0	0	1 (100%)	0	5 (9.6%)

Table 14. TNR AFT 24 Flake size range Phase 1 & 2/3

Flake size ranges	21-25mm	26-30mm	Total
Phase 1	1	1	2
Phase 2	2	0	2
Total	**3 (75%)**	**1 (25%)**	**4**

7.2.4 TNR AFT 24 Summary

Site TNR AFT 24 displayed a very low density of archaeological material, despite the apparently intact soil profile and low levels of disturbance. Previous land clearing, ploughing and erosion may have removed surface level artefacts, however previous regional modelling suggests that sites along crests and ridges tend to display low artefact densities. It is likely that this was a transitory area with some low intensity cultural activity as is suggested by the axe/hatchet and blade fragment as well as low levels of artefact curation and manufacture.

7.3 TNR AFT 26 (AHIMS 45-5-4798)

Site TNR AFT 26 was situated on the crest and upper slopes of a north-wester spur overlooking a series of interconnecting creeks (Figure 9). The site was located within Lot 1 DP838361 and Lot 2 DP851626 approximately 400 metres west of The Northern Road and 600 metres west of the intersection with Eaton Road.

The site is spatially defined by the hilltop gradients of the spur overlooking Duncans Creek, immediately south west of a confluence and projecting between the two tributaries. The site was in close proximity to several other sites (TNR AFT 24, 25 and 27).

The site had been cleared of native vegetation with varying levels of disturbance across the site. Areas within close proximity to dams and creek lines in particular were disturbed by erosion and dam construction activities while the elevated gently sloping areas adjacent to the creek lines had generally low levels of disturbance with relatively intact soil profiles.

TNR AFT 26 Quick Reference	
Creek system	**Landforms**
Duncans Creek	Crest
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
25 squares Total 25 m^2	2 open areas Total 50m^2
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
40 total artefacts Mean density 1.6/m^2	139 total artefacts Mean density 2.8/m^2
Phase 1 & 2/3 combined	
Total sample: 75 m^2, 179 artefacts Mean density 2.4/m^2	

Five artefacts were located during the original site survey, identified within a sheet erosion scour adjacent to a creek bank. The artefacts comprised three Tuff flake fragments, one Quartz flake fragment and a Quartz angular fragment.

Plate 12. (Main picture) Facing west, view across crest and OA1 (Top right) View north towards creek, S14 in foreground. (Lower right). S92 completed, view north towards TNR AFT 24 on opposite side of creek.

7.3.1 Soils, landform and disturbance

Soils were mostly uniform across the excavated part of the site area apart from some variation in excavated depth across the landform. Similar to TNR AFT 22, deposit on the crest proper tended to be shallower (averaging 15-20cm depth) than that excavated towards the break of the upper slope (averaging 20-30cm depth). A better developed A horizon was evident at the site, with a deeper upper humic topsoil overlying a red-brown silty clay loam to clay loam. Coarse fragments were frequent, with numerous squares containing fine ironstone gravels, Fe/Mn staining and fragments of shale and sandstone. Charcoal flecking was also common, with some larger patches in association with burnt root channels (most likely from vegetation clearance).

Mixing between the A horizon and the underlying B horizon clays was widespread, with nodules and lumps of clay of varying sizes present in the A horizon in the majority of squares. Some cuts and undulations were identified into the B horizon in the Phase 1 squares, but it was the open area excavations that revealed the true nature and extent of these disturbances, with deep plough furrows visible through the basal clay. The deep ploughing of the crest explains the generally mixed and homogenous nature of the soils across this landform. Erosion appears to be less widespread, and the landform retained a better depth of topsoil, due to the gentler gradient in comparison to TNR AFT 24 and less stock activity.

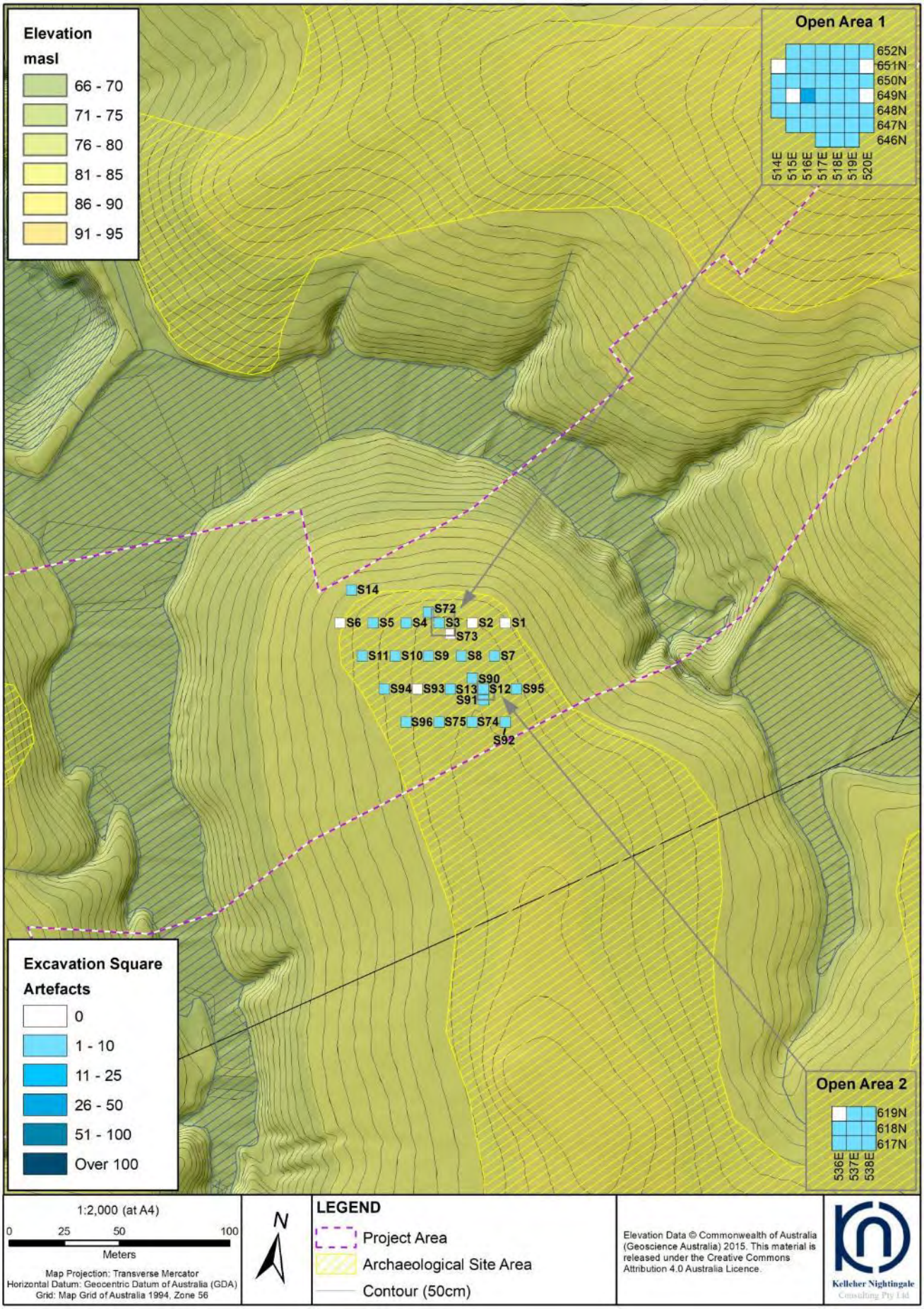


Figure 9. TNR AFT 26 excavation results

S2 east section

S6 south section

S7 north section

OA2 west section and base

OA1 north section and base

OA1 west section and base

Plate 13. Representative section profiles and open areas, TNR AFT 26

7.3.2 Phase 1 results

A total of 25 1x1m Phase 1 squares were excavated at TNR AFT 26 during the initial salvage stage. These included 25 quad unit (each 0.25m^2) and the corresponding 25 0.75m^2 S square extensions, for a total of 25m^2 Phase 1 salvage excavation. Four transects were aligned approximately east-west across the project area, focused on the northern part of the crest landform containing the site. Phase 1 squares were spaced at a 15m interval along each transect, and transects were spaced 15m apart. The position of the squares along each transect was staggered by 5m between transects. Several Phase 1 squares (S14, S72-73 and S90-91) were offset from the main transects in order to provide fuller coverage of the landform.

A total of 40 artefacts were recovered during the Phase 1 program, giving a mean artefact density across the Phase 1 sample of 1.6 artefacts/m^2. Artefacts were identified in 20 of the 25 completed 1x1m squares (80% of squares), spread across the sample area at low densities. The majority of positive squares contained between 1-3 artefacts, with the highest density encountered at S3 (n=6), which contained artefacts both in the quad unit and in the S-extension.

Table 15. TNR AFT 26 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S1	0	0	**0**	S14	0	1	**1**
S2	0	0	**0**	S72	1	0	**1**
S3	1	5	**6**	S73	0	0	**0**
S4	1	2	**3**	S74	0	1	**1**
S5	0	1	**1**	S75	0	3	**3**
S6	0	0	**0**	S90	0	1	**1**
S7	0	1	**1**	S91	1	1	**2**
S8	0	1	**1**	S92	2	1	**3**
S9	0	2	**2**	S93	0	0	**0**
S10	0	1	**1**	S94	0	1	**1**
S11	0	2	**2**	S95	0	3	**3**
S12	0	3	**3**	S96	0	2	**2**
S13	0	2	**2**	**Site Total**	**6**	**34**	**40**

From the 20 Phase 1 squares that contained artefacts, five (25%) contained artefacts in the initial quad unit. Four of these went on the also contain artefacts in the corresponding S-square extension, except for S72. The remaining 15 squares were only found to contain artefacts when the quad was expanded to a 1x1m. In total, nine of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive). Overall artefact densities were low, with almost half of the positive squares (n=9) containing just a single artefact within the 1x1m excavated area. The spread of disperse material across the crest is likely the result of extensive ploughing (evidence in the base of the open area) and mixing of the deposit.

Amongst the Phase 1 assemblage, silcrete was the most commonly recovered raw material type (n=22), comprising 55% of artefacts. Tuff and quartz were present in similar proportions (n=7, 17.5% and n=8, 20% respectively). Individual artefacts of chert, petrified wood and igneous were also recovered. There was no clear patterning in raw material distribution, with the different material types spread across the crest.

The assemblage mostly comprised broken flake debitage, with unmodified proximal, medial and distal flake fragments accounting for 60% of the assemblage (n=24). Nine complete flakes were recorded, mostly on silcrete but one each on tuff and chert, accounting for 22.5% of artefacts. The remaining 15.5% was comprised of angular fragments, primarily within the quartz assemblage. The igneous artefact was identified as a medial flake fragment, possibly fractured from a hammerstone or ground axe. No cores or tool types were identified within the Phase 1 assemblage.

Table 16. TNR AFT 26 Phase 1 Reduction and material summary

Reduction Types	Whole flakes	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	7	2	2	10	1	22 (55%)
Tuff	1	0	1	4	1	7 (17.5%)
Quartz	0	0	0	3	5	8 (20%)
Chert	1	0	0	0	0	1 (2.5%)
Other	0	0	1 (Igneous)	1 (P. Wood))	0	2 (5%)
Total	**9 (22.5%)**	**2 (5%)**	**4 (10%)**	**18 (45%)**	**7 (15.5%)**	**40**

Two of the Phase 1 squares were subsequently selected for Phase 2/3 open area expansion.

Open Area 1 (OA1) was expanded around S3, which contained the highest artefact count from the Phase 1 program suggesting a localised higher density at this location just above the break of the upper slope adjoining the crest. Open Area 2 (OA2) was positioned around S12, which contained three artefacts of quartz and tuff and offered the opportunity to further investigate the flatter, more elevated part of the crest.

7.3.3 Phase 2/3 results

Two areas of Phase 2/3 excavation were undertaken across the site: Open Areas 1 and 2 (Figure 10). In total, an additional 50m^2 of excavation was completed as part of Phase 2/3 salvage. OA1 comprised a large irregularly shaped open area expansion of 42m^2 around S3, creating a contiguous open area of 43m^2. A total of 129 artefacts were recovered from OA1 (including S3), giving a mean artefact density of 3/m^2. Excluding S3, mean artefact density was 2.9/m^2. Most of the OA1 squares contained low densities of less than 10 artefacts, with one localised high point at 516E 649N (n=12). Four excavated squares contained no artefacts, mostly on the periphery of the open area.

Open Area 2 was smaller, comprising an 8m^2 extension to S12 to form a 3x3m open area. A total of 16 Phase 2/3 artefacts were recovered from the expansion area, yielding a total of 19 for the open area (including artefacts from S12) and a mean density of 2.1/m^2. Excluding S12, the mean artefact density was slightly lower at 2/m^2. Individual squares densities were low (<5), with the highest concentration at 538E 618N (n=5) immediately east of S12. One square on the periphery contained no artefacts (536E 619N).

The results of the Phase 2/3 salvage confirmed the Phase 1 findings of a very low density and relatively dispersed deposit, with no concentrations of artefacts or higher density activity areas identified during either dispersed Phase 1 or contiguous Phase 2/3 excavation.

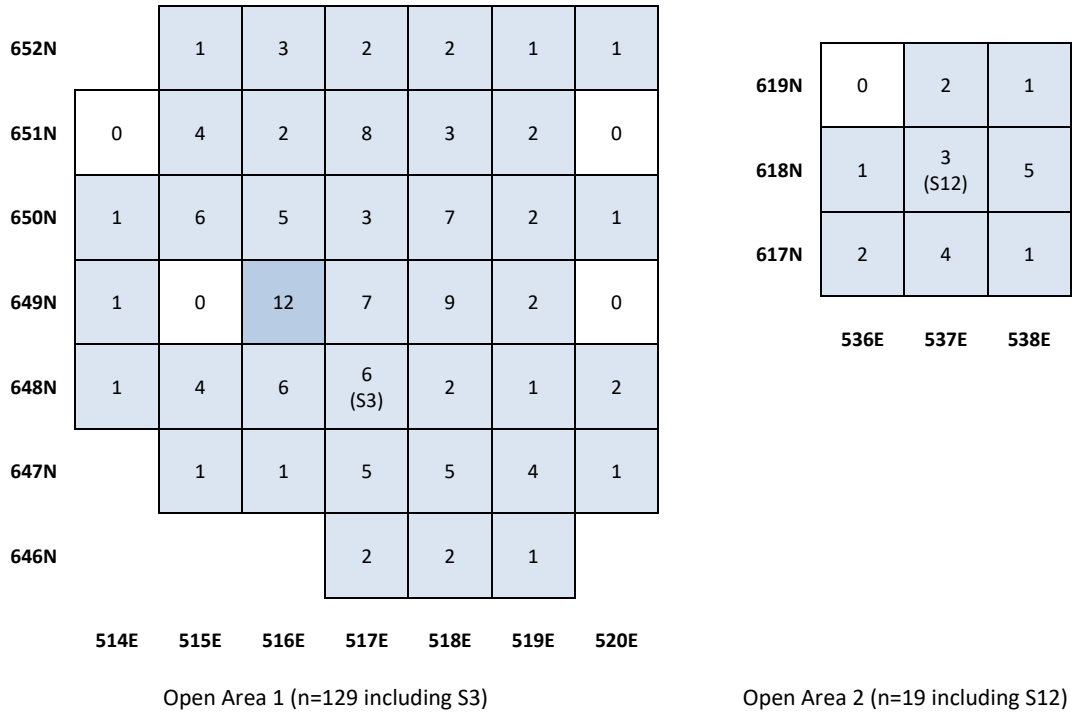


Figure 10. TNR AFT 26 artefact distribution in open areas

As with the Phase 1 results, the most common raw material for the Phase 2/3 artefacts (n=139, excluding Phase 1 squares) was silcrete, comprising 82% of the assemblage (n=114). The second most frequent was quartz (n=16, 11.5%) with smaller numbers of tuff (n=6) and chert (n=3) (Table 17). OA2 contained a significant proportion of quartz (43.8%), with this raw material equalling silcrete frequency in this open area, and no tuff; however the sample size was small with just 16 Phase 2/3 artefacts recovered from this area. OA1 was dominated by silcrete with 87% (n=107). No further igneous or petrified wood material was recovered during the Phase 2/3 excavations.

Table 17. TNR AFT 26 Phase 2/3 Raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Chert	Total
OA1	107 87%	6 4.9%	9 7.3%	1 0.8%	123 88.5%
OA2	7 43.8%	-	7 43.8%	2 12.4%	16 11.5%
Total	**114** **82%**	**6** **4.3%**	**16** **11.5%**	**3** **2.2%**	**139**

Flake fragments were the most common artefact type comprising almost 64% of the assemblage, including proximal, medial and distal fragments. Angular fragments were the second most frequent comprising just over 17% of the assemblage, with a relatively low number of complete flakes (n=20, 14.4%) found only within the silcrete and quartz assemblages. Former ploughing of the paddock may have contributed to the high level of fragmentation in the assemblage. Seven silcrete cores were identified, comprising 5% of the Phase 2/3 assemblage.

Table 18. TNR AFT 26 Phase 2/3 Reduction Types

Reduction Types	Core	Whole flakes	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	7	17	17	12	46	15	114 (82%)
Tuff	0	0	0	2	2	2	6 (4.3%)
Quartz	0	3	0	1	6	6	16 (11.5%)
	0	0	0	1	1	1	3 (2.2%)
Total	**7 (5%)**	**20 (14.4%)**	**17 (12.2%)**	**16 (11.5%)**	**55 (39.6%)**	**24 (17.3%)**	**139**

The majority of flakes within the total assemblage (i.e. counting artefacts from both Phase 1 and Phase 2/3) were less than 25mm in size (maximum dimension). Only two flakes, one of chert and one of silcrete, were larger than this (between 26-35mm). Percussion lengths for these two artefacts were 23.6mm for the chert flake (max. dimension 31-35mm) and 29.4mm for the silcrete flake. Both of these larger flakes were recovered during Phase 1 excavation. The largest artefact encountered was a single silcrete distal fragment with a maximum dimension of between 36-40mm. Core sizes were also small, with the largest having a maximum dimension of 31-35mm.

Table 19. TNR AFT 26 Flake size range Phase 1 & 2/3

Flake size ranges	6-10mm	11-15mm	16-20mm	21-25mm	26-30mm	31-35mm	Total
Phase 1	3	2	0	2	1	1	9
Phase 2/3	4	6	7	3	0	0	20
Total	**7** **24.1%**	**8** **27.6%**	**7** **24.1%**	**5** **17.2%**	**1** **3.4%**	**1** **3.4%**	**29**

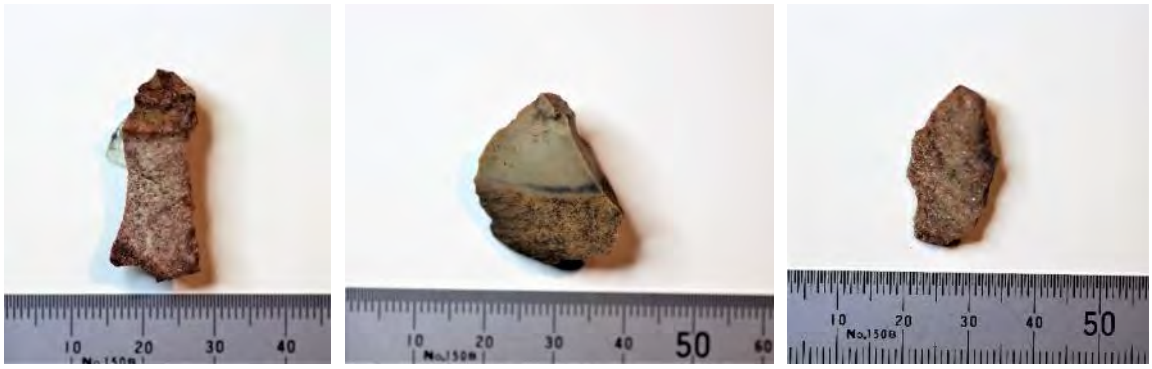


Plate 14. TNR AFT 26 – Flakes: (L) #057 Silcrete, (C) #058 Chert, (R) #061 Silcrete

As stated previously, cores represented 5% of the total Phase 2 assemblage (n=7) and were found only within the silcrete assemblage. One of these was identified as a core fragment. Of the remaining six cores, 50% were unifacial (n=3), with single instances of multidirectional, unifacial-rotated and bifacial cores. Most cores exhibited only limited use, with two or fewer negative scars, however the small size range of the cores suggested that these were either wasted core material or fragments of larger cobbles. The bifacial core exhibited moderate to high usage with six identifiable negative scars. Three of the lower use cores had between 30-70% of cortex remaining, with the remaining cores exhibiting none, including the core fragment.

A total of five modified artefacts/tools were identified. All of these were made from silcrete and were located at Open Area 1 within the Phase 2/3 assemblage. Three backed artefacts were identified, including one proximal blade fragment and two geometric microliths. The geometric microliths were particularly small, with maximum dimensions between 11-15mm, and both appeared have unfinished backing and were either broken through use or during the manufacturing process. Two retouched artefacts were also recovered, although no formal types were identified.

There was a relatively high proportion of cortical artefacts found throughout the different raw material assemblages, with the highest proportion found within the quartz assemblage (29.2%). The silcrete assemblage had the second highest (and statistically relevant) proportion of 26.5%. The overall proportion of cortical artefacts in the assemblage was 25.7% (n=46). Of the cortical artefacts, a relatively equal proportion retained between 1-30% cortex (n=22, 47.8%) and 31-69% cortex (n=20, 43.5%). Four artefacts were highly cortical, retaining 70-99% (8.7%).

Table 20. **TNR AFT 26 Cortical artefacts Phase 1 & 2/3**

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	Igneous	Total
TNR AFT 26 all artefacts	136	13	24	4	1	1	179
Artefacts with cortex	36 26.5%	2 15.4%	7 29.2%	1 25%	0	0	46 25.7%

7.3.4 TNR AFT 26 Summary

The area of impact at site TNR AFT 26 limited the excavation to the ridge crest with results revealing a low-density artefact scatter across the area. Silcrete was the only raw material found in any significant numbers, although smaller representative samples of other raw materials are consistent with other sites within western Sydney. The number of cores located within the silcrete assemblage appeared slightly high, although when calculated with all platform debitage (complete flakes, proximal fragments) the ratio of cores to flakes was approximately 1:5. The small size and low intensity use of cores suggest that larger core material is missing from the excavated area, possibly taken away for further use. The sample of modified artefacts within the assemblage suggests that tools were being used in this area for specific purposes, rather than being produced or curated in the area. It is likely that site TNR AFT 26 was an intermittently used area utilised for specific purposes such as hunting rather than a general purpose campsite.

7.4 TNR AFT 27 (AHIMS 45-5-4799)

Site TNR AFT 27 was located on the crest and slopes adjacent to the western bank of an unnamed creek (Duncans Creek system) (Figure 11). The site extended across the southern boundary of Lot 2 DP851626 and the northern boundaries of Lots 19, 20 and 21 DP258581. The site is spatially defined by the gradient of the hilltop and foreshore exposure linking the hilltop to the creek. The site was in close proximity to a number of other sites in the vicinity, including TNR AFT 24, 25, 26 and 28 located along the crests and slopes surrounding the Duncans Creek system.

The site had been historically cleared of native vegetation and showed variable levels of disturbance, particularly areas within close proximity to dams and creek lines. These areas had been impacted by various levels of disturbance primarily by erosion and dam construction activities. Elevated gently sloping areas adjacent to the creek lines displayed lower levels of disturbance, with the soil profile assessed as being a closed deflationary system with notable aggradation suggesting an intact soil profile.

TNR AFT 27 Quick Reference	
Creek system	**Landforms**
Duncans Creek	Crest and slope
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
25 squares Total 25 m^2	3 open areas Total 51m^2
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
66 total artefacts Mean density 2.6/m^2	630 total artefacts Mean density 12.3/m^2
Phase 1 & 2/3 combined	
Total sample: 76 m^2, 696 artefacts Mean density 9.1/m^2	

The survey identified one silcrete flake on the lower north-eastern slope approximately 25 metres west of the creek bank and a further silcrete flake located on the hill just below the crest.

Plate 15. (Main picture) Facing east, view down slope towards OA8. (Top right) View west upslope towards crest, S148 in foreground. (Lower right) S170 completed, view north west along crest landform.

7.4.1 Soils, landform and disturbance

Soil profiles were found to vary widely across the site and were linked to the differing landform elements present across the site area. The western end of the site was situated on the crest proper and adjoining upper slopes above c.90m ASL in an area of regrowth trees. For the most part, soils on the crest and adjoining eastern upper slope (east of the lot boundary) were found to be shallow and deflated despite the vegetation cover, with average depths less than 10cm and several very shallow examples <5cm. This part of the site beneath the trees has been used by cattle over a prolonged period which has destabilised the deposit. Soil materials comprised a very thin, dry humic layer above a gravelly (ironstone) silty clay loam to silty clay, above very stiff dry bioturbated basal clay. Charcoal flecking was abundant with some denser patches likely due to tree burning events. Larger areas of discoloured soil were also evident in OA7 on the edge of the crest due to burnt roots.

This contrasted with profiles encountered on the western upper slope adjoining the crest, on the other side of the lot boundary where stock activity was significantly lower. On the western side of the boundary, soil profiles averaged 10-20cm depth and comprised a pale brown silty clay loam with bioturbated clay patches, above a reddish compact clay. A slightly better depth of humic topsoil was also retained on the western slope.

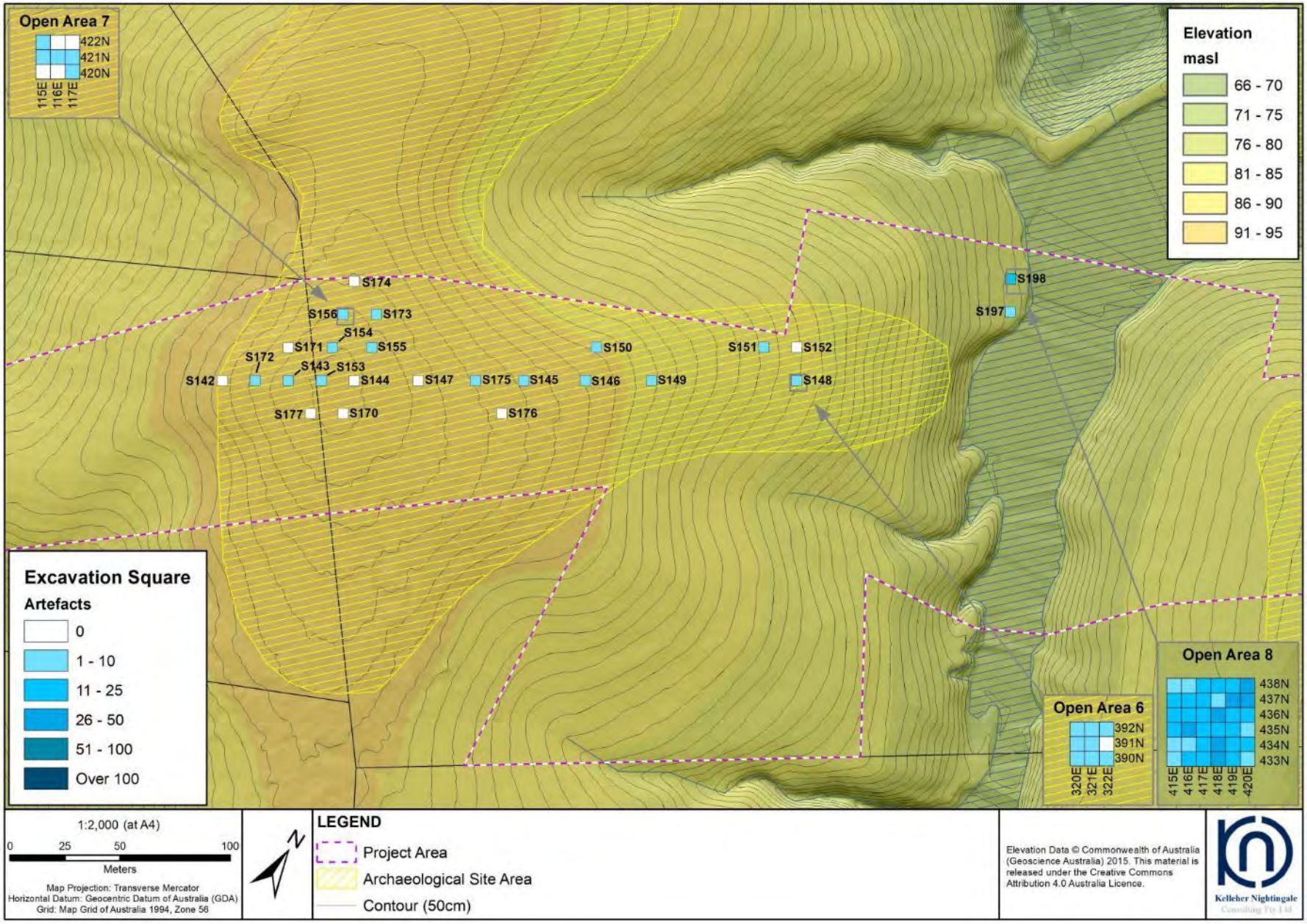


Figure 11. TNR AFT 27 excavation results

Phase 1 squares excavated on the eastern slope displayed increasing depth down the slope towards the creekline. S146, 149 and 150 averaged 10-15cm with less obvious stock disturbance than squares to the west and comprised silty clay loam above an undulating red clay B horizon. S148, 151 and 152 were positioned to target a small bench in the slope and were slightly deeper, up to 16cm. Later expansion of S148 into OA6 revealed an undulating clay base with extensive tree root infills and a collapsed animal burrow.

The two Phase 1 squares excavated at the easternmost extent of the site immediately above the creek displayed the deepest profiles(22-32cm) and a siltier alluvial influence, with pale grey-brown to yellow-brown silty loam to silty clay loam with abundant Fe/Mn flecks and nodules<5mm and increasing clay content with depth. The B horizon comprised a yellowish brown clay. Subsequent open area expansion confirmed the deeper siltier deposits on the lower slope bench above the creek.

S144 south section

S143 north section

S150 south section

OA6 east section and base

OA7 south section and base

OA8 south section and base

Plate 16. Representative section profiles and open areas, TNR AFT 27

7.4.2 Phase 1 results

Phase 1 salvage at TNR AFT 27 was comprised of 25 1x1m squares made up of 25 quad units (0.25m^2) and the corresponding 25 0.75m^2 S-square extensions. The total amount of Phase 1 salvage excavation was 25m^2. Phase 1 transects were positioned in an east-west direction bisecting the crest and running down the eastern slope to the creek. Shorter transects were aligned to the north and south to provide better coverage of the site area. Squares were spaced at regular intervals along each transect and staggered by 5m between transects. Several offsets were required for pits to avoid vegetation and trees, and to target the midslope bench at S148.

A total of 66 artefacts were recovered from the Phase 1 salvage excavation, yielding a mean artefact density across the Phase 1 sample of 2.6 artefacts/m^2. Artefacts were recovered from 16 of the 25 completed Phase 1 squares (64% of squares). These were mostly present in low densities (1-2 per m^2) with only four of the Phase 1 squares containing <5 artefacts. The highest densities were present at S197 (n=9) and S198 (n=20) on the lower slope bench immediately above the creek, while the zero squares were distributed on the crest and adjoining eastern upper slope.

Within the 16 positive squares, 11 did not contain any artefacts in the initial 0.25m^2 quad unit but were found to contain artefacts when expanded to 1x1m. S151 was the only square which contained artefacts in the initial NW quad but did not contain further artefacts in the corresponding S-square extension. In total, ten of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive).

Table 21. TNR AFT 27 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S142	0	0	**0**	S155	0	3	**3**
S143	0	1	**1**	S156	0	5	**5**
S144	0	0	**0**	S170	0	0	**0**
S145	6	2	**8**	S171	0	0	**0**
S146	0	1	**1**	S172	0	2	**2**
S147	0	0	**0**	S173	0	1	**1**
S148	3	5	**8**	S174	0	0	**0**
S149	0	1	**1**	S175	0	2	**2**
S150	0	1	**1**	S176	0	0	**0**
S151	2	0	**2**	S177	0	0	**0**
S152	0	0	**0**	S197	1	8	**9**
S153	0	1	**1**	S198	4	16	**20**
S154	0	1	**1**	**Site Total**	**16**	**50**	**66**

Silcrete was the most common raw material, comprising 50% of the total Phase 1 assemblage (n=33). Tuff comprised just over 27% of the assemblage (n=18), with small numbers of quartz and chert (each n=7) making up the majority of the remainder. One fine grained siliceous (FGS) core was also identified.

Artefacts were predominantly flake fragments, comprising 48.5% of the total assemblage (n=32), with non-diagnostic angular fragments constituting just over 30% of the assemblage (n=20). Complete flakes were found within the silcrete, tuff and quartz assemblages with a total number of 12 identified, including one bipolar quartz flake. Two cores were identified, constituting 3% of the Phase 1 assemblage, with the FGS core displaying a slightly higher level of reduction with three negative scars, as opposed to the silcrete core which had one negative scar. One tuff backed blade was located within S197 adjacent to the creek.

Table 22. TNR AFT 27 Phase 1 reduction and material summary

Reduction Types	Core	Whole flakes	Bipolar flakes	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	1	7	0	5	1	13	6	33 (50%)
Tuff	0	2	0	1	2	6	7	18 (27.3%)
Quartz	0	2	1	0	0	2	2	7 (10.6%)
Chert	0	0	0	0	1	1	5	7 (10.6%)
FGS	1	0	0	0	0	0	0	1 (1.5%)
Total	**2 (3%)**	**11 (16.7%)**	**1 (1.5%)**	**6 (9.1%)**	**4 (6.1%)**	**22 (33.3%)**	**20 (30.3%)**	**66**

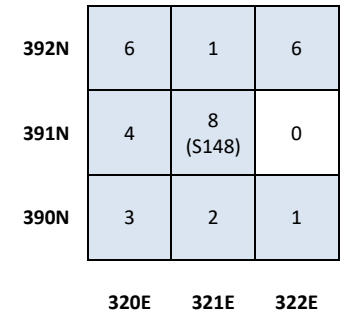
Three Phase 1 squares were subsequently selected for Phase 2/3 open area expansion. Open Area 6 (OA6) was expanded around S148 on the bench in the eastern slope above the creek, which contained eight artefacts. Open Area 7 (OA7) was positioned on the top of the crest around S156 (n=5) where better depth of deposit was retained (10-15cm as opposed to 3-5cm). Open Area 8 (OA8) was located around S198 immediately adjacent to the creek, which contained the highest Phase 1 artefact count (n=20).

7.4.3 Phase 2/3 results

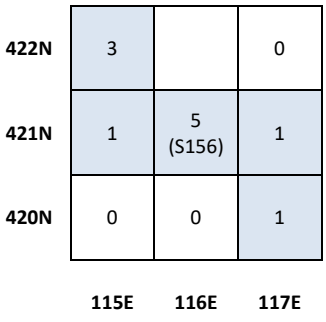
Three areas of Phase 2/3 excavation were undertaken at the site and were positioned on three distinct parts of the landform associated with the site area. In total, 51m^2 of additional Phase 2/3 excavation was undertaken and recovered 630 artefacts, for a mean Phase 2/3 artefact density of 12.4/m^2.

OA6 comprised an 8m^2 expansion to S148 to form a 3x3m open area. A total of 23 Phase 2/3 artefacts were recovered from these squares, giving a total artefact count for the open area of 31 and a mean artefact density of 3.4/m^2 (including S148). Excluding S148, the Phase 2/3 artefact count was 23 and density 2.9/m^2. OA7 also comprised a 3x3m open area, composed of an 8m^2 extension to S156. A total of 11 artefacts were recovered from the open area, giving a mean artefact density of 1.2/m^2 (including S156). Excluding the Phase 1 square, artefact count and density for OA7 was very low at just n=6 and 0.75/m^2. Both OA6 and OA7 did not contain any squares with more than ten artefacts.

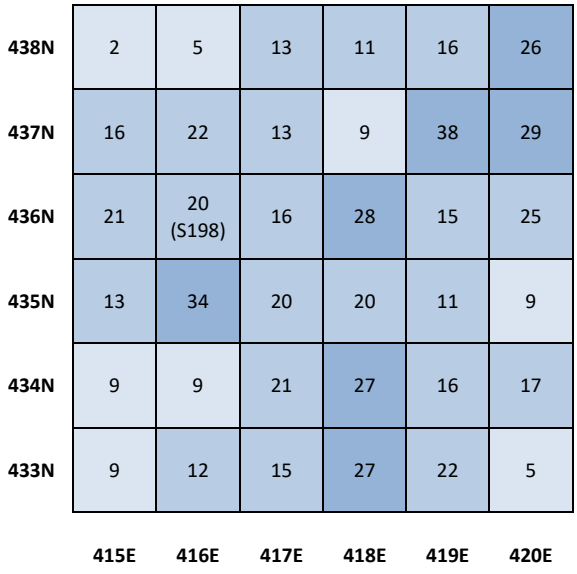
OA8 was located around S198 on the lower slope, selected for expansion due to the highest Phase 1 artefact count of n=20. A total of 35 additional 1x1m squares were extended to form a 6x6m open area of 36m^2. In total, OA8 contained 621 artefacts and displayed a mean artefact density of 17.3/m^2. Excluding S198, artefact count and mean density for the open area was n=601 and 17.2/m^2. OA8 displayed the highest artefact densities at the site with two squares containing >30 artefacts and a further 12 squares containing 20-30 artefacts. All squares at OA8 contained artefacts.



Open Area 6 (n=31 including S148)



Open Area 7 (n=11 including S156)



Open Area 8 (n=621 including S198)

Figure 12. TNR AFT 27 artefact distribution in open areas

Table 23. TNR AFT 27 Phase 2/3 open areas

Phase 2/3 Open Areas	Phase 1 Square	Size of Phase 2/3 Excavation Area*	Artefact Count*	Mean Artefact Density
Open Area 6	S 148 – 321E 391N (n=8)	9m²	31	3.4/m²
Open Area 7	S 156 – 116E 421N (n=5)	9m²	11	1.2/m²
Open Area 8	S 198 – 416E 436N (n=20)	36m²	621	17.2/m²

*Total includes Phase 1 squares

The results of the Phase 2/3 salvage confirmed the Phase 1 findings of a very low density and relatively dispersed deposit on the crest, with a low to moderate density in the deeper deposit of the adjoining slopes and a localised concentration on the lower slope bench immediately above the creekline.

Plate 17. OA6, view east downslope towards creek and OA8

Plate 18. OA7, view west to fenceline and western slope

Plate 19. OA8, view east to creek and dam

As with the Phase 1 excavation, silcrete was the most common raw material comprising 63.5% of the assemblage (n=400), with a relatively large amount of tuff also recovered comprising 25.6% of the assemblage (n=161). Smaller numbers of quartz (n=23) and chert (n=42) were encountered, with small numbers of petrified wood (n=3) and a singular quartzite artefact identified. These rarer raw materials were identified solely at OA8.

Table 24. TNR AFT 27 Phase 2/3 Raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	Quartzite	Total
OA6	9 39.1%	10 43.5%	3 13%	1 4.3%	0	0	**23** **3.7%**
OA7	1 16.7%	3 50%	2 33.3%	0	0	0	**6** **1%**
OA8	390 64.9%	148 24.6%	18 3%	41 6.8%	3 0.5%	1 0.2%	**601** **95.4%**
Total	**400** **63.5%**	**161** **25.6%**	**23** **3.7%**	**42** **6.7%**	**3** **0.5%**	**1** **0.2%**	**630**

The most common reduction types were flake fragments, comprising 58.2% of the assemblage (n=140), with a relatively low proportion of non-diagnostic angular fragments. Distal flake fragments were the most common form of broken flake debitage, followed by similar proportion of proximal and medial fragments. There was a high percentage of angular fragments within the tuff assemblage (42.2% of tuff, n=68), with a subsequently lower proportion of complete flakes (13%, n=21) for this raw material.

Complete flakes, including a single quartz bipolar flake, comprised 17% of the Phase 2/3 assemblage (n=107). Fifteen cores were identified, primarily within the silcrete assemblage, but also present within the tuff, quartz and chert assemblages, and comprise 2.4% of the Phase 2/3 assemblage. Two artefacts were identified as either heat shatter or crenate fracture (Table 25). Overall reduction type proportions were similar between Phase 1 and Phase 2/3, with a difference of c.10% in angular fragment/flake fragment percentage frequency between the salvage Phases (Table 26).

Table 25. TNR AFT 27 Phase 2/3 Reduction Types

Reduction Types	Core	Whole flakes	Bipolar Flake	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Heat / Crenated Fracture	Total
Silcrete	11	76	0	48	44	163	57	1	**400**
Tuff	2	21	0	9	15	45	68	1	**161**
Quartz	1	3	1	1	0	10	7	0	**23**
Chert	1	6	0	1	4	23	7	0	**42**
P. Wood	0	0	0	0	1	1	1	0	**3**
Quartzite	0	0	0	0	0	1	0	0	**1**
Total	**15** **2.4%**	**106** **16.8%**	**1** **0.2%**	**59** **9.4%**	**64** **10.2%**	**243** **38.6%**	**140** **22.2%**	**2** **0.3%**	**630**

Table 26. TNR AFT 27 Phase 1 & Phase 2/3 Reduction Types

Reduction Types	Whole flakes	Flake fragment	Angular fragment	Cores	Total
Phase 1	12 18.2%	32 48.5%	20 30.3%	2 3%	66 9.5%
Phase 2*	107 17.1%	366 58.3%	140 22.3%	15 2.4%	628* 90.5%
Total	**119** **17.1%**	**398** **57.3%**	**160** **23.1%**	**17** **2.4%**	**694**

* 1 Silcrete and 1 Tuff crenate fracture not included

Flake sizes were generally small throughout both the Phase 1 and 2/3 excavations, with just over 76% (n=91) under 20mm in size (maximum dimension), including 34 under 10mm. No Phase 1 flakes were larger than 30mm. A small number of larger flakes were recovered from Phase 2/3 ranging up to 55mm, with the two largest being within the chert and tuff assemblages.

Table 27. TNR AFT 27 Phase 1 & 2/3 Flake size range

Size range	0-5mm	6-10mm	11-15mm	16-20mm	21-25mm	26-30mm	31-35mm	36-40mm	41-60mm	Total
Phase 1	0	2	5	2	2	1	0	0	0	**12**
Phase 2/3	2	30	31	19	12	5	4	2	2	**107**
Total	**2** **1.7%**	**32** **26.9%**	**36** **30.3%**	**21** **17.6%**	**14** **11.8%**	**6** **5%**	**4** **3.4%**	**2** **1.7%**	**2** **1.7%**	**119**

Cores represented 2.4% of the Phase 1 and 2/3 assemblages (n=17) with the majority found within the silcrete assemblage (n=12). Small numbers of cores were also found within the tuff, quartz, chert and FGS assemblages. Flaking patterns were highly varied. The most common type was unifacial (n=6) and these exhibited low intensity reduction with all having three or less negative scars, although some partial scars were also observed. Other flaking patterns included one unifacial rotated, four multidirectional, three bifacial, one quartz bipolar core and a silcrete tranchet core. Only one core fragment was identified. The most heavily utilised cores were bifacial with each having four to five negative scars. The tranchet core is part of the process known as the Redbank A Strategy utilised in the creation of backed blades. Cortex was observed on 10 of the cores, almost 59% of the core assemblage. The largest core was a tuff bifacial core with a maximum dimension of 50mm and five negative scars. Core sizes ranged between 16–50 mm.

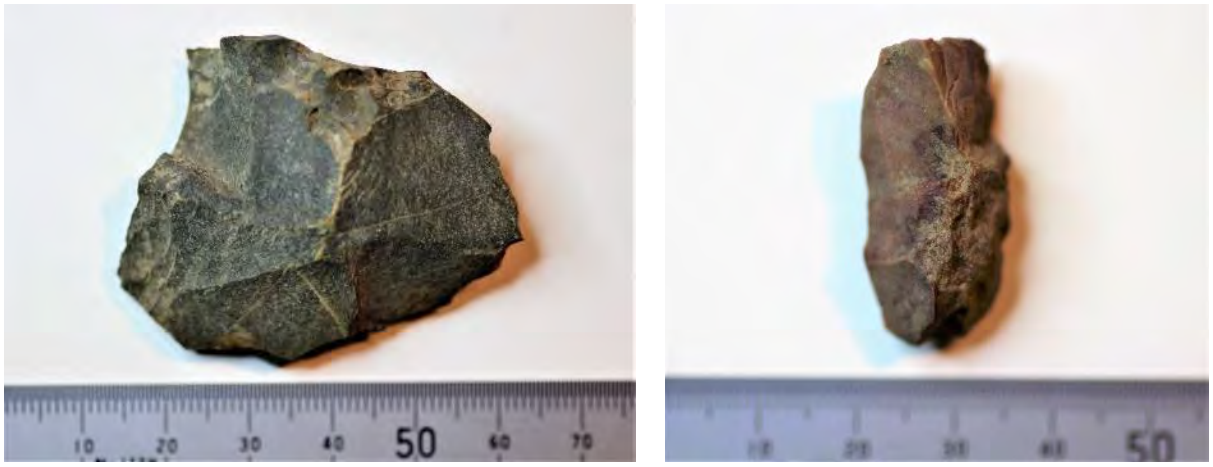


Plate 20. TNR AFT 27 Cores: (L) #864 Chert bifacial core, (R) #989 Silcrete Tranchet core

Cortical artefacts made up 19.4% of the entire assemblage (n=135). There was some variation between material assemblages; with only one chert cortical artefact located comprising 2% of the chert assemblage, compared to tuff which had the highest percentage of cortical artefacts (27.4%, n=49). Quartz also had a relatively high level of cortex with 23.3% of the assemblage (n=7). Silcrete artefacts, the highest representative sample in the complete assemblage, was 18% cortical with 78 cortical artefacts identified.

When present, cortex was generally recorded at low levels, with most artefacts retaining between 1-30% (n=77, 57% of cortical artefacts followed by moderately cortical artefacts displaying between 31-69% (n=38, 28.2% of cortical artefacts). Highly cortical artefacts were those displaying between 70-99% (n=16) and 100% (n=4), which together accounted for the remaining 14.8% of the cortical assemblage.

Table 28. TNR AFT 27 Phase 1 & 2/3 Cortical Artefacts

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	Quartzite	FGS	Total
TNR AFT 27 all Artefacts	433	179	30	49	3	3	1	696
Artefacts with cortex	78 18%	49 27.4%	7 23.3%	1 2%	0	0	0	135 19.4%

A total of 17 modified artefacts were identified, comprising 2.4% of the total site assemblage. The majority of the backed and retouched artefacts were found within the silcrete assemblage (n=13), with a small number of chert (n=3) and one tuff tool also identified. Backed artefacts were the most common tool type (n=14), including two complete blades, eight blade fragments and four geometric microliths. All geometric microliths were between 11-15mm in size (maximum size). Two non-formal retouched artefacts were found within the silcrete assemblage, as well as one chert scraper. All modified artefacts were found on the lower slope adjacent to the creek, in S197 and OA8.

Table 29. TNR AFT 27 Phase 1 & 2/3 Modified Artefacts

Modified artefacts	Backed		Retouched		Total
	Blade (F)	Geometric	Non-Specific	Scraper	
Phase 1	1	0	0	0	1 5.9%
Phase 2/3	9	4	2	1	16 94.1%
Total	**10** **58.8%**	**4** **23.5%**	**2** **11.8%**	**1** **5.9%**	**17**

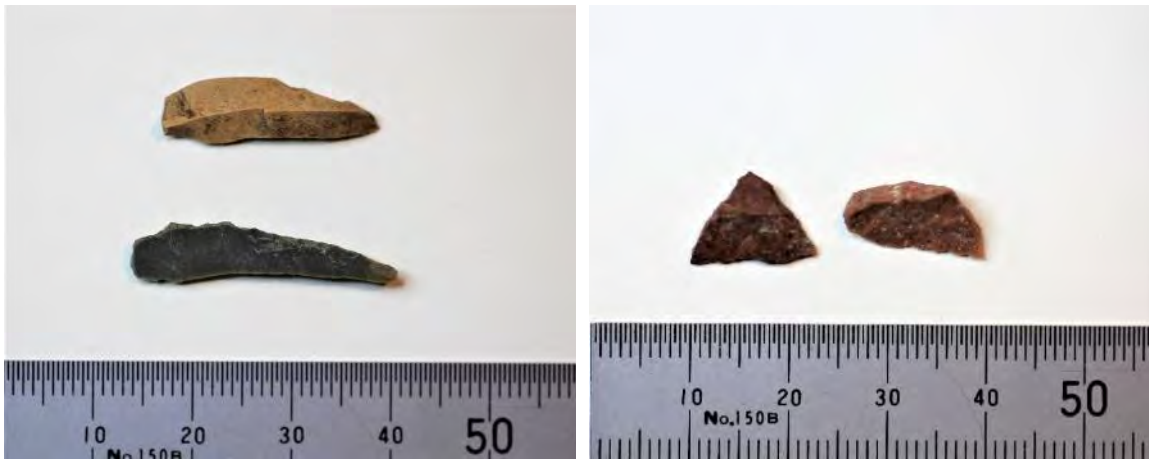


Plate 21. AFT 27 Backed artefacts – (L) #104 & #706 Tuff (top) & Chart (bottom) blades, (R) #753 & 785 Silcrete geometric microliths

Plate 22. #1158 Yellow silcrete geometric microlith

Plate 23. #822 Chert Scraper

7.4.4 TNR AFT 27 Summary

Site TNR AFT 27 was spread over a number of landform elements, predominantly the upper ridge crest with a spur running downwards to lower slopes adjacent to water sources. The Phase 1 excavation revealed a generally low artefact density across the site with higher densities located on the lower slopes to the east and mid-slope. The two Phase 2/3 excavations located on the crest and mid-slope (OA6 & 7) showed a low density artefact distribution whereas OA8 on the lower slope yielded a medium density of artefacts and a more complex assemblage. The presence of a core utilised in the process of manufacturing blades, and the presence of complete blades suggest that tools were being manufactured on site, not just used. Silcrete and tuff were found in relatively large numbers, as well as small samples of other materials, suggesting that use of raw materials may have changed over time, indicating extended intermittent use of the site. The lack of more intensive, high density archaeological deposit would indicate that this area was not a primary campsite but possibly a satellite area utilising local resources close to water and on the higher portions of the site.

7.5 TNR AFT 29 (AHIMS 45-5-4801)

Site TNR AFT 29 was located on the crest and upper slopes of a saddle and associated spur overlooking a west flowing tributary of Duncans Creek (Figure 13). The site was situated on the eastern side of Willowdene Avenue and bisected by Vicar Park Lane running roughly east-northeast through the site within Lot 28 DP259698 and Lot 33 DP259698.

TNR AFT 29 Quick Reference	
Creek system	**Landforms**
Duncans Creek	Crest and saddle
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
15 squares Total 15 m^2	N/A
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
10 total artefacts Mean density 0.7/m^2	N/A
Phase 1 & 2/3 combined	
Total sample: 15 m^2, 10 artefacts Mean density 0.7/m^2	

The site was well defined by the remnant spur top, exhibiting no contemporary disturbance (buildings, Lot levelling) in the north, however the southern portion of the site was moderately disturbed by construction activities associated with an electricity easement and various buildings. The remaining portions of the site exhibited low levels of disturbance associated with vegetation clearance and limited erosion along tracks.

Surface visibility during the original survey was variable across the site with good visibility along tracks and poor visibility with vegetation cover. A moderate depth of soil cover was evident and the site was assessed as having moderate archaeological value. Four silcrete artefacts were identified during the survey in cuttings along Vicar Park Lane and Willowdene Avenue, including a unidirectional core and core fragment.

Plate 24. (Main picture) Facing east, view across site area and saddle, S65 in foreground (Top right) Laying out transect in treed area north of Vicar Park Lane. (Lower right). S126 completed, facing west.

7.5.1 Soils, landform and disturbance

Phase 1 squares excavated across the saddle to the south of Vicar Park Lane (S65-71) displayed similar profiles and averaged between 7-12cm deep. The A unit comprised a thin (2cm) layer of humic topsoil with thick pasture grass roots above a homogenous grey-brown silty loam with 10-30% coarse fragments (primarily ironstone). The B horizon comprised a dry, blocky orange-red clay with coarse fragments. Mixing of the B horizon into the A unit was evident at several squares, with small clay lumps and patches in the lower part of the A unit. Charcoal was mostly absent, with one concentration identified in association with a burnt tree root channel at S70.

On the northern side of Vicar Park Lane, Phase 1 squares were located in an area of patchy regrowth vegetation and tree cover. Bioturbation of the deposit was more evident in this part of the site with increased insect and tree root activity. This part of the site was located on a spur crest and upper slope overlooking a drainage valley associated with the Duncans Creek system. Soil profiles were slightly deeper, averaging 10-17cm and up to 24cm. Soils comprised compact brown silty clay loam with scattered ironstone and frequent charcoal. B horizon comprised orange-red to red-brown slightly undulating compact clay. Some mixing of horizons was evident with orange clay lumps present in the lower A unit in several squares, possibly due to ploughing. S124 was shallow and showed some signs of possible disturbance by machinery. Plate 25 shows representative soil section profiles from the site.

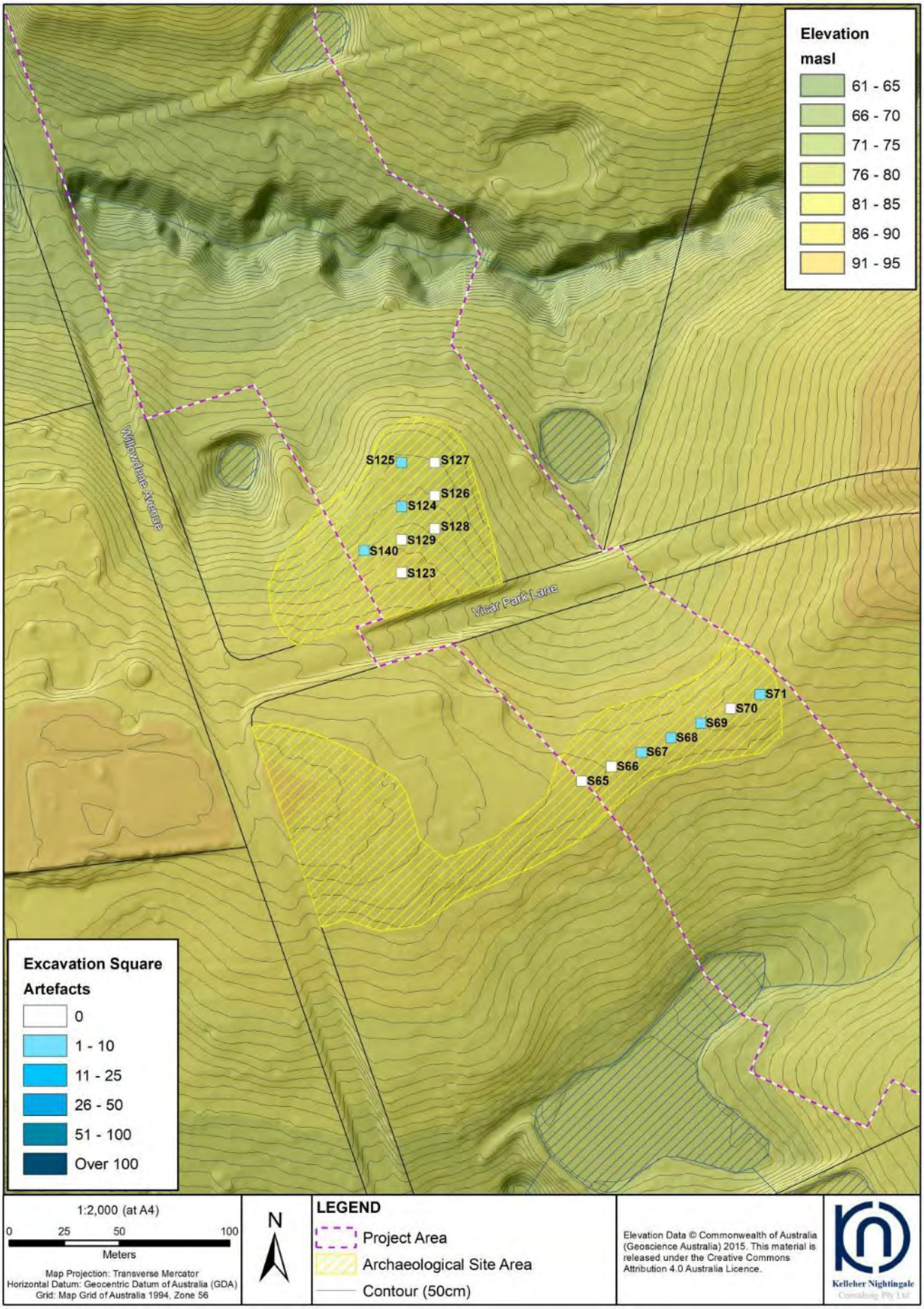


Figure 13. TNR AFT 29 excavation results

S65 south section

S71 south section

S128 north section

S140 north section

Plate 25. Representative section profiles, TNR AFT 29

7.5.2 Phase 1 Results

A total of 15 Phase 1 squares were excavated across the two portions of the TNR AFT 29 site area overlapped by the project corridor. These comprised 15 initial quad units (each 0.25m^2) and the corresponding 15 S-square extensions (each 0.75m^2) for a total excavated Phase 1 sample of 15m^2. Seven squares were positioned across the saddle landform south of Vicar Park Lane, aligned along a single east-west running transect (S65-71). These were spaced at 15m intervals along the transect and covered the full width of the project area. Phase 1 excavation to the north of Vicar Park Lane took place on two parallel north-south transects spaced 15m apart with an additional square (S140) a further 15m to the west. Squares were spaced at 15m intervals and staggered by 5m between the two transects. Some small offsets were required to avoid trees. A total of 8 Phase 1 units were located north of the road, including S123-129 and S140.

A total of 10 artefacts were recovered, giving a very low mean artefact density across the site of just 0.7/m^2. Artefacts were identified in seven of the 15 Phase 1 squares (46.7% of squares) and were found in both investigated parts of the site both north and south of the road.

Table 30. TNR AFT 29 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S123	0	0	**0**	S65	0	0	**0**
S124	1	0	**1**	S66	0	0	**0**
S125	1	0	**1**	S67	0	1	**1**
S126	0	0	**0**	S68	0	3	**3**
S127	0	0	**0**	S69	0	2	**2**
S128	0	0	**0**	S70	0	0	**0**
S129	0	0	**0**	S71	0	1	**1**
S140	0	1	**1**	**Site Total**	**2**	**8**	**10**

The highest density was at S68 located in the centre of the saddle landform to the south of the road (n=3). Neighbouring S69 contained two artefacts while the remaining positive squares only contained single artefacts. S124 and S125 north of the road were the only Phase 1 squares which contained artefacts in their initial quad units. Neither contained further artefacts when expanded to full 1x1m squares. The rest of the artefact-containing Phase 1 squares only had artefacts present in the S-extension units, with the initial quad units found to be empty. In total, eight of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive).

The assemblage raw material was predominantly silcrete (n=7, 70%), with one each of Tuff, Quartz and Chert. Artefacts were primarily complete flakes or flake fragments (60%), with three angular fragments (30%), and one tuff core fragment also present. Flake sizes were small, between 11-20mm, with two smaller angular fragments (6-10mm). The core fragment was the largest artefact recovered with a size range of 36-40mm. No cortex was identified on any of the artefacts. No modified artefacts, or tools, were recovered.

Table 31. TNR AFT 29 Phase 1 reduction and material summary

Reduction Types	Core fragment	Whole flakes	Flake fragment	Angular frag.	Total
Silcrete	0	3	3	1	**7 (70%)**
Tuff	1	0	0	0	**1 (10%)**
Quartz	0	0	0	1	**1 (10%)**
Chert	0	0	0	1	**1 (10%)**
Total	**1 (10%)**	**3 (30%)**	**3 (30%)**	**3 (30%)**	

No triggers for Phase 2/3 salvage were identified at the site and due to the very low artefact density, open area excavations were not undertaken.

7.5.3 TNR AFT 29 Summary

Despite the relatively undisturbed nature of the site assessed during the survey, very few artefacts were located during the excavation. It is possible that the level of disturbance was underestimated, particularly along the ridge saddle which had suffered some disturbance form ploughing and installation of a transmission line and presumable vehicle use. For the northern portion of the site, the geography of the area may have meant that the area was not utilised by Aboriginal people in the past and may have simply been a transitory area across the landscape.

7.6 TNR AFT 30 (AHIMS 45-5-4797)

Site TNR AFT 30 was located on the upper north-eastern slope and crest of a south-westerly running spur, approximately 250 metres to the south of an unnamed tributary of the Duncans Creek system (Figure 14). The site was located within Lot 1 DP838361 approximately 620m south-east of the intersection of Willowdene Avenue and Vicar Park Lane. The extent of the site was limited to the crest (similar to TNR AFT 31).

Modern disturbance was limited to vegetation clearance and erosion along tracks. Moderate depth of soil was evident across the landform with the area assessed as having moderate archaeological value and was most notable for its spatial definition. The site landform is well-defined and distinct and offers good view corridors and aspect over the surrounding landscape and the creek valleys to the north, west and south.

Two artefacts were identified during the original survey, including one quartz bipolar core and a grey banded chert angular fragment with red cortex.

TNR AFT 30 Quick Reference	
Creek system	**Landforms**
Duncans Creek	Crest
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
20 squares Total 20 m^2	2 open areas Total 16m^2
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
7 total artefacts Mean density 0.3/m^2	12 total artefacts Mean density 0.7/m^2
Phase 1 & 2/3 combined	
Total sample: 36 m^2, 19 artefacts Mean density 0.5/m^2	

Plate 26. (Main picture) OA12 completed, view to south west (Top right) View to west, S44 in foreground. (Lower right). S199 completed, view east to crest.

7.6.1 Soils, landform and disturbance

Some slight variation in soil structure was evident across the site between the crest proper in the east and the adjoining upper spur slope in the west. The excavation program supported the survey findings, namely that a relatively good depth of soil was retained on the crest (similar landforms are often badly eroded/deflated). The majority of squares excavated on the crest (S32, 33, 34, 35, 36, 38 and 40) displayed a relatively well-structured profile with an intact A horizon. Deposit comprised humic topsoil above pale orange-brown to light brown silty loam with occasional charcoal in the upper A horizon. This graded to a darker orange-brown clay loam in the lower A horizon, above a B horizon of compact orange-brown clay with occasional cracking and undulations. Squares showing the silty loam: clay loam differentiation in the A horizon tended to be slightly deeper (>10cm) compared to squares with a more homogenous A unit.

Squares with a single unit A horizon were primarily located on the adjoining western upper slope, and tended to be slightly shallower (<10cm) although variation in basal clay depth was also evident due to tree root disturbance. These squares comprised thin humic topsoil followed by an orange-brown clay loam with a weak, blocky structure and occasional charcoal. Scattered clay lumps were also present. Basal clay was uneven red-brown compact clay. Bioturbation of the deposit from tree root and insect activity was more evident in squares on the upper slope, particularly S42 which had a large root channel and across the base of OA11. Severe disturbance was evident in S37 and 46 on the crest, which displayed mixed fill and rubble with modern rubbish (brick, sandstone, plastic pipe).

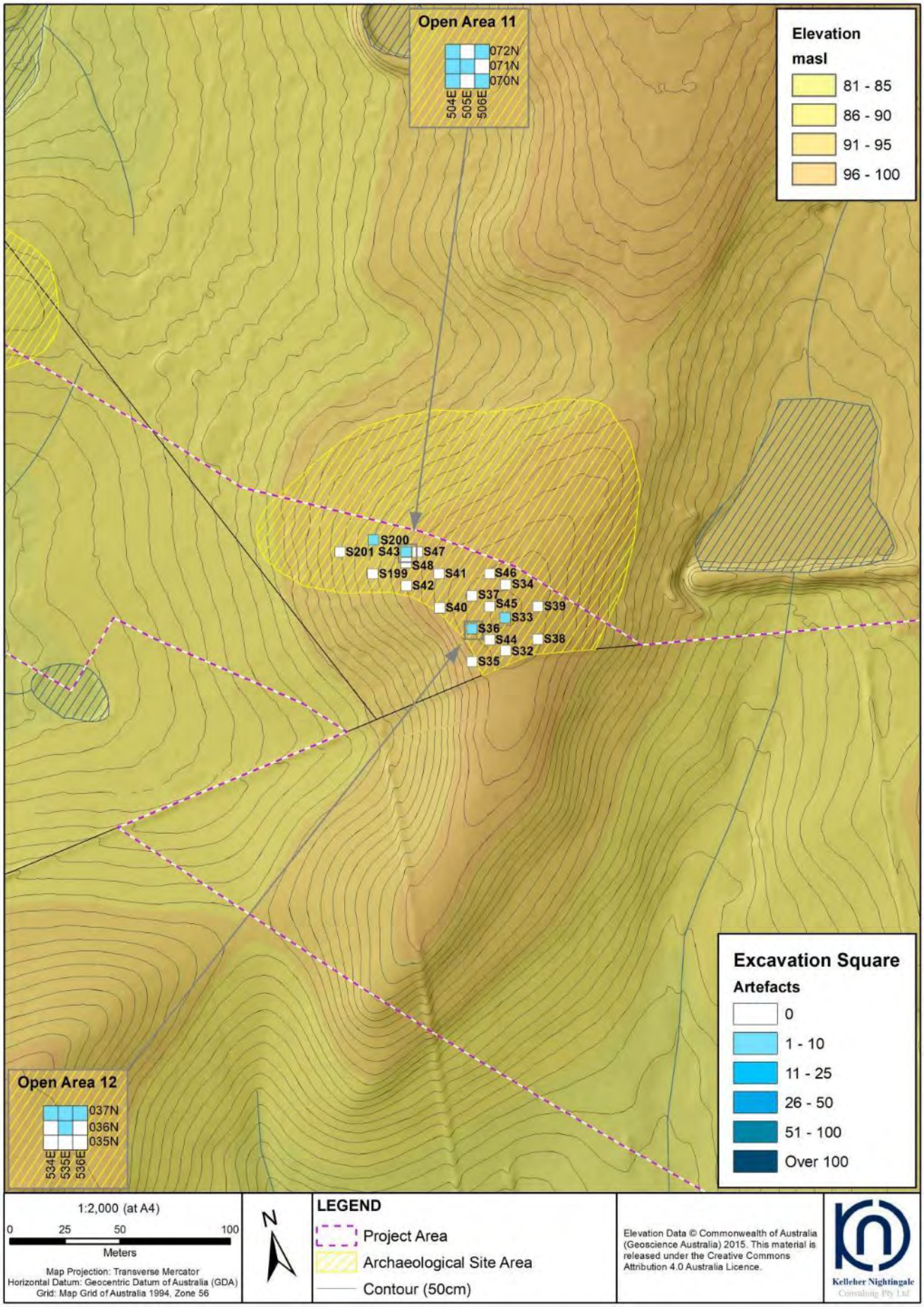
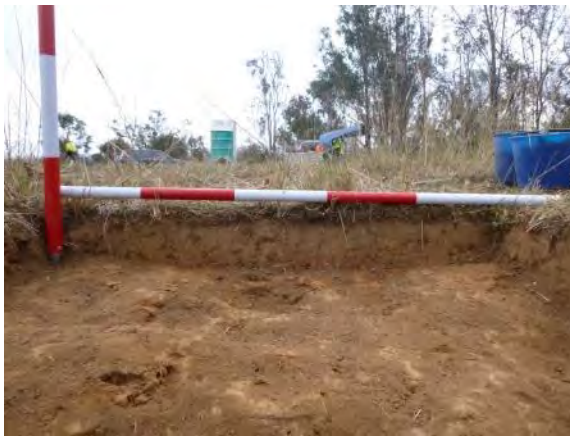


Figure 14. TNR AFT 30 excavation results



S34 west section

S38 north section

S48 north section

S201 north section

OA11 west section and base

OA12 south section and base

Plate 27. Representative section profiles and open areas, TNR AFT 30

7.6.2 Phase 1 results

A total of 20 1x1m Phase 1 squares were excavated during the initial stage of salvage. These were made up of 20 quad units (each 0.25m^2) and their 20 accompanying 0.75m^2 S square extensions. Phase 1 squares were aligned at 15m intervals along several short transects running approximately north south across the crest and to the north west down onto the upper slope. Square positions were staggered between adjoining transects to ensure maximum coverage of the landform and site area.

A total of 7 artefacts were recovered during the Phase 1 program, giving a very low mean artefact density across the Phase 1 sample of 0.3/m^2. Artefacts were present in just four of the 20 excavated squares (20% of squares); two on the crest (S33 and 36) and two on the adjoining slope (S43 and 200). Three squares had a density of two artefacts (S33, 36 & 43) with only one found in S200. Both S33 and S36 on the crest contained artefacts both in the initial NW quad unit and in the subsequent S-square extension. At S43 the quad unit contained 2 artefacts while the rest of the square was empty, while at S200 the single artefact was located within the S-square extension and the initial quad did not contain any artefacts. In total, 18 of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive).

Table 32. TNR AFT 30 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S32	0	0	**0**	S42	0	0	**0**
S33	1	1	**2**	S43	2	0	**2**
S34	0	0	**0**	S44	0	0	**0**
S35	0	0	**0**	S45	0	0	**0**
S36	1	1	**2**	S46	0	0	**0**
S37	0	0	**0**	S47	0	0	**0**
S38	0	0	**0**	S48	0	0	**0**
S39	0	0	**0**	S199	0	0	**0**
S40	0	0	**0**	S200	0	1	**1**
S41	0	0	**0**	S201	0	0	**0**
Site Total	**4**	**3**	**7**				

Phase 1 excavations recovered a range of raw materials and artefact types despite the very low artefact count from the sample. Silcrete was the most common raw material type (n=5, 71.4%) along with single occurrences of Tuff and Quartz. Interestingly, cores were the most common reduction type (n=3) followed by flake fragments (medial and distal, n=1 each) along with one non-diagnostic angular fragment and one whole flake of quartz.

Table 33. TNR AFT 30 Phase 1 Reduction and material summary

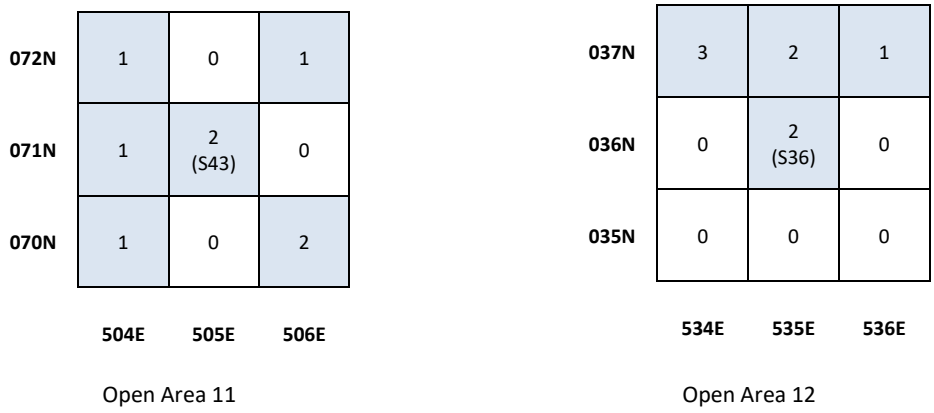
Reduction Types	Core	Whole flake	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	3	0	1	0	1	5 (71.4%)
Tuff	0	0	0	1	0	1 (14.3%)
Quartz	0	1	0	0	0	1 (14.3%)
Total	**3 (42.8%)**	**1 (14.3%)**	**1 (14.3%)**	**1 (14.3%)**	**1 (14.3%)**	**7**

Two of the Phase 1 squares were subsequently selected for Phase 2/3 open area expansion. Open Area 11 (OA11) was expanded around S43 which contained two silcrete cores. Open Area 12 (OA12) was expanded around S36 which contained two silcrete artefacts and displayed a good depth of intact soil structure.

7.6.3 Phase 2/3 results

Two areas of Phase 2/3 excavation were undertaken at the site: Open Area 11 and Open Area 12. Each comprised an 8m^2 extension to the selected Phase 1 squares to create two 3m x 3m (9m^2) open areas (Figure 15). In total, 16 additional 1m^2 squares were excavated as part of the Phase 2/3 program.

An additional 12 artefacts were recovered by the Phase 2/3 program, with six in each Open Area. The highest density was 3 at 534E 037N in OA12, with all other positive squares containing 1-2 artefacts. Both open areas displayed mean artefact densities of 0.75/m^2 or 1/m^2 including the Phase 1 squares.



Open Area 11 Open Area 12

Figure 15. TNR AFT 30 artefact distribution in open areas

Almost all artefacts recovered from the site were silcrete (n=17) with one tuff and one quartz artefact also recovered also from the Phase 1 sample. The majority of artefacts were flake fragments (42.1%), complete flakes (26.3%) and a high percentage of cores (26.3%). One angular fragment was identified.

Table 34. TNR AFT 30 Phase 1 & 2/3 Raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Total
Phase 1	5 (71.4%)	1 (14.3%)	1 (14.3%)	**7 (36.8%)**
OA11	6 (100%)	0	0	**6 (31.6%)**
OA12	6 (100%)	0	0	**6 (31.6%)**
Total	**17 89.4%**	**1 5.3%**	**1 5.3%**	**19**

Table 35. TNR AFT 30 Phase 1 & 2/3 Reduction Types

Reduction Types	Cores	Whole flakes	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	5	4	2	5	1	17
Tuff	0	0	0	1	0	1
Quartz	0	1	0	0	0	1
Total	**5 (26.3%)**	**5 (26.3%)**	**2 (10.5%)**	**6 (31.6%)**	**1 (5.3%)**	**19**

Complete flakes ranged in size between 11-25mm with the largest being a silcrete flake with a percussion length of 21.5mm and a weight of 2.29g. Cortical artefacts were confined to the silcrete assemblage and comprised a relatively high 41.2% of that assemblage (n=7). Four of these displayed 1-30% cortex, two displayed 31-69% cortex and one angular fragment with 70-99% cortex.

Table 36. TNR AFT 30 Flake size range Phase 1 & 2/3

Flake size ranges	11-15mm	16-20mm	21-25mm	Total
Phase 1	0	1	0	1
Phase 2/3	1	2	1	4
Total	**1 (20%)**	**3 (60%)**	**1 (20%)**	**5**

Table 37. TNR AFT 30 Cortical Artefacts Phase 1 & 2/3

Raw Materials	Silcrete	Tuff	Quartz	Total
TNR AFT 30 all artefacts	17	1	1	19
Artefacts with cortex	7 (41.2%)	0	0	7 (36.8%)

All cores were found within the silcrete assemblage with three recovered from the Phase 1 excavation and two from Phase 2/3 Open Area 11. Core sizes were generally small with maximum sizes ranging between 16-30mm. The largest was a 1-30% cortical multi-directional core (25.4mm) with a weight of 4.79g and two negative scars. A number of flaking patterns were identified on cores including two multi-directional, one unifacial, one unifacial-rotated and one flake core (a flake that has then been used as a core). The most intensively reduced core was the multi-directional example with four negative scars. All other cores had two or fewer negative scars.

No modified artefacts were recovered from TNR AFT 30.

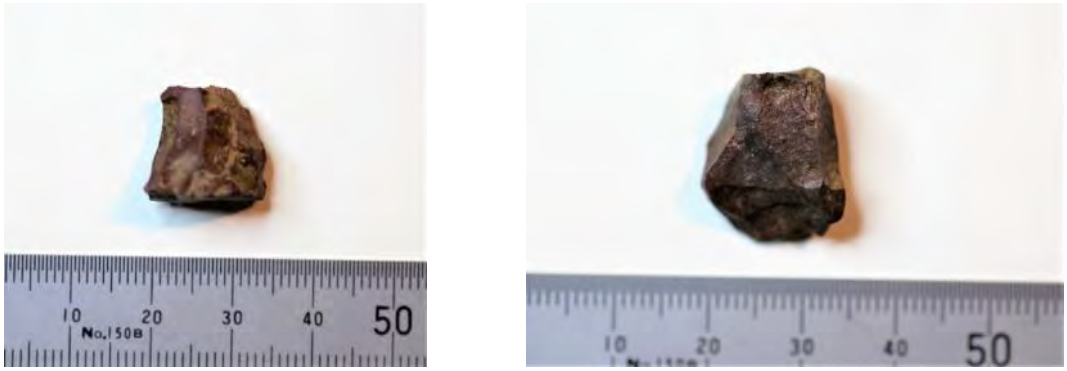


Plate 28. TNR AFT 30 – (L) #145 Silcrete unifacial-rotated blade core, (R) #146 Silcrete multidirectional core

7.6.4 TNR AFT 30 Summary

As with many of the crest and ridgetop sites within the study area, site TNR AFT 30 yielded a very low density of artefacts within both the Phase 1 and Phase 2/3 excavations. The low density of archaeological material, despite the mostly intact soil profile and low levels of disturbance, suggests previous land clearing, ploughing and erosion may have removed surface level artefacts, however regional modelling indicates that sites along crests and ridges tend to display low artefact densities as a function of past human behaviour in these locations. A notable finding from TNR AFT 30 was the high percentage of cores within the assemblage (26%), although this must be taken into context with the small sample size. However, core sizes were small and probably discarded once they were too small to be further reduced. The lack of any backed or retouched artefacts indicate that no specific activity was being undertaken in this area and as with TNR AFT 29 the ridge and crest was likely used as a route to pass through the landscape.

7.7 TNR AFT 31 (AHIMS 45-5-4802)

Site TNR AFT 31 was located on the crest and upper slopes of a low western spur overlooking the junction of two unnamed channels, which constitute parts of the Duncans Creek system (Figure 16). The spur projects into the creek valley separating the higher ridges containing neighbouring sites TNR AFT 29 to the north west and TNR AFT 30 to the south east.

The site is situated within Lot 1 DP838361, Lot 27 DP259698 and Lot 28 DP259698, approximately 380 metres south-east of the intersection of Willowdene Avenue and Vicar Park Lane. Similar to TNR AFT 30, the site was limited to the archaeological deposit along the crest.

Modern disturbance was mostly limited to vegetation clearance, erosion along tracks and construction of fencing. A moderate depth of soil was evident across the landform with the site assessed as having moderate archaeological potential. The original survey identified one silcrete flake along a fenceline exposure on the crest.

TNR AFT 31 Quick Reference	
Creek system	**Landforms**
Duncans Creek	Crest
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
25 squares Total 25 m^2	1 open area Total 50m^2
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
20 total artefacts Mean density 0.8/m^2	87 total artefacts Mean density 1.7/m^2
Phase 1 & 2/3 combined	
Total sample: 75 m^2, 107 artefacts Mean density 1.4/m^2	

Plate 29. (Main picture) View east towards site on crest (arrowed) from dam edge. (Top right) View north down slope towards creek valley, S115 in foreground. (Lower right). S122 completed, view south towards crest.

7.7.1 Soils, landform and disturbance

Soil profiles varied across the landform. Squares excavated to the south of the fenceline in the cleared paddock (S22-31) showed good structural development with clear differentiation of sub-units within the A horizon. Squares were an average of 14-20cm deep apart from S27 which displayed a shallow, skeletal profile >6cm deep. Typical profiles comprised up to 5cm light to medium chocolate brown silty loam topsoil with abundant grass roots and occasional fine Fe/Mn gravels <5%. Scattered charcoal flecking was present in most squares. The topsoil was underlain by an orange-brown clayey silt grading to a silty clay, with increasing clay content and chroma with depth. This contained Fe/Mn gravels between 10-30%, frequent charcoal flecking and small nodules with occasional concentrations associated with burnt root channels. Larger, angular ironstone coarse fragments were also present in lower levels. The basal clay comprised a richly coloured orange- to red-brown clay to silty clay with Fe/Mn at 5% and ironstone fragments at 2%, with some evident bioturbation.

The majority of squares excavated on the slope to the north of the fenceline were slightly shallower (c. 10-15cm) and were missing the better developed topsoil evident on the crest. Profiles on the slope comprised a single unit of heavily bioturbated orange-brown silty clay loam with up to 10% angular ironstone gravels. Soils were compact and clay content increased towards the base. Scattered Fe/Mn and charcoal also occurred, along with baked clay nodules. B horizon comprised undulating, bioturbated red-brown clay. The three northernmost squares excavated towards the base of the slope were deeper and displayed a higher silt content, comprising pale orange-brown silty loam above silty clay. S116 contained some glass and ceramic sherds but other evident disturbance was limited to bioturbation and tree activity.

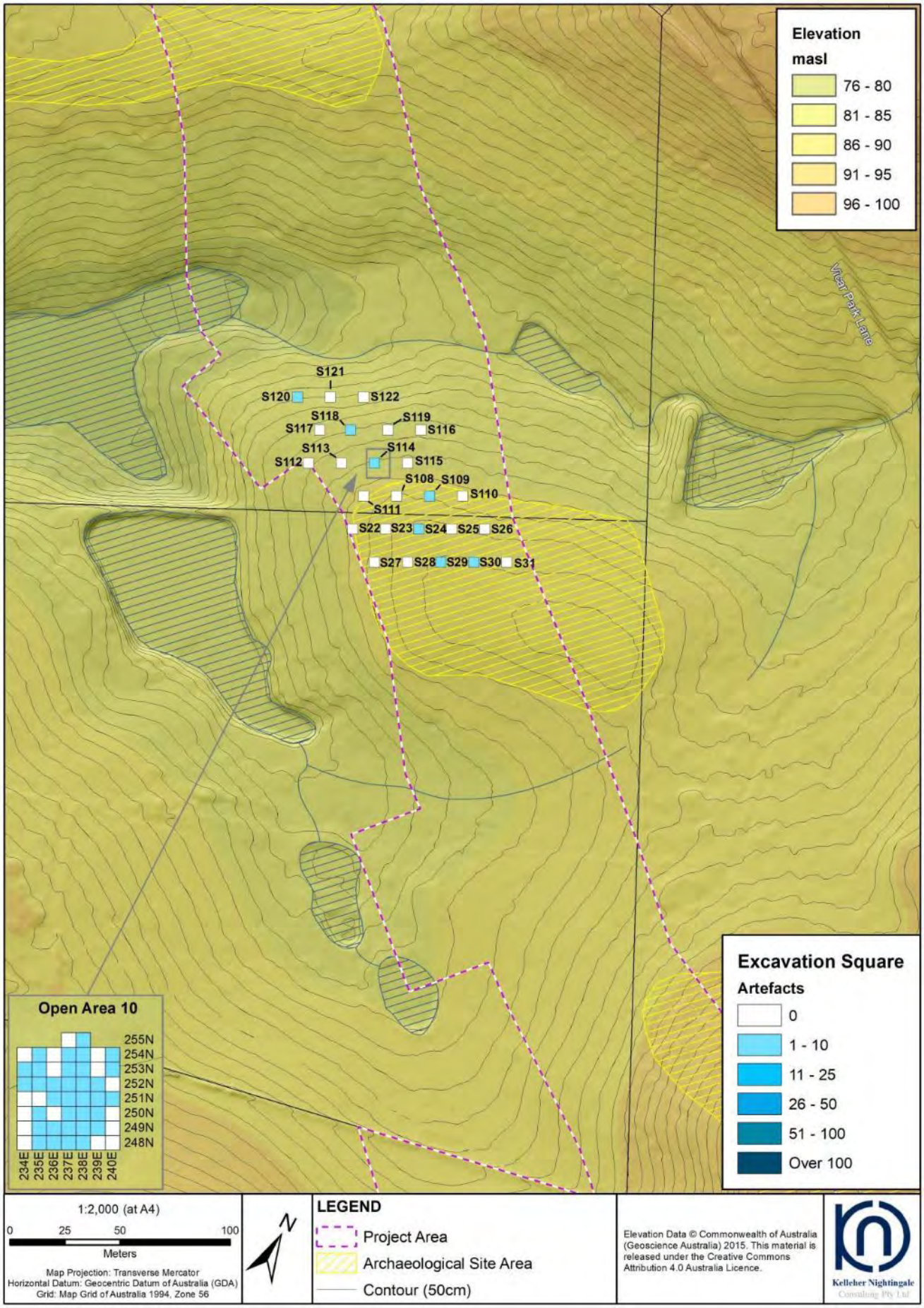


Figure 16. TNR AFT 31 excavation results

S22 north section

S26 east section

S113 south section

S120 south section

OA10 north section and base (after rain)

OA10 240E 249N east section (after rain)

Plate 30. Representative section profiles and open area, TNR AFT 31

7.7.2 Phase 1 results

A total of 25 1x1m Phase 1 squares were excavated at TNR AFT 31 during the initial salvage stage. These included 25 quad unit (each 0.25m^2) and the corresponding 25 x 0.75m^2 S square extensions, for a total of 25m^2 Phase 1 salvage excavation. Six transects were aligned approximately east-west across the site area on both sides of the fenceline. The paddock to the south of the fenceline was cleared pasture while the northern portion of the site was vegetated with regrowth trees. Phase 1 squares were spaced at 15m intervals along the transects (with occasional small offsets necessary to avoid trees north of the fenceline), and staggered by 5m between transects. The two transects located south of the fenceline contained five squares each while those to the north of the fenceline contained 3-4 squares.

A total of 20 artefacts were recovered during the Phase 1 program, giving a mean artefact density across the Phase 1 sample of 0.8 artefacts/m^2. Artefacts were identified in only seven of the 25 completed 1x1m squares (28% of squares), spread across the sample area at low densities.

The highest density of artefacts was identified at S114 which contained 5 artefacts, followed by S24 and S30 (each n=4) and S29 (n=3) in the cleared paddock south of the fenceline. The remaining positive squares from the treed area contained lower densities with 1-2 artefacts present in S109, S118 and S120.

From the seven Phase 1 squares that contained artefacts, only two (28%) contained artefacts in the initial quad unit (S29 and S109) Both of these went on to also contain artefacts in their corresponding S-square extensions. In the remaining five squares, the initial quad unit was empty and artefacts were only identified when the quad was expanded to a 1x1m. In total, 18 of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (i.e. both NW quad and S-extension were negative, or both were positive).

Table 38. TNR AFT 31 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S22	0	0	**0**	S111	0	0	**0**
S23	0	0	**0**	S112	0	0	**0**
S24	0	4	**4**	S113	0	0	**0**
S25	0	0	**0**	S114	0	5	**5**
S26	0	0	**0**	S115	0	0	**0**
S27	0	0	**0**	S116	0	0	**0**
S28	0	0	**0**	S117	0	0	**0**
S29	1	2	**3**	S118	0	1	**1**
S30	0	4	**4**	S119	0	0	**0**
S31	0	0	**0**	S120	0	1	**1**
S108	0	0	**0**	S121	0	0	**0**
S109	1	1	**2**	S122	0	0	**0**
S110	0	0	**0**	**Site Total**	**2**	**18**	**20**

The Phase 1 assemblage consisted primarily of silcrete and quartz, found in almost equal proportions comprising nine silcrete artefacts (45%) and eight quartz (40%), with a small number of tuff (n=3) artefacts also recovered. The quartz assemblage was more fragmented with the majority being distal or angular fragments with one complete flake, compared to the silcrete assemblage which was comprised of over 50% complete flakes (n=5) and one core. As well as the silcrete example, one tuff core was also identified, with both having two negative scars. The tuff core was identified as bipolar. Both cores displayed no remnant cortex.

Table 39. TNR AFT 31 Phase 1 Reduction and material summary

Reduction Types	Core	Whole flakes	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	1	5	1	0	1	1	**9 (45%)**
Tuff	1	0	1	1	0	0	**3 (15%)**
Quartz	0	1	0	0	4	3	**8 (40%)**
Total	**2 (10%)**	**6 (30%)**	**2 (10%)**	**1 (5%)**	**5 (25%)**	**4 (20%)**	**20**

One of the Phase 1 squares was subsequently selected for Phase 2/3 open area expansion.

Open Area 10 (OA10) was expanded around S114, which contained the highest artefact count from the Phase 1 program (n=5) suggesting a localised higher density at this location. Artefacts included a silcrete core and flake debitage with varying levels of cortex.

7.7.3 Phase 2/3 results

One area of Phase 2/3 excavation was undertaken at the site: Open Area 10. In total, an additional 50m^2 of excavation was completed as part of Phase 2/3 salvage (Figure 17). OA10 comprised a large irregularly shaped open area expansion of 50m^2 around SS114, creating a contiguous open area of 51m^2. A total of 92 artefacts were recovered from OA1 (including S114), giving a mean artefact density of 1.8/m^2. Excluding S114, mean artefact density was 1.7/m^2. Most of the OA10 squares contained low densities of 5 or fewer artefacts, with the localised high point present to the east of the Phase 1 square at 238E 251N (n=10) and two adjoining squares containing >5 artefacts (239E 251N and 238E 250N). Seventeen excavated squares contained no artefacts, mostly on the periphery of the open area.

The results of the Phase 2/3 salvage confirmed the Phase 1 findings of a mostly low density and relatively dispersed deposit, with no concentrations of artefacts or higher density activity areas identified during either dispersed Phase 1 or contiguous Phase 2/3 excavation.

255N				0	2		
254N	0	1	0	2	4	0	2
253N	1	2	0	4	2	0	1
252N	1	3	4	5	4	1	0
251N	0	0	1	5 (S114)	10	8	1
250N	0	1	0	3	6	1	0
249N	0	1	2	3	3	1	0
248N	0	2	2	1	2	0	0
	234E	**235E**	**236E**	**237E**	**238E**	**239E**	**240E**

Open Area 10 (n=92 including S114)

Figure 17. TNR AFT 31 artefact distribution in open area

The raw materials retrieved from OA10 were the same mixture as found in the Phase 1 excavation, although silcrete was the most prominent raw material comprising 80.4% (n=70) of the Phase 2/3 assemblage. Lower numbers of quartz (n=13) and tuff (n=4) were also recovered. As with the Phase 1 excavation the quartz assemblage was highly fragmented although one bipolar core was identified.

Table 40. TNR AFT 31 Phase 1 & 2/3 raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Total
Phase 1	9 45%	3 15%	8 40%	20 18.7%
OA10 (Phase 2/3)	70 80.5%	4 4.6%	13 14.9%	87 81.3%
Total	**79** **73.8%**	**7** **6.5%**	**21** **19.6%**	**107**

Overall, flake fragments comprised the majority of the Phase 2/3 assemblage (67.4%) with a low percentage of angular fragments (7%) and a relatively low number of complete flakes (n=12, 14%). The number of cores identified, however, was high with most being silcrete (n=9) and one quartz, comprising 11.6% of the assemblage.

Table 41. TNR AFT 31 Phase 2/3 Reduction Types

Reduction Types	Core	Whole flakes	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	9	11	7	5	33	5	**70 (80.5%)**
Tuff	0	1	0	1	1	0	**4 (4.6%)**
Quartz	1	0	0	2	9	1	**13 (14.9%)**
Total	**10 (11.6%)**	**12 (14%)**	**7 (8.1%)**	**8 (9.3%)**	**43 (50%)**	**6 (7%)**	**87**

Table 42. TNR AFT 31 Phase 1 & 2/3 reduction summary

Reduction Types	Complete flakes	Flake fragment	Angular fragment	Cores	Total
Phase 1	6 30%	8 40%	4 20%	2 10%	20 18.7%
Phase 2	12 13.8%	59 67.8%	6 6.9%	10 11.5%	87 81.3%
Total	**18** **16.8%**	**67** **62.6%**	**10** **9.3%**	**12** **11.2%**	**107**

Silcrete was the most common raw material throughout the combined salvage assemblage, although primarily within the open area assemblage. Only two other raw materials, tuff and quartz were represented in the assemblage. The most common reduction types were flake fragments comprising 62.6% of the assemblage (n=67) including proximal, medial and distal fragments, with a relatively low number of angular fragments (n=10, 9.3%). Complete flakes comprised 16.8% of the entire assemblage. There was a higher than average number of cores identified (n=12) comprising 11.2% of the assemblage.

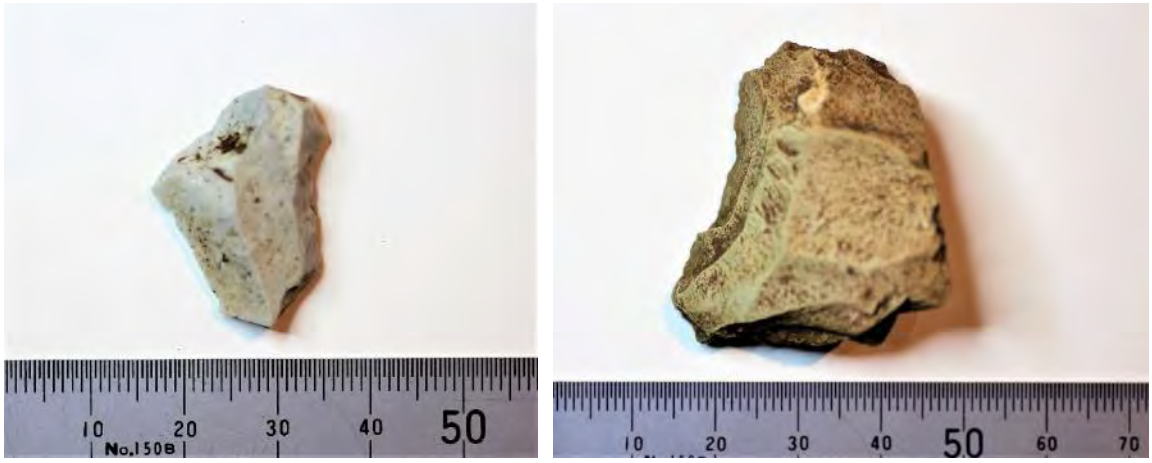


Plate 31. (L) #149 White silcrete retouched flake, (R) #554 Heavily weathered silicified tuff distal fragment

Flake sizes were generally small, with the majority (77.8%) having a maximum dimension of less than 20mm, with one silcrete flake less than 10mm. The largest flake was retouched and found within the tuff assemblage in the open area, with a maximum dimension of 31-35mm and a percussion length of 27.4mm. One silcrete flake had 100% cortex, indicating that some primary reduction was occurring on site.

Table 43. TNR AFT 31 Flake size

Flake size ranges	6-10mm	11-15mm	16-20mm	21-25mm	26-30mm	31-35mm	Total
Phase 1	0	2	1	3	0	0	**6**
Phase 2/3	1	6	4	0	0	1	**12**
Total	**1** **5.6%**	**8** **44.4%**	**5** **27.8%**	**3** **16.7%**	**0**	**1** **5.6%**	**18**

The number of cortical artefacts within the silcrete assemblage was 25 (31.6%) with the lowest number found within the quartz assemblage (14.3%). The frequency of cortical artefacts within the tuff assemblage was high at 42.9%, however the low numbers of tuff artefacts are not statistically meaningful. Overall cortical artefacts comprised 29% of the assemblage. These mostly displayed 1-30% cortex (n= 20, 64.5% of cortical artefacts), with lower numbers of 31-69% cortex (n=7), 70-99% cortex (n=3) and the aforementioned 100% cortical silcrete flake.

Table 44. TNR AFT 31 Cortical artefacts

Raw Materials	Silcrete	Tuff	Quartz	Total
All Artefacts Phase 1 & 2	79	7	21	107
Artefacts with cortex	25 31.6%	3 42.9%	3 14.3%	31 29%

Cores (n=10) represent over 11% of the assemblage and were found primarily within the silcrete assemblage, with one tuff and one quartz core. Core flaking patterns were varied, including two unifacial, one unifacial-rotated, three multi-directional, one bidirectional, one bifacial and two bipolar. Two core fragments were also identified within the silcrete assemblage, and one of these displayed three partial scars. Core sizes were generally small, with all but one having maximum dimensions of between 20-30mm. The largest core was a silcrete unifacial core between 31-35mm in size with two negative scars and no cortex. One other unifacial core, silcrete, had an elongate (blade) negative scar. Most cores displayed low intensity use with between 1-2 negative scars although it is likely that most of the cores were wasted, or in other words at the limit of their functional usefulness. One silcrete unifacial core had four negative scars. A total of six cores retained cortex (50% of the core assemblage).

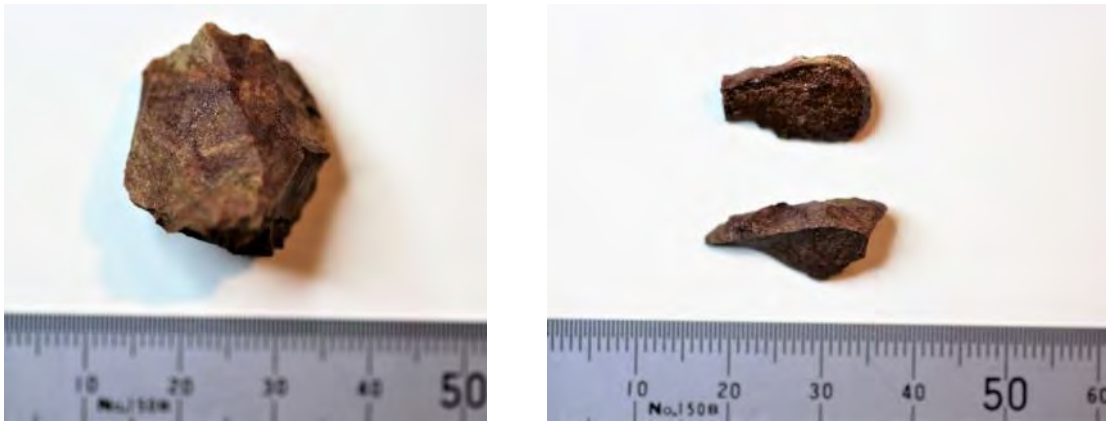


Plate 32. AFT 31 – (L) #598 Silcrete unifacial-rotated core, (R) #559 & #574 Silcrete backed blade fragments – proximal (upper) distal (lower).

A total of nine modified artefacts were identified at the site, comprising 8.4% of the total assemblage, a higher than average ratio compared to other similar sites in the region. Most were located in OA10 (n=8), with most modified artefacts found within the silcrete assemblage (n=8) and one tuff retouched flake. Five backed artefacts were identified, including one complete blade (poorly formed), three blade fragments and one geometric microlith. The four retouched artefacts were non-formal, meaning they had various levels and types of retouch but no specific typology (such as scraper).

Table 45. TNR AFT 31 Modified artefacts

Modified Artefacts	Backed			Retouched		Hammerstone / Axe Hatchet Frag.	Total
	Blade (F)	Geometric	Elouera	Non Specific	Scraper		
Phase 1	0	0	0	1	0	0	**1 11.1%**
Phase 2/3	4	1	0	3	0	0	**8 88.9%**
Total	**4 44.4%**	**1 11.1%**	**0**	**4 44.4%**	**0**	**0**	**9**

7.7.4 TNR AFT 31 Summary

Site TNR AFT 31 was the central site in a complex of sites including TNR AFT 29 to the north and TNR AFT 30 to the south. Like these other sites located on crests, TNR AFT 31 displayed a low-density artefact scatter across the landform although with a relatively higher artefact number than AFT 29 and 30. One characteristic in common to all three sites was the elevated percentage of cores within the assemblage, in this case 11.2%. All tending to be small and underutilised, with some exceptions. One of the cores was identified as having an elongate scar, possibly representing some tool manufacturing occurring on site, although the tools recovered were most likely being utilised and discarded due to breakage or through use. The number of cortical artefacts was relatively high, specifically among the core assemblage. This high level of cortex suggests that there was some limited access to lithic raw material in the area, which may be why there was a slightly higher number of artefacts on this site compared to AFT 29 and 30, possibly a place within the landscape to replenish and curate stone resources. Overall however, site TNR AFT 31 appears to a part of a cultural pathway between larger more long term occupation sites.

7.8 B6 (AHIMS 45-5-2636)

B6 Quick Reference	
Creek system	**Landforms**
Badgerys Creek	Lower slope and flat
Phase 1 sample	**Phase 2/3 sample (not incl. Phase 1)**
42 squares Total 42 m^2	5 open areas Total 117m^2
Phase 1 artefacts	**Phase 2/3 artefacts (not incl. Phase 1)**
316 total artefacts Mean density 7.5/m^2	2754 total artefacts Mean density 23.5/m^2
Phase 1 & 2/3 combined	
Total sample: 159m^2, 3070 artefacts Mean density 19.3/m^2	

Site B6 was previously recorded by Navin Officer in 1997 and was revisited during the KNC survey (2016) to assess site condition and to define the site boundary in relation to the project area corridor for The Northern Road upgrade. Modern disturbance from road construction, drainage cuttings and the installation of utilities had disturbed the landform in the vicinity of The Northern Road and effectively bisected the site.

The site area was located on a lower slope and flat with a northerly aspect adjacent to Badgerys Creek, along both creek banks and both sides of the creek on either side of The Northern Road. B6 was situated within Lot 1 DP838361, Lot 92 DP27550 and Lot 2 DP1232438, and within adjacent areas of The Northern Road corridor (Figures 18 and 18a). Despite the disturbances already described, the remainder of the site had low levels of disturbance and was assessed as having moderate archaeological potential. A number of surface artefacts had been previously recorded at the site, including a mudstone multiplatform core, one chert flake and one quartz flake. The salvage areas were situated on both the northern and the southern sides of the Northern Road corridor adjacent to the creek.

Plate 33. (Main picture) OA3, view to north across site area to creek from the Northern Road (Top right) View south east across Phase 1 transects to creek, S53 in foreground. (Lower right) S195 completed, view west to The Northern Road, Badgerys Creek at left.

7.8.1 Soils, landform and disturbance

To the north of The Northern Road soil profiles showed some slight variation between the northern and southern parts of the site on either side of the creek but shared the same basic characteristics. Average depth of Phase 1 test squares was around 20-25cm with some shallower examples along the northern side of the creek. Typical soil profiles on the northern side of the creek comprised a sandy to silty loam humic topsoil above an A unit of pale grey to pale brown silty loam with frequent Fe/Mn inclusions. Ironstone and other gravels were present in all squares between 30-50 metres from the creek (S49, 50, 54, 55, 58 and 194) but were mostly absent in other squares. Squares excavated on the western transects (S49-57) displayed a lower A unit of orange brown silty clay loam while squares to the east did not. The B unit comprised compact orange-brown clay. Charcoal and baked clay were abundant and often concentrated in root channels near the basal clay, with large baked clay deposits in S55 and 194 in particular.

On the southern side of the creek, deposit comprised grey brown silty loam with Fe/Mn inclusions throughout. Squares along the western transect closer to the creek (S59-61) displayed a similar orange-brown lower A unit as squares to the north but this disappeared to the east and south, where the silty loam directly overlay a yellow clay base. Squares displaying ironstone gravels were scattered across the transects without the obvious patterning seen to the north. Charcoal and baked clay were common, particularly in S60, 61 and 189.

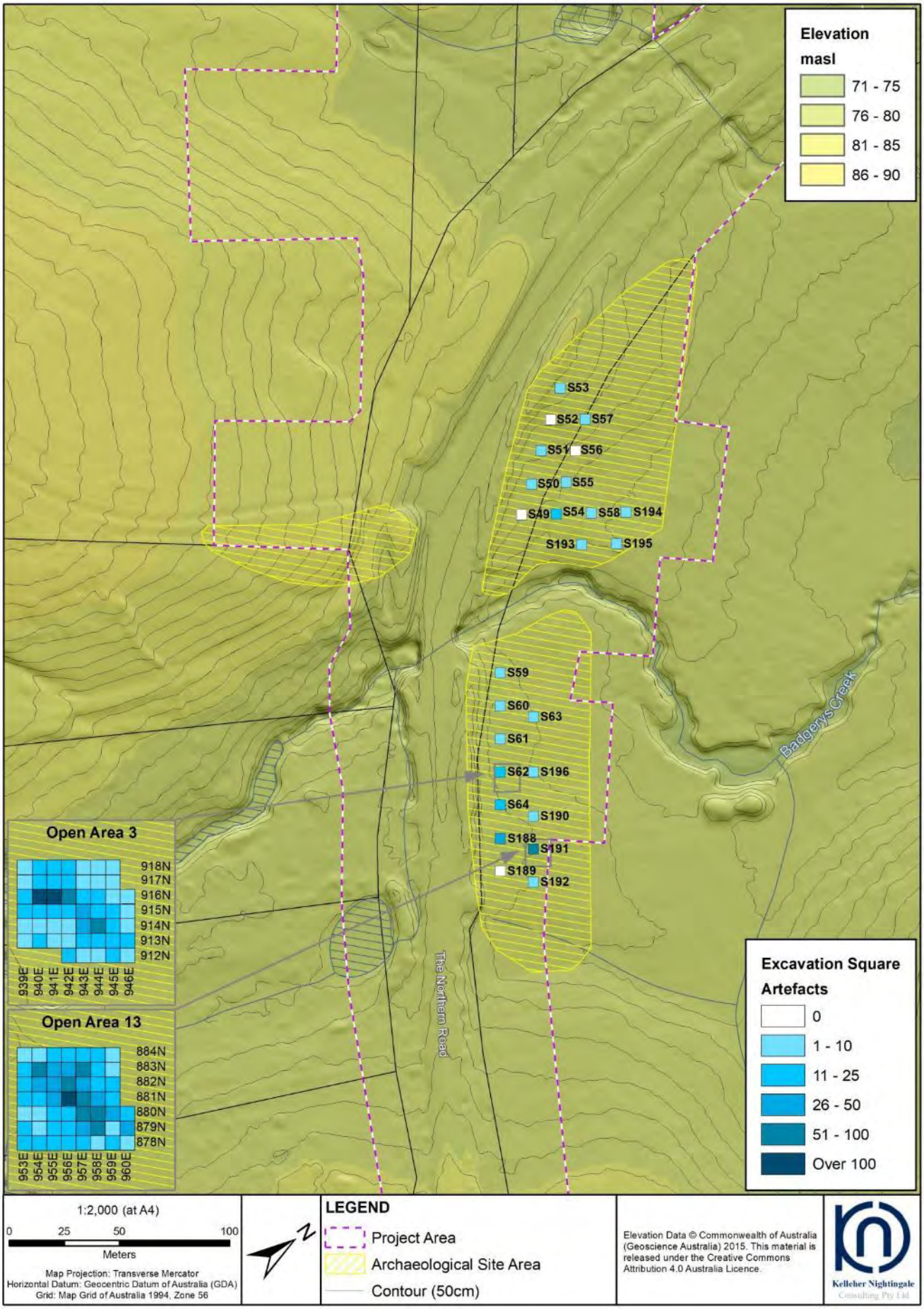


Figure 18. B6 excavation results (north of The Northern Road)

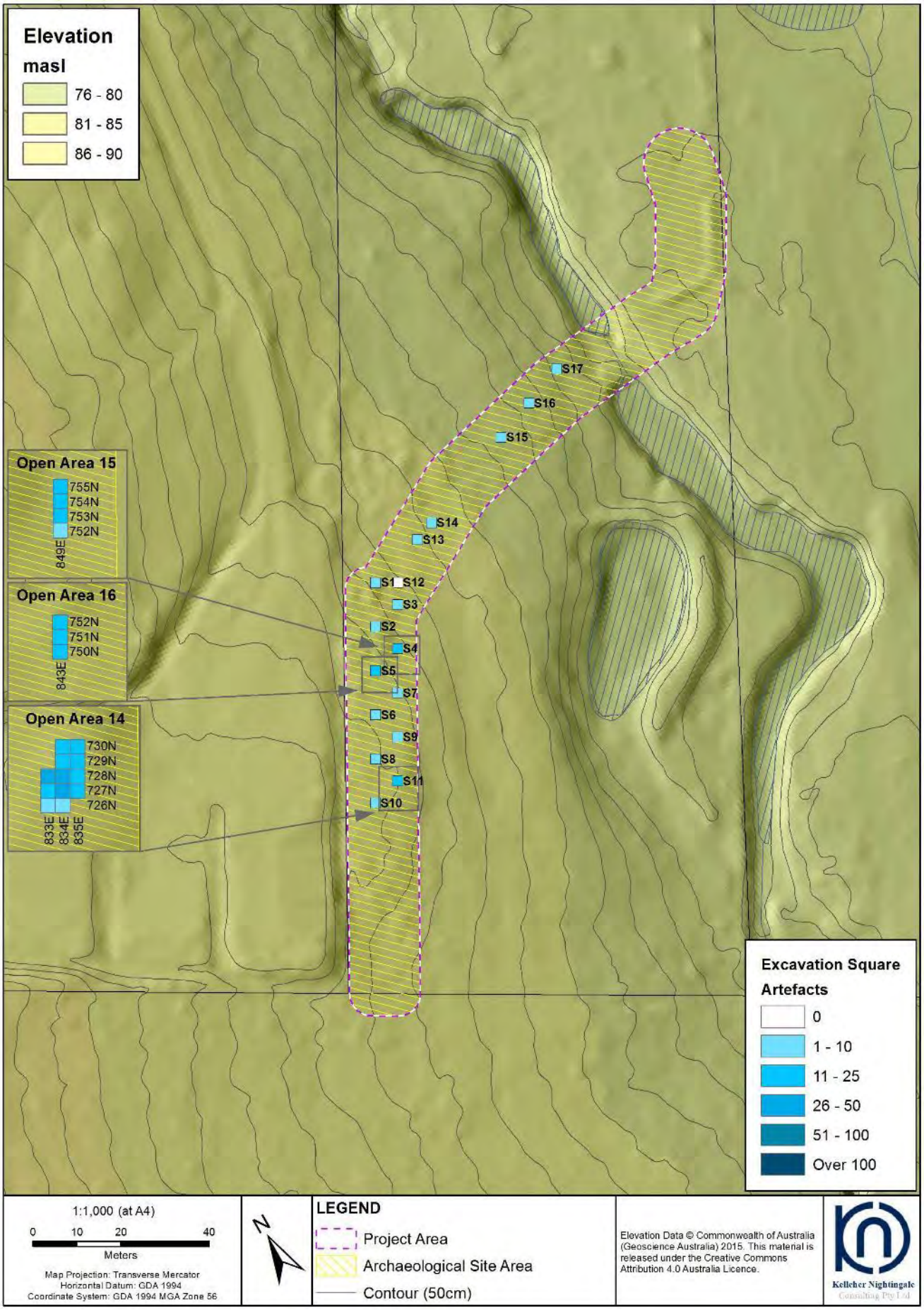


Figure 18a. B6 excavation results (south of The Northern Road)

Plate 34. Southern side of The Northern Road (Top) Excavated OA16, facing south-west, range poles at southern section, Badgerys Creek in the background (Left) S17 in the foreground, adjacent to Badgerys Creek, facing north (Top right) Excavated OA15, facing west towards Badgerys Creek (Middle right) S5 in the foreground, with S6, 8 and 10, and S7, 9 and 11 to the left, facing north (Lower right) S12 in the foreground, with S3, 4 and 7 in the background, and S1, 2, 5 and 6 to the right, facing south

Soils at Open Area 13 comprised a medium grey-brown silty clay loam above a bleached A2 horizon of pale grey to pale yellow-brown silty clay loam to clayey silt with abundant Fe/Mn inclusions above a mottled yellow/brown silty basal clay, with charcoal throughout the profile. At Open Area 3, soils comprised grey-brown silty loam to silty clay loam with clay content gradually increasing with depth and scattered Fe/Mn and fine ironstone gravels throughout. The bleached A2 horizon evident at OA13 was absent. B horizon comprised yellow-brown compact clay with small ironstone gravels. Bioturbation at the base of the A unit was evident with clay mixed into to the lower A horizon, as well as large areas of baked clay and charcoal associated with burnt tree roots.

S50 south section

S61 west section

S190 south section

S195 north section

OA13 west section and base

OA3 north section and base

Plate 35. North of The Northern Road - Representative section profiles and open areas, B6

To the south of The Northern Road the site extended on a flat above the floodplain of Badgerys Creek. Disturbances observed comprised a vehicle access track located at the northern site extent, with the majority of the area being subject to deflation of natural soil layers and importation of road gravel. A total of 17 Phase 1 squares were excavated on the southern side of The Northern Road, and three open areas: Open Area 14, Open Area 15 and Open Area 16.

Soil profiles showed some variation in depth and level of soil disturbance. The depths of Phase 1 squares ranged between 17 to 60cm with the shallower, more deflated soils encountered within the northern extent and areas closer to the creek. The majority of squares had mixed soils to an average depth of 25cm, with some introduced gravel and clay mottled with natural soils. These disturbances most likely stem from past agricultural use of the area which has caused horizontal movement and mixture of cultural objects. Typical soil profiles (Plate 36: S5, S14, Open Area 15, Open Area 16) comprised reddish brown silty clay loam with clay nodules to an average of 25cm, overlying greyish brown clay loam with abundance of Fe/Mn gravel and increasing compaction to an average of 35cm, overlying compacted reddish brown clay at the base.

Some pockets of remnant soils that did not contain traces of disturbance, were noted within the southern extent of the salvaged site area (S8, S10 and S11) and within the area adjacent to Badgerys Creek (S15 and S17). Some deflation of the soils was visible within the areas adjacent to the creek, most likely stemming from flooding events. Typical soil profiles (Plate 36: S17, Open Area 14) comprised light greyish brown sandy clay loam to an average depth of 30cm, overlying reddish brown clayey silt to 40cm, overlying mottled clayey silt with reddish brown clay, and red clay at the base. Fe/Mn gravel was abundant from approximately 10cm depth and increased in frequency with depth. Large tree roots were noted within Open Area 14 (Plate 34 and 36) which have caused vertical and horizontal movement of the cultural material.

Overall, soils were found to be generally intact despite the alluvial influence of the adjacent creek, with some evidence for waterlogging/inundation due to low energy flood events. Some textural differentiation of the A horizon on both sides of the creek suggests that regular flood events do not have sufficient energy to strip or completely homogenise the profiles, but strong vertical stratigraphy and depth was absent suggesting likely vertical collapse of archaeological information (i.e. retaining only horizontal spatial integrity). Collapse of burnt root channels and infill, as well as bioturbation, has also contributed to vertical mixing of the deposit in certain areas.

S5 east section

S9 east section

S14 south section

S17 south section

Open Area 14 west section and base

Open Area 14 north section and base

Open Area 15 east section and base

OA16 north section and base

Plate 36. South of The Northern Road – Representative section profiles and open areas, B6

7.8.2 Phase 1 results

Phase 1 salvage at B6 was comprised of 42 1x1m squares made up of 42 quad units (0.25m^2) and the corresponding 42 0.75m^2 S-square extensions. The total amount of Phase 1 salvage excavation was 42m^2. Phase 1 transects were positioned across the lower slope and flats on both sides of the creek and were oriented north-west to south-east and north-east to south-west across the site area on both sides of The Northern Road. On the northern side of The Northern Road, four transects of varying length were placed on the northern side of the creek, with two on the southern side of the creek. Squares were spaced at 15m intervals along each transect, with transects spaced 15m apart. Squares on adjacent transects were staggered by 5m between transects. On the southern side of The Northern Road, a total of three transects were excavated on the northern side of the creek. Squares were spaced at 10m intervals along each transect, with some squares offset due to observed disturbance and the spatial limits of the impact area.

A total of 316 artefacts were recovered from the Phase 1 salvage excavation, yielding a mean artefact density across the Phase 1 sample of 7.5 artefacts/m^2. This was the highest Phase 1 mean density of any of the sites investigated during The Northern Road Upgrade Stage 4 salvage program. Artefacts were recovered from 38 of the 42 completed Phase 1 squares (90% of squares) located across the site. All of the zero squares were located on the northern side of the creek.

The highest artefact density was at S191 which contained 68 artefacts, followed by S188 (n=27), S62 (n=24) and S11 (n=23). Five further squares contained >10 artefacts (S4 and S5 (n=16 each), S54 (n=13), S64 (n=12) and S2 (n=10)). All other positive squares contained fewer than 10 artefacts, the majority fewer than five artefacts (n=24). S11 was the only Phase 1 square on the northern side of the creek which contained more than twenty artefacts. The other higher density squares mentioned above were located on the southern side of the creek at approximately 70-100m from the channel.

Within the 38 positive squares, 14 did not contain any artefacts in the initial 0.25m^2 quad unit but were found to contain artefacts when expanded to 1x1m. S15 and S51 were the only squares that contained artefacts in the initial NW quad (n=1 each) but did not contain further artefacts in the corresponding S-square extension. In total, 26 of the Phase 1 squares showed a presence/absence correlation between the quad units and the completed 1x1m square (*i.e.* both NW quad and S-extension were negative, or both were positive).

Table 46. B6 Phase 1 artefact counts

Unit	NW Quad	S extension	Phase 1 square total	Unit	NW Quad	S extension	Phase 1 square total
S1	0	4	**4**	S53	0	1	**1**
S2	2	8	**10**	S54	0	13	**13**
S3	1	4	**5**	S55	1	2	**3**
S4	3	13	**16**	S56	0	0	**0**
S5	7	9	**16**	S57	0	1	**1**
S6	1	7	**8**	S58	1	1	**2**
S7	0	3	**3**	S59	0	1	**1**
S8	1	3	**4**	S60	0	3	**3**
S9	1	3	**4**	S61	0	4	**4**
S10	0	1	**1**	S62	0	24	**24**
S11	7	16	**23**	S63	1	7	**8**
S12	0	0	**0**	S64	1	11	**12**
S13	2	2	**4**	S188	15	12	**27**
S14	4	2	**6**	S189	0	3	**3**
S15	1	0	**1**	S190	1	2	**3**
S16	0	2	**2**	S191	13	55	**68**
S17	1	4	**5**	S192	2	6	**8**
S49	0	0	**0**	S193	0	1	**1**
S50	3	1	**4**	S194	1	3	**4**
S51	1	0	**1**	S195	3	5	**8**
S52	0	0	**0**	S196	0	5	**5**
				Site Total	***74***	***242***	***316***

Silcrete was the most common raw material comprising 65.5% of the Phase 1 assemblage (n=207). Tuff was represented by 16.2% (n=51), followed by quartz with 10.4% (n=33). Small numbers of chert, petrified wood, quartzite, FGS and mudstone were also recovered.

Flake fragments were the most common reduction type (proximal, medial and distal), comprising just over 52% of the total assemblage (n=166), with complete flakes comprising a relatively high proportion of the assemblage (25.9%). Angular fragments comprised 16.8% of the assemblage while a small number of cores were also identified (n=15, 4.7%).

Cores were found within the silcrete, tuff and quartz assemblages, ranging between 10 and 54mm in maximum size with a red silcrete multi-directional core being the largest. This example weighed 69.19g, did not display any amount of cortex and had nine negative scars. Three modified artefacts were identified, all within the silcrete assemblage, including two backed blade fragments and one retouched artefact.

Table 47. B6 Phase 1 Reduction and material summary

Reduction Types	Core	Whole flakes*	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	12	50	29	27	62	27	207 (65.5%)
Tuff	1	18	3	5	13	11	51 (16.2%)
Quartz	2	6		3	13	9	33 (10.4%)
Chert		6		1	5	5	17 (5.4%)
P. wood		1			1		2 (0.6%)
Quartzite					1		1 (0.3%)
FGS		1		1	1	1	4 (1.3%)
Mudstone				1			1 (0.3%)
Total	**15 (4.7%)**	**82 (25.9%)**	**32 (10.1%)**	**38 (12%)**	**96 (30.4%)**	**53 (16.8%)**	**316**

*includes bipolar and split flakes

Five Phase 1 squares were subsequently selected for Phase 2/3 open area expansion. On the northern side of The Northern Road, two open areas were excavated: Open Area 3 (OA3) was expanded around S62, which contained 24 artefacts in the Phase 1 square including rarer raw material types (petrified wood, quartzite and FGS). Open Area 13 (OA13) was expanded around S191, which contained the highest Phase 1 density of 68 artefacts. Both open areas were located on the lower slope/flat on the southern side of Badgerys Creek, between approximately 90-120m from the channel. On the southern side of The Northern Road, three open areas were excavated. Open Area 14 (OA14) was expanded around S11, which contained 23 artefacts in the Phase 1 square. It contained seven artefacts in the initial 0.25m^2 quad unit (Table 46), including the largest core in the assemblage, and a further 16 artefacts in the expanded S-square. Open Areas 15 and 16 (OA15 and OA16) were expanded around two further squares (S4 and S5 respectively) that contained 16 artefacts each in the Phase 1 excavation. All open areas were located on a flat above the flood zone on the northern side of the Badgerys Creek (Figure 18).

7.8.3 Phase 2/3 results

Five areas of Phase 2/3 excavation were undertaken at site B6 (Figures 18 and 19). In total, 117m^2 of additional Phase 2/3 excavation was undertaken and recovered 2,754 artefacts, for a mean Phase 2/3 artefact density of 23.5/m^2.

On the northern side of The Northern Road, two open areas were excavated: OA3 and OA13. OA3 comprised a 50m^2 expansion to S62 to form a 6 x 7m open area with shorter 1m extensions to the south and east, totalling 51m^2. A total of 1020 Phase 2/3 artefacts were recovered, giving a total artefact count for the open area of 1044 and a mean artefact density of 20.5/m^2 (including S62). Excluding S62, the Phase 2/3 artefact density was 20.4/m^2. OA13 was located to the south east of OA3 and was expanded around S191, selected for expansion due to the highest Phase 1 artefact count of n=68. A total of 51 additional 1x1m squares were extended to form a 7x7m open area with a short 1m extension to the east between 878-880N. In total, OA13 contained 1497 artefacts in 52m^2 and displayed a mean artefact density of 28.8/m^2. Excluding S191, artefact count and mean density for the open area was n=1429 and 28/m^2. All Phase 2/3 squares at both northern open areas were found to contain artefacts. The highest density square was located at OA3 square 941E 916N which contained 152 artefacts. Two adjacent squares also showed a moderate to high density of artefacts (940E 916N n=115 and 942E 916N n=68). A moderate density peak was also evident at 944E 914N to the south east (n=67). No other squares in the open area contained >50 artefacts. In contrast, the highest density square at OA13 was 956E 881N (n=103) however OA13 contained a further seven squares with >50 artefacts, creating a cluster of moderate density squares around the high point adjacent to the original Phase 1 square and a more even distribution of artefacts than at OA3.

On the southern side of The Northern Road, three open areas were excavated: OA14, OA15 and OA16. OA14 comprised an 11m^2 expansion to S11 to form an irregularly shaped open area totalling 12m^2 (Plate 39). S11 was expanded due to the high number (n=23) and range of artefact types recovered from S11. A total of 238 Phase 2/3 artefacts were recovered, giving a total artefact count for the open area of 261 and a mean artefact density of 21.8/m^2 (including S11). Excluding S11, the Phase 2/3 artefact density was 21.6/m^2. OA15 was located to the north of OA14 and was expanded around S4, selected for expansion due to the second highest Phase 1 artefact count of n=16. A total of four additional 1x1m squares were extended to form a 1x4m open area (Plate 40). In total, OA15 contained 56 artefacts in 4m^2 and displayed a mean artefact density of 14/m^2. Excluding S4, artefact count and mean density for the open area was n=40 and 13.3/m^2. OA16 was located to the immediate south-west of OA15 and was expanded around S5, selected for expansion due to the same number of artefacts as S4 (n=16). Two additional 1x1m squares were extended to form a 1x3m open area (Plate 41). In total, OA16 contained 43 artefacts in 3m^2 and displayed a mean artefact density of 14.3/m^2. Excluding S5, artefact count and mean density for the open area was n=27 and 13.5/m^2. All Phase 2/3 squares at all three open areas on the southern side of The Northern Road were found to contain artefacts. The highest density square was located at OA14 834E 728N which contained 46 artefacts. One adjacent square also showed a moderate density of artefacts (834E 728N n=33). No other squares in the southern open areas contained >30 artefacts.

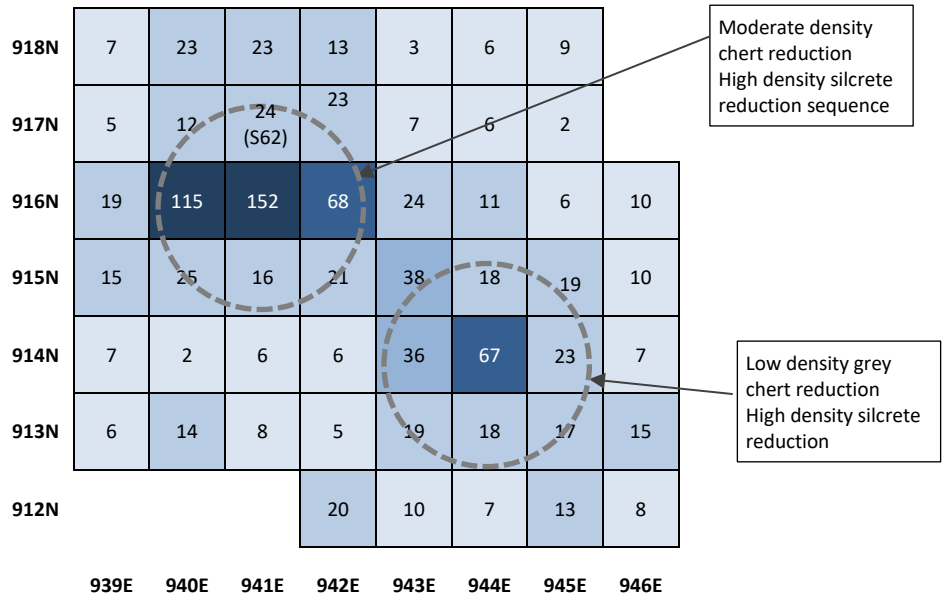
Plate 37. OA3 completed, view west to The Northern Road

Plate 38. OA13 completed, view north to creek at tree line. OA3 visible background left

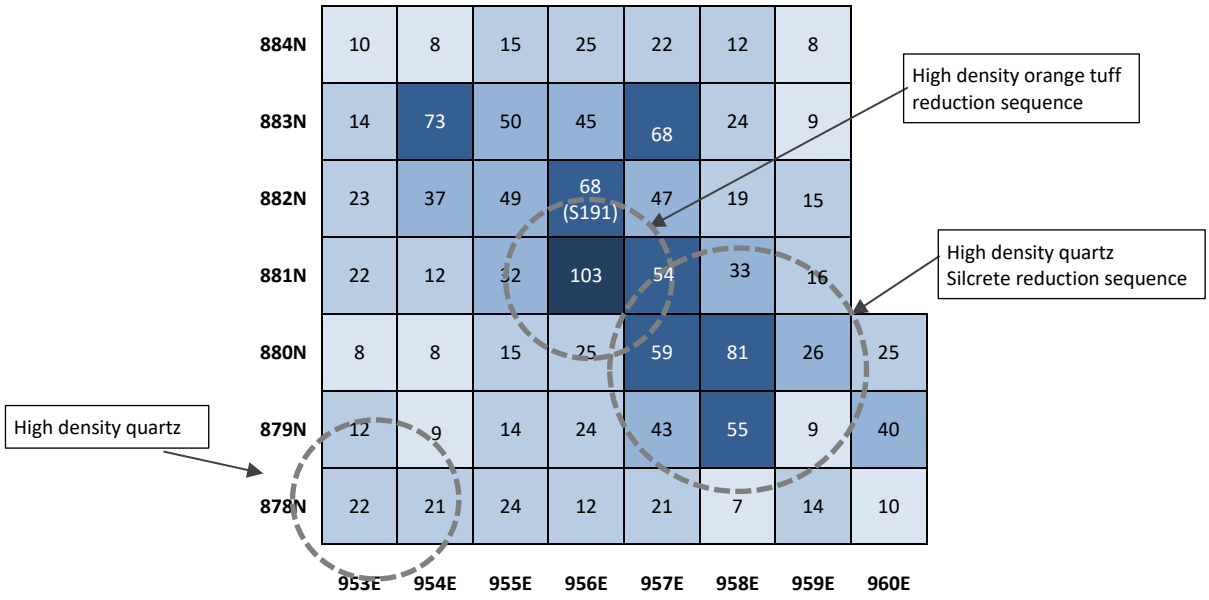
Plate 39. South of The Northern Road - Open Area 14 completed, facing north-east

Plate 40. South of The Northern Road - Open Area 15 completed, facing south-west

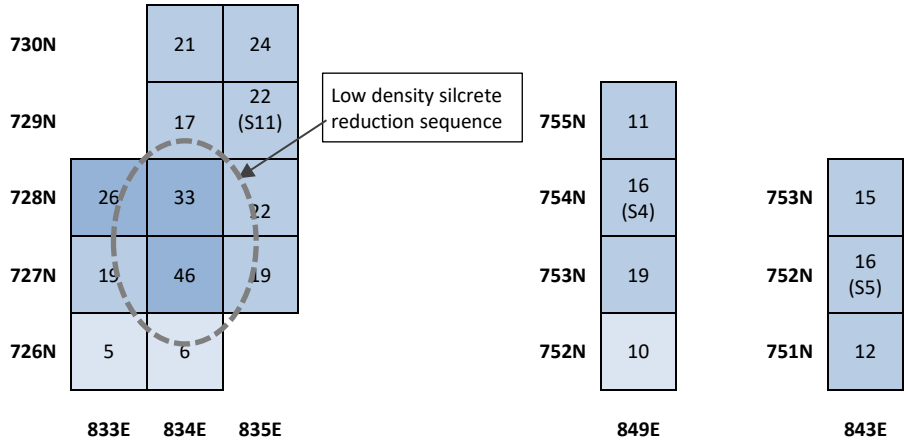
Plate 41. South of The Northern Road - Open Area 16 completed, facing east towards Badgerys Creek



Open Area 3 (n=1044 including S62)



Open Area 13 (n=1497 including S198)



Open Area 14 (n=261 including S11); Open Area 15 (n=56 including S4); Open Area 16 (n=43 including S5)

Figure 19. B6 artefact distribution in open areas and identified events

Within alluvial soil profiles it can be difficult to pinpoint specific events, such as individual reduction sequences or knapping events due to movement of artefacts from flood effects. However, occasionally it is possible to identify individual events due to high densities of specific raw materials. During artefact recording a number of these areas were pinpointed in the open areas of this site.

Two areas were identified in OA3 around the two higher density squares, firstly was a moderate density red/brown and grey/green chert reduction sequence mixed with a high density red/yellow silcrete sequence at 940-941E 916N. The second area was centred around 944E 914N which was a low-density grey chert reduction sequence mixed with a moderate-high density red/yellow silcrete reduction sequence. In OA13 two areas of high density quartz were identified, one of which was also interspersed with a high density silcrete reduction sequence, and a discrete high density orange tuff reduction sequence was located adjacent to S191 at high density square 956E 881N.

One area was identified in the southern side of The Northern Road at OA14 around two higher density squares, 834E 727-728N. Out of 79 artefacts, 73 were made of silcrete (92.4%). Two cores were recovered, one geometric microlith and one retouched split flake.

The most common raw material was silcrete which comprised 63.85% of the Phase 2/3assemblage (n=1,757) with quartz the second most common comprising 20.4% of the assemblage (n=554). Tuff and chert each had a significant number of artefacts comprising 10.2% (n=279) and 5% (n=137) of the assemblage respectively. Small numbers of petrified wood, quartzite, mudstone and igneous material were also identified. The majority of quartzite artefacts were found to the north of The Northern Road, with only three found south of The Northern Road within OA16. Igneous and mudstone artefacts were found only to the north of The Northern Road, while one MGS was recovered to the south.

Table 48. B6 Phase 2/3 Reduction Types and raw material

Reduction Types	Core	Whole flakes[1]	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	42	482	206	155	699	173	**1,757 (63.8%)**
Tuff[2]	3	103	16	16	96	47	**281 (10.2%)**
Quartz	3	116	7	38	210	180	**554 (20.1%)**
Chert	5	34	7	7	61	23	**137 (5%)**
P. Wood	1	0	1	0	5	4	**11 (0.4%)**
Quartzite	1	3	0	2	2	1	**9 (0.3%)**
Mudstone	0	2	0	0	0	0	**2 (0.1%)**
MGS	0	0	0	1	0	0	**1 (0.04%)**
Igneous	0	2	0	0	0	0	**2 (0.1%)**
Total	**55 (2%)**	**742 (26.94%)**	**237 (8.61%)**	**219 (7.95%)**	**1,073 (38.96%)**	**428 (15.54%)**	**2,754**

1 includes bipolar and split flakes; 2 heat shatter/crenate fracture included (total n=2)

Table 49. B6: Phase 1 and Phase 2/3 Reduction Types

Reduction Types	Whole flakes	Flake fragment	Angular fragment	Cores	Total
Phase 1	82 25.9%	166 52.5%	53 16.8%	15 4.7%	316 10.3%
Phase 2/3*	742 26.9%	1,529 55.5%	428 15.5%	55 2%	2,754 89.7%
Total	**825 26.8%**	**1,694 55.2%**	**481 15.7%**	**70 2.3%**	**3,070**

* 1 Tuff Crenate fracture and 1 Tuff Heat shatter included

Table 50. B6 Raw material summary per area

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	Quartzite	Mudstone	FGS	MGS	Igneous	Total
Phase 1	207 65.5%	51 16.1%	33 10.4%	17 5.4%	2 0.7%	1 0.3%	1 0.3%	4 1.3%	0	0	**316** **10.3%**
OA3 – eastern side	692 67.8%	68 6.7%	157 15.4%	88 8.6%	9 0.9%	3 0.3%	2 0.2%	0	0	1 0.1%	**1,020** **33.2%**
OA13	814 57%	180 12.6%	389 27.2%	44 3.1%	1 0.1%	0	0	0		1 0.1%	**1,429** **46.5%**
OA14	201 84.5%	25 10.5%	4 1.7%	4 1.7%	1 0.4%	2 0.8%	0	0	1 0.4%	0	**238** **7.8**
OA15	32 80%	5 12.5%	1 2.5%	1 2.5%	0	1 2.5%	0	0	0	0	**40** **1.3**
OA16	18 66.7%	3 11.1%	3 11.1%	0	0	3 11.1%	0	0	0	0	**27** **0.9**
Total	**1,964** **64%**	**332** **10.82%**	**587** **19.12%**	**154** **5.02%**	**13** **0.42%**	**10** **0.33%**	**3** **0.1%**	**4** **0.13%**	**1** **0.03%**	**2** **0.07%**	3,070

Plate 42. #3210 Large tuff flake – ventral (L) and dorsal (R) surfaces

Plate 43. Pink beige silcrete retouched flake #80 (S11), and yellow flake #114 (OA1, 833E 736N), both used as cores

Complete flakes, including bipolar and split flakes, comprised a relatively high percentage of the Phase 2/3 assemblage (26.94%, n=742) and 26.87% of the combined total site assemblage (n=825). Most of the bipolar flakes (n=36) were quartz, however there was a small number of chert (n=2), silcrete (n=3) and quartzite (n=1) bipolar flakes. Two complete igneous flakes identified in the Phase 2/3 assemblage were likely to be either unintentional flaking from hammerstones or axes/hatchets, or repurposing of these larger tools. Broken flake fragments were the most common reduction type comprising 55.2% of the Phase 2/3 assemblage, with a relatively low number of angular fragments (15.54%). To the east of The Northern Road, total of forty-one cores were located within the Phase 2/3 squares, distributed evenly between OA3 (n=21) and OA13 (n=20). Total of 25 cores were identified to the west of The Northern Road, eleven recorded in the Phase 1, out of those four within the square associated with OA1. The majority of cores were of silcrete but a smaller number of chert, quartz, and tuff and one each petrified wood and quartzite were also recovered. Two tuff artefacts were identified as heat shatter and/or crenate fracture. Two flakes were recovered in OA1 that were subsequently used as cores (Plate 43). Overall reduction type proportions were very similar between Phase 1 and Phase 2/3 of salvage.

Flake sizes were generally small, with 80% less than 20mm in maximum size with the highest numbers (313) found between 11-15mm and 182 (22.1%) less than 10mm (Table 52). The majority of the remainder were between 20-40mm, with a smaller number (n=11) up to 70mm. The largest flake was from the tuff assemblage located in OA13 with a percussion length of 65.4mm and a weight of 13.88g.

Table 51. B6 Phase 1 & 2/3 Flake size range

Size range	0-5mm	6-10mm	11-15mm	16-20mm	21-25mm	26-30mm	31-35mm	36-40mm	>40mm	Total
Phase 1	0	24	36	12	6	3	1	1	0	**83 10.1%**
Phase 2/3	10	148	277	154	83	32	16	11	11	**742 89.9%**
Total	**10 1.2%**	**172 20.9%**	**313 37.9%**	**166 20.1%**	**89 10.8%**	**35 4.2%**	**17 2.1%**	**12 1.5%**	**11 1.3%**	**825**

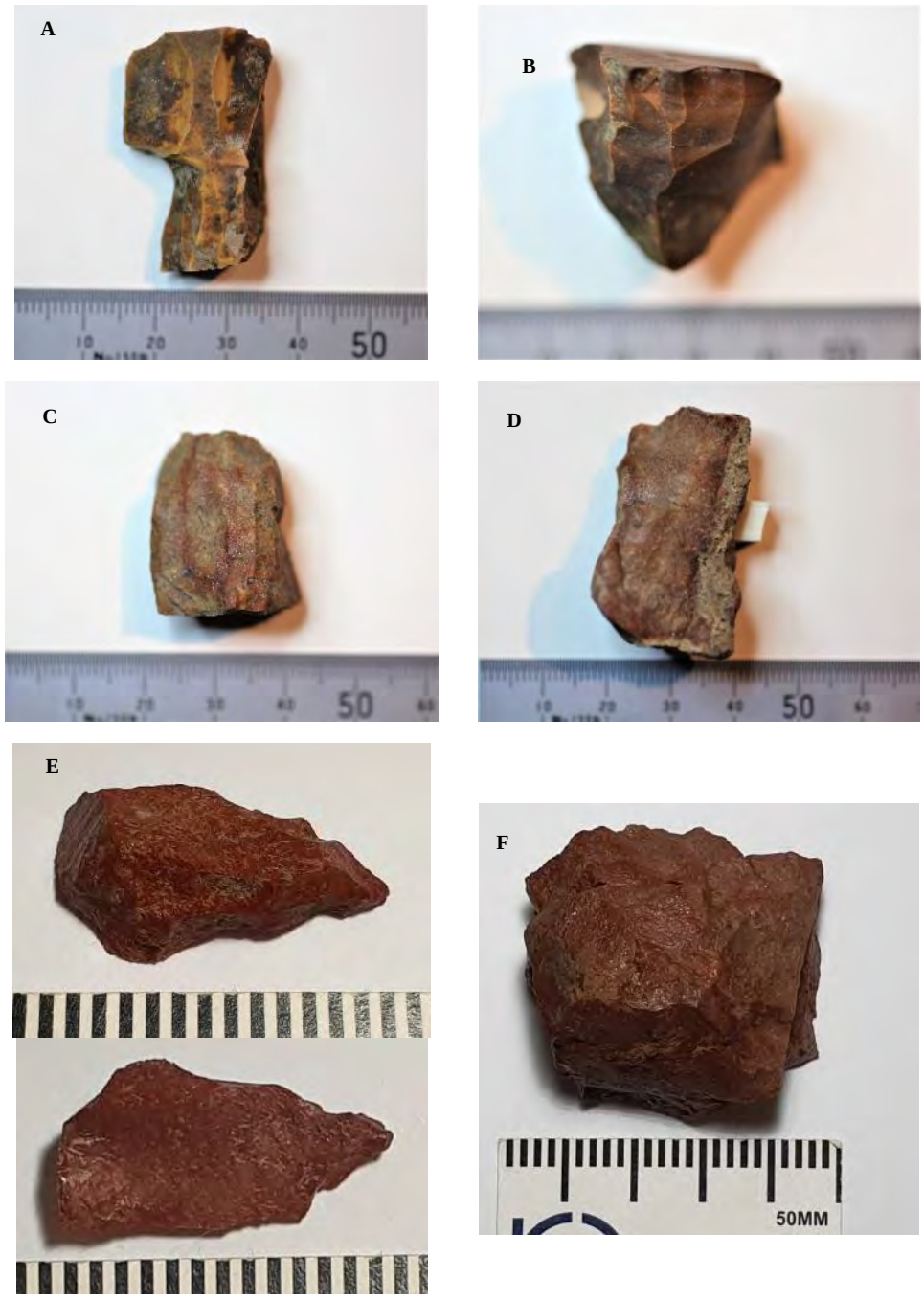


Plate 44. A #3139 Tuff flake (blade) core, B #3366 Tuff unifacial-rotated core, C #1507 Silcrete unifacial-rotated (blade) core, D #1514 Silcrete unifacial-rotated (blade) core, E #399 Red silcrete backed tool used a core F #74 Red silcrete multidirectional core with nine negative flake scars

Cores represented 2.28% of the total site assemblage (n=70). Nine of these (12.9%) were identified as fragments although one chert core fragment had three identifiable partial negative scars. Of the remaining 61 cores, the most common flaking pattern was unifacial (n=19), with low (1-3) numbers of negative scars and half being cortical examples (n=10). Four of the unifacial cores had blade or elongate scars, with one identified as a blade core. One core was identified as having been previously used as a backed tool, that was then flaked (Plate 44). There was a wide variety of other flaking patterns, including five unifacial-rotated, 18 multidirectional, six bidirectional, four bifacial, six bipolar and three flake cores. Twenty three cores showed medium intensity use with between 4-6 negative scars, with one flake core and two multidirectional exhibiting 6 scars. Four more of these cores were identified as blade cores. Core sizes were generally small, with maximum dimensions ranging between 6-50mm, with the heaviest being a silcrete multidirectional core weighing 69.19g, with nine negative scars and no cortex (Plate 44). A total of 37 cores (52.8%), including fragments, had identifiable remnant cortex of up to 69% of the total surface area.

Table 52. B6 Phase 1 and 2/3 Cortical Artefacts

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	Quartzite	Mudstone	FGS	MGS	Igneous	Total
B6 all Artefacts	1,964	332	587	154	13	10	3	4	1	2	**3,070**
Artefacts with cortex	427 21.7%	97 29.2%	131 22.3%	21 13.6%	4 30.8%	0	1 33.3%	0	1 100%	1 50%	**683 22.2%**

Almost 23% of the site assemblage displayed some level of remnant cortex (n=683), with the highest proportion of cortical artefacts found within the MGS assemblage (100%) igneous assemblage (50%, n=1) and mudstone (33.3%, n=1) although numbers of these materials were too low for meaningful analysis. The silcrete and quartz assemblages, representing the largest number of artefacts, both had just over 20% of cortical artefacts.

When present, cortex was generally recorded at low levels, with most artefacts retaining between 1-30% (n=418, 61.2% of cortical artefacts) followed by moderately cortical artefacts displaying between 31-69% (n=184, 26.9% of cortical artefacts). Highly cortical artefacts were those displaying between 70-99% (n=68) and 100% (n=13), which together accounted for the remaining 12% of the cortical assemblage.

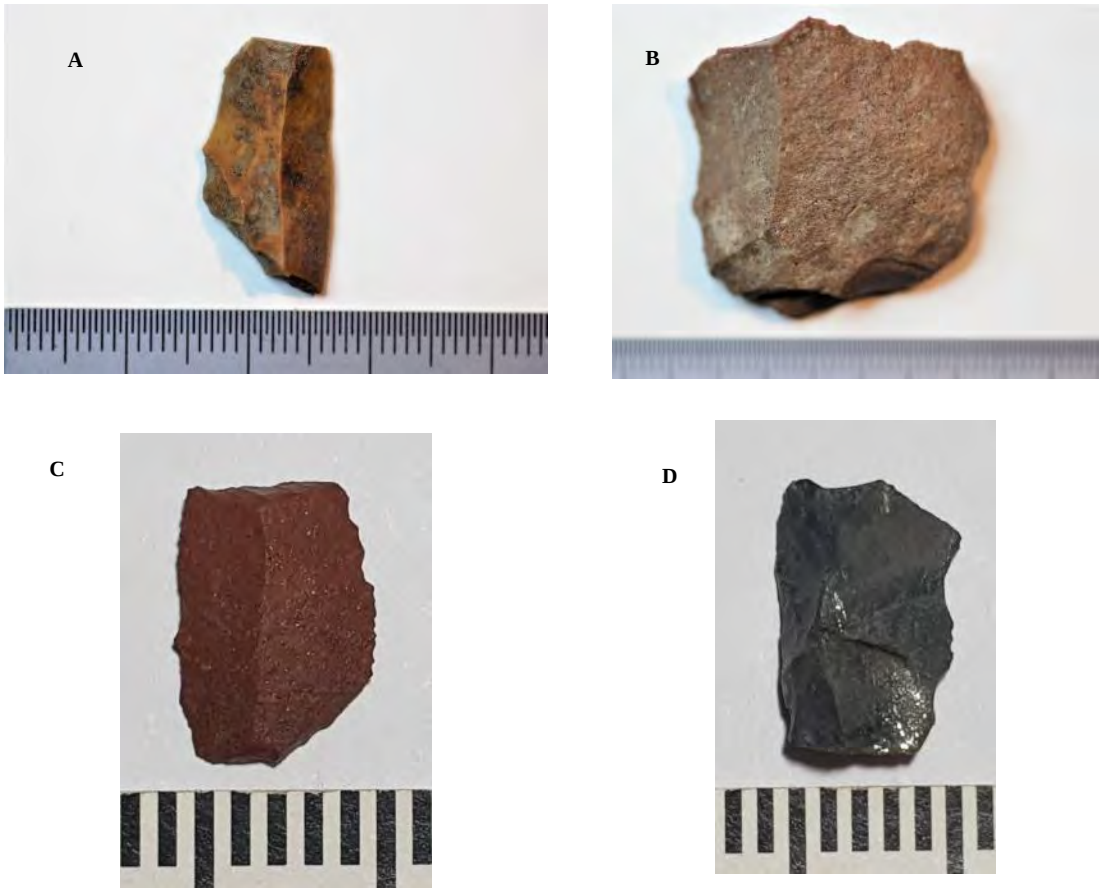


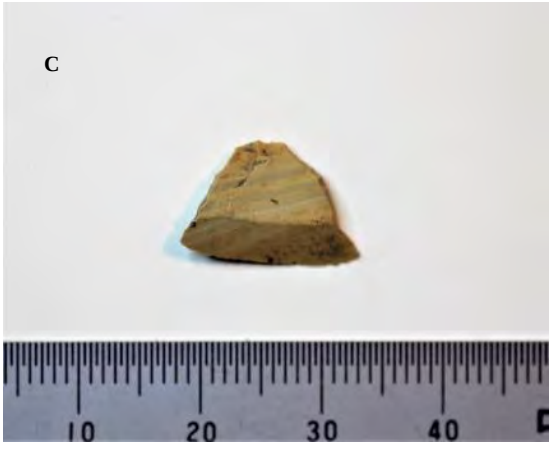
Plate 45. A #3140 Tuff end scraper, B #2622 Silcrete scraper , C #357 Red silcrete scraper with usewear, and D #385 grey silcrete scraper

A total of 64 modified artefacts were located within the Phase 2/3 excavations, with 72 identified overall across the site (Table 53). Together, modified artefacts comprised 2.3% of the assemblage. Backed artefacts were found primarily within the silcrete assemblage (n=37), along with nine tuff backed artefacts including one geometric microlith and one quartz backed blade. The majority of backed artefacts were blade fragments (n=20) and complete blades (n=14) with five non-diagnostic backed fragments. The largest complete blade was from the tuff assemblage with a maximum size range of 41-45mm, a percussion length of 39.2mm and a weight of 1.85g. Blade sizes ranged primarily between 16-35mm. Eight geometric microliths were identified, all with a maximum size range of between 11-20mm.

Retouched artefacts were primarily non-formal types (n=17) with various levels of retouch. One of these was a heavily weathered distal fragment of silcrete (26-30mm) with large serrated retouch on the right lateral margin, and another silcrete flake displayed slight dentate retouch. This was a relatively large flake with a maximum dimension of 31-35mm, a percussion length of 32.5mm and 5.05g weight. Formal types include seven scrapers with three identified as end scrapers, and a single Tula Adze located in OA13. The Tula Adze was the largest retouched artefact with a size range of 51-55m, percussion length of 50.9mm and a weight of 32.41g.

Table 53. B6 Modified artefacts

Modified Artefacts	Backed			Retouched		Tula Adze	Total
	Blade (F)	Geometric	Non. Diagnostic	Non. Specific	Scraper		
Phase 1	3	0	1	3	1	0	**8 11.1%**
Phase 2/3	31	8	4	14	6	1	**64 88.9%**
Total	**34 47.2%**	**8 11.1%**	**5 6.9%**	**17 23.6%**	**7 9.8%**	**1 1.4%**	**72**



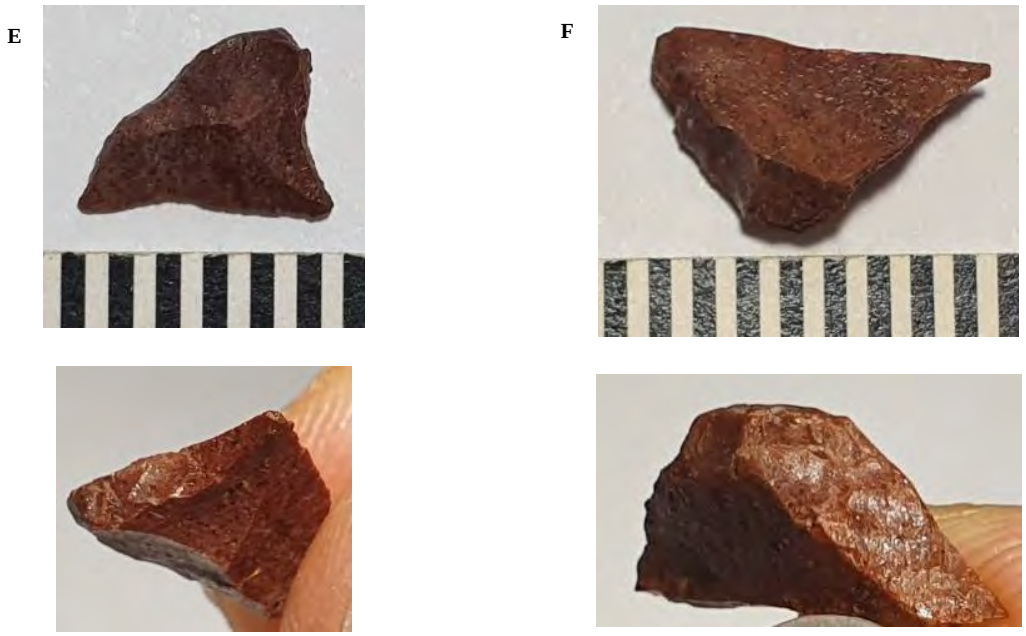


Plate 46. A #1354 #1412 Quartz and silcrete backed blades, B #1645 #1570 #1761 tuff and silcrete backed blades, C #2010 Tuff geometric microlith, D #3467 silcrete distal fragment with large serrated retouch, E #179 Red silcrete geometric microlith, F #373 Orange silcrete geometric microlith

Plate 47. #3050 Tuff Tula Adze

7.8.4 B6 summary

Site B6 extended from higher crest and slopes in the north, transecting Badgerys Creek and extending on an alluvial bench and lower slope to the south. As such, a higher density of artefacts would be expected in the southern section. Phase 1 excavations supported this theory, with Phase 2/3 excavations yielding a high number of stone artefacts and a medium to high density of artefacts across the site. The number of artefacts and the technology identified revealed a complex site consisting of specific individual activities, interspersed with an artefact assemblage generally connected with domestic activities, in other words a long-term campsite, occupied repeatedly over time.

7.9 B54 (AHIMS 45-5-2790)

Site B54 was located on a lower slope and flat bordering Badgerys Creek, approximately 850 metres to the north east (downstream) of site B6. B54 was originally identified by Navin Officer during an Aboriginal cultural heritage study in 1997 of the then proposed airport area as part of an assessment of potential sites for a second major airport for Sydney.

The survey identified B54 on the eroded margin of a drainage gully adjacent to Badgerys Creek. Artefacts included one single-platform silcrete core and a chert flake. Some portions of the site area were disturbed due to erosion and stock trampling along the creek margin.

It was later identified that works associated with the TNR4 project would have a partial impact on site B54 within the WSA lands. The site was therefore included in the TNR 4 salvage program and was salvaged in accordance with the approved methodology prepared by Navin Officer (2017) and included in the WSA ACH CEMP (WSA Co 2018). Salvage took place within the area overlapped by the TNR4 project corridor.

B54 Quick Reference	
Creek system	**Landforms**
Badgerys Creek	Lower slope and flat
Phase 1 sample	**Phase 4 sample (not incl. Phase 1)**
20 Phase 1 squares (50 x 100cm) Total: 10m^2	7 open areas Total: 47m^2
Phase 1 artefacts	**Phase 4 artefacts (not incl. Phase 1)**
45 artefacts Mean density 4.5/m^2	1,040 artefacts Mean density 22.1/m^2
Phase 1 & 4 combined	
Sample: Total 57 m^2 1,085 artefacts Mean density 19/m^2	

7.9.1 Salvage methodology

Archaeological salvage at B54 used the approved excavation methodology in the WSA ACH CEMP and not the same methodology used for the TNR4 salvage sites. B54 salvage was undertaken in two Phases as per the WSA ACH CEMP. Phase 1 salvage involved the excavation of a series of 50cm x 1m squares spaced at 10m intervals along transects. Each Phase 1 square was comprised of two individual 0.5m x 0.5m units. Due to the narrow width of the project corridor and TNR 4 impact area, Phase 1 comprised a single transect of approximately 300m length aligned north-south along the eastern extent of the site area (Figure 20). A total of 20 Phase 1 squares were excavated, giving a total Phase 1 sample of 10m^2 across the site.

As per the WSA ACH CEMP, the purpose of Phase 1 salvage is to "sample or 'test' the deposit and micro-topographic variation across the salvage location, within a consistent spatial arrangement and using a consistent sample unit". This was achieved with the spatial arrangement of Phase 1 squares used in the current program. In accordance with the WSA ACH CEMP, Phase 1 results inform the requirement for placement of additional 0.5m x 1m squares on complementary transects (Phases 2 and 3) or the requirement for Phase 4 salvage expansion (open area expansion). Following completion of Phase 1 excavations, sufficient information was recovered to inform the placement of additional Phase 4 squares to continue salvage. Seven Phase 1 squares were selected for expansion. At each of these, expansion comprised the excavation of an additional adjoining 0.5m x 1m unit to form a total area of 1m^2. One of these locations (OA1) was then selected for a full open area expansion. At OA1, the majority of expansion squares were excavated in 1m x 1m units. At the north eastern corner, a series of additional 0.5m x 0.5m units were excavated to extend around a high density deposit identified at this location (see Figure 22). The result was an irregularly shaped open area totalling 44.5m^2 (including the Phase 1 square). Combined with the Phase 4 squares adjoining the other six Phase 1 locations, the total amount excavated for Phase 4 was 47.5m^2.

All units were excavated in 10cm (100mm) spits to the basal clay layer which was generally encountered between 20-30cm depth. Most squares had three spits.

Plate 48. (L) View south east across creek from northern site extent (R) 420E 515N view to north down transect

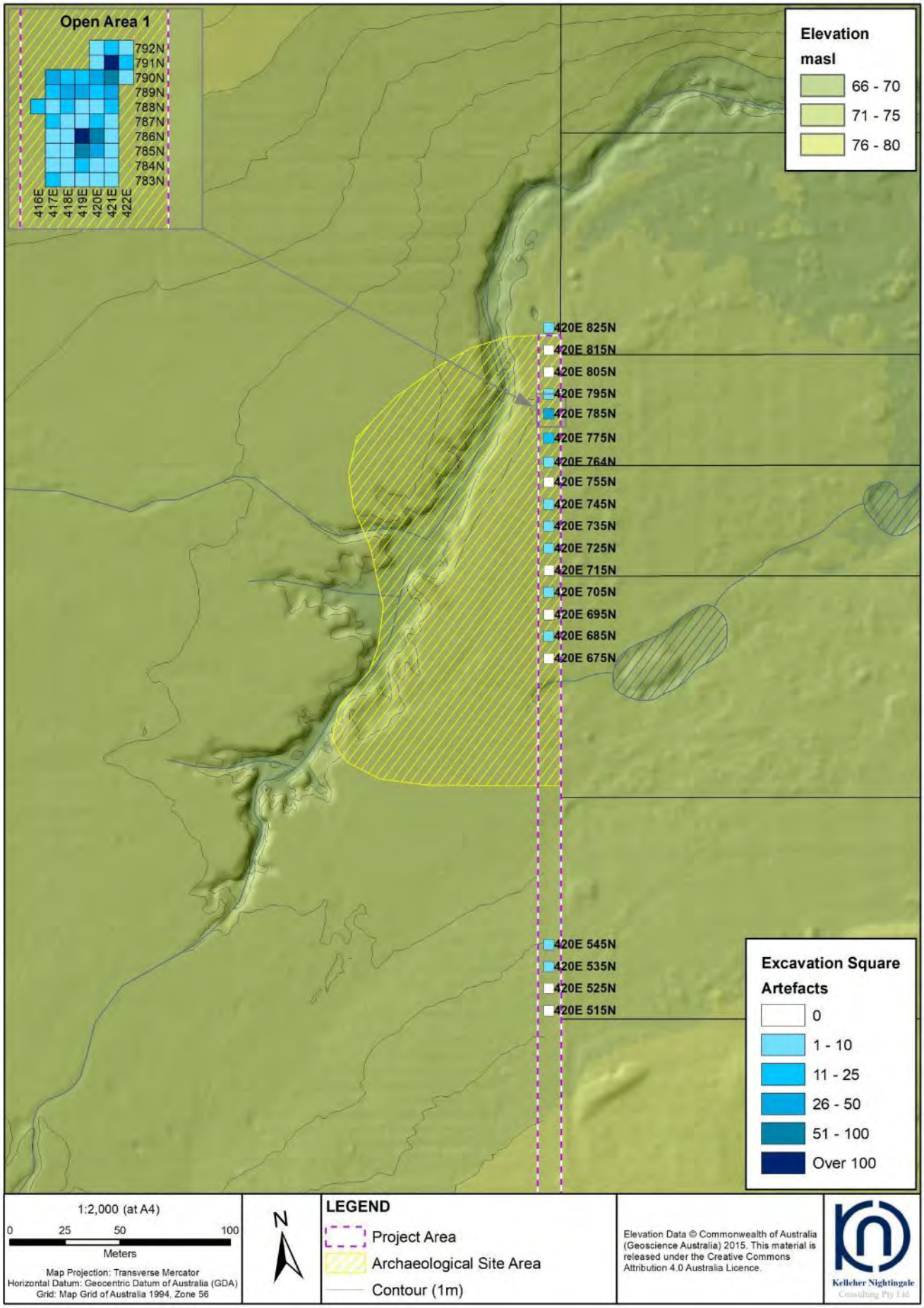


Figure 20. B54 excavation results – OAs 2-7 not shown

7.9.2 Soils, landform and disturbance

Soil profiles generally showed a strong alluvial influence, expected given their proximity to the creekline and low elevation of the landform. Typical profiles across the northern part of the salvage area (675N-825N) comprised loose silty humic topsoil above an upper A horizon of pale grey-brown to pinkish brown silty loam. This displayed few inclusions. The lower A horizon comprised pinkish to greyish brown silty loam with abundant Fe/Mn gravels/inclusion up to 20%. These were small in size and distributed evenly throughout the profile, with a slight increase in concentration towards the base. Charcoal flecking and occasional larger patches also occurred, and several squares showed evidence of burnt tree roots including charcoal, baked clay and associated infilled root channels. Red-brown clay content increased with depth and the basal clay comprised a compact red-brown to yellow-brown sticky silty clay with Fe/Mn continuing into the base. Average depth of squares was 25-30cm. Squares excavated in the southern part of the site (515N-545N) showed less alluvial influence, comprising red-brown silty loam with less frequent fine Fe/Mn and few other inclusions, above a red-brown silty clay. Average depths of excavated squares were shallower, around 20cm, apart from 420E 525N which had an extensively disturbed base due to a burnt root channel. Bioturbation and insect activity was frequent across the site but overall soils were intact with little anthropomorphic disturbance.

420E 774.5N south section

420E 735N north section

420E 545N north section

420E 805N OA5 south section

OA1 south section and base

Plate 49. Representative section profiles and open area, B54

7.9.3 Phase 1 results

A total of 40 0.5m x 1m units were excavated during Phase 1 salvage at B54, combined into 20 1m x 0.5m Phase 1 squares. This yielded a total Phase 1 sample of 10m^2. Each Phase 1 square was given a unique coordinate identifier at the north west corner, with two 0.25m^2 units extended below this on a north-south alignment along the transect. Each unit was assigned a coordinate based on its position in the Phase 1 square (e.g. 420E 705N for the northern of the two units, matching the Phase 1 square ID, and 420E 704.5N for the southern of the two units, given its position 0.5m to the south). The two 0.25m^2 units were excavated and sieved separately to allow for a finer grained analysis of artefact distribution. Table 54 below shows the artefact count from each unit (N north and S South) and the total for each combined 1m x 0.5m Phase 1 square.

Table 54. B54 Phase 1 artefact counts

ID	N	S	Phase 1 square total	ID	N	S	Phase 1 square total
420E 515N	0	0	**0**	420E 735N	1	0	**1**
420E 525N	0	0	**0**	420E 745N	1	2	**3**
420E 535N	0	1	**1**	420E 755N	0	0	**0**
420E 545N	2	1	**3**	420E 764N	2	0	**2**
420E 675N	0	0	**0**	420E 775N	4	6	**10**
420E 685N	1	1	**2**	420E 785N	15	2	**17**
420E 695N	0	0	**0**	420E 795N	0	2	**2**
420E 705N	1	0	**1**	420E 805N	0	0	**0**
420E 715N	0	0	**0**	420E 815N	0	0	**0**
420E 725N	2	0	**2**	420E 825N	0	1	**1**
Phase 1 total			**45**				

Mean artefact density from the Phase 1 sample was 4.5/m^2 across the investigated portion of the site area. The highest artefact count was present at 420E 785N which contained 17 artefacts, accounting for over a third of the total Phase 1 assemblage, followed by adjacent 420E 775N 10m to the south with 10 artefacts. The remaining positive squares contained low densities of 1-3 artefacts each.

Silcrete was the most common raw material comprising 71.1% of the assemblage (n=32), with quartz comprising 22.2% of the assemblage (n=10) and tuff the remainder (n=3). No other raw materials were recovered during this phase of the excavation.

Flake fragments were the most common reduction type (proximal, medial & distal) comprising 66.7% of the assemblage, with all of the quartz and tuff assemblage comprised of fragments and angular fragments. Seven complete flakes (15.6%) and two cores (4.4%) were identified within the silcrete assemblage. The remaining 13.3% were angular fragments. One core was identified as a fragment, while the other was bifacial with five negative scars and a maximum size range of 31-35mm weighing 12.5g. This was recovered from 420E 785N along with various silcrete debitage. No cortex was located on any of the cores or complete flakes.

One small (11-15mm) tuff retouched distal fragment was recovered, with retouch on the distal margin creating a concave edge, in the southern unit of 420E 745N (i.e. within unit 420E 744.5N). No other modified artefacts or tools were recovered during Phase 1 salvage.

Table 55. B54 Phase 1 Artefact and material summary

Reduction Types	Core	Complete flakes*	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete	2	7	3	6	11	3	32 (71.1%)
Tuff	0	0	0	1	2	0	3 (6.7%)
Quartz	0	0	0	1	6	3	10 (22.2%)
Total	**2 (4.4%)**	**7 (15.6%)**	**3 (6.7%)**	**8 (17.8%)**	**19 (42.2%)**	**6 (13.3%)**	**45**

*Including bipolar & split flakes

Seven of the Phase 1 squares were subsequently selected for additional Phase 4 excavation: 420E 785N (OA1), 420E 775N (OA2), 420E 764N (OA3), 420E 795N (OA4), 420E 805N (OA5), 420E 695N (OA6) and 420E 685N (OA7). All Phase 4 excavation was undertaken in the northern part of the site, at distances of less than 70m from the creek.

7.9.4 Phase 4 results

Seven locations of Phase 4 excavation were undertaken at the site. Six of these comprised additional 1m x 0.5m extensions to existing Phase 1 squares (Open Areas 2-7, Figure 21) to create 1m x 1m open areas and one comprised a larger open area expansion of Phase 1 square 420E 785N, which had the highest artefact count from the Phase 1 program (Open Area 1, Figures 21 and 22).

	420E	420.5E
775N	4 (Ph.1)	3
774.5N	6 (Ph.1)	1

Open Area 2 (n=14 including Phase 1)

	420E	420.5E
764N	2 (Ph.1)	0
763.5N	0 (Ph.1)	1

Open Area 3 (n=3 including Phase 1)

	420E	420.5E
795N	0 (Ph.1)	0
794.5N	2 (Ph.1)	6

Open Area 4 (n=8 including Phase 1)

	420E	420.5E
805N	0 (Ph.1)	2
804.5N	0 (Ph.1)	0

Open Area 5 (n=2 including Phase 1)

	420E	420.5E
695N	0 (Ph.1)	0
694.5N	0 (Ph.1)	1

Open Area 6 (n=1 including Phase 1)

	420E	420.5E
685N	1 (Ph.1)	0
684.5N	1 (Ph.1)	1

Open Area 7 (n=3 including Phase 1)

	416E	417E	418E	419E	420E	421E	422E
792N					1	11	2
791N					9	133	20
790N		28	13	13	29	88	7
789N		23	40	47	22	36	
788N	15	6	12	6	9	20	
787N		11	2	7	12	9	
786N		8	8	103	69	5	
785N		9	9	69	47	10	
784N		8	4	22	3	8	
783N		16	2	5	1	5	

Open Area 1 (n=1042 including Phase 1), layout modified into 1m x1m squares

Figure 21. B54 artefact distribution in open areas

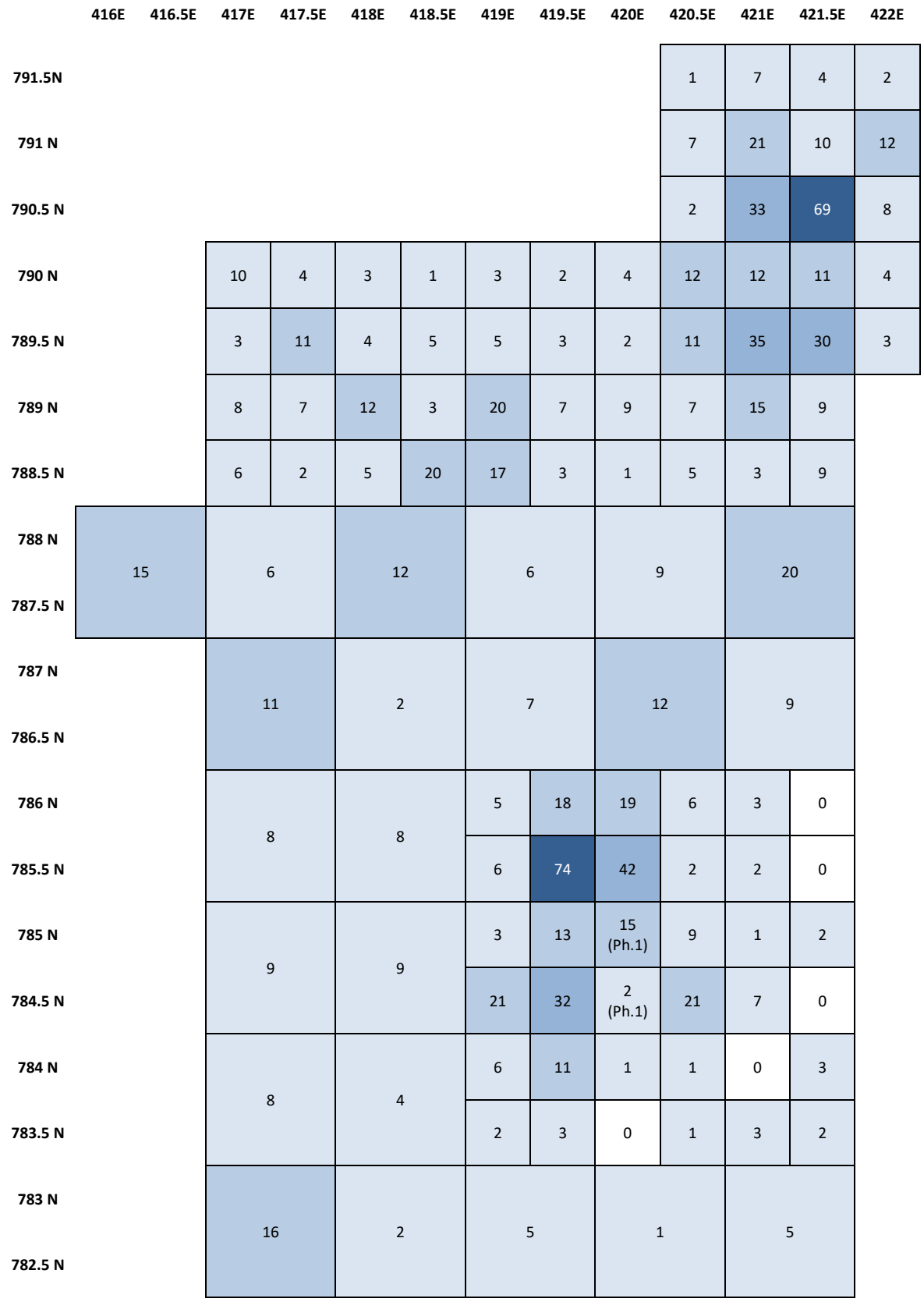


Figure 22. B54 Open Area 1 as excavated, showing artefact distribution

Squares at Open Area 1 were excavated both as 1m x 1m and 0.5m x 0.5m units. Figure 22 shows the open area and artefact counts as it was actually excavated, totalling 44.5m^2 while Figure 21 shows a modified layout used for analysis requiring counts per square metre, totalling 48m^2. Combining the 0.5m x 0.5m units into 1m x 1m squares leads to the variation in square count and mean artefact density between the two figures.

In total, Phase 4 salvage of B54 recovered 1,040 artefacts from a total of 47m² with an average Phase 4 artefact density of 22.1/m², not including Phase 1 squares.

At Open Areas 2-7, Phase 4 salvage comprised a 1m x 0.5m extension of the Phase 1 squares, giving a Phase 4 sample of 0.5m^2 at each area and 3m^2 for the six areas combined. The smaller open areas contained low artefact densities, with the high point of Phase 4 salvage at OA4 420.5E 794.5N which contained six artefacts, although when Phase 1 totals were included, the 1m x 1m open area with the highest artefact count was OA2 (n=16). The other 1m x 1m open areas all contained fewer than 3 artefacts even including the Phase 1 totals.

At Open Area 1, 22 1m x 1m squares and 88 0.5m x 0.5m units were excavated, for a total Phase 4 excavation sample of 44m^2 and an open area of 44.5m^2 including the Phase 1 square. A total of 1,042 artefacts were recovered (including Phase 1) giving a mean artefact density of 23.3/m^2. Excluding the Phase 1 square, artefact count was 1,025 and mean density was 23.3/m^2. When the density map is modified to conform to a per square metre count (in line with other sites investigated for TNR 4) as shown in Figure 21, two areas of high density are visible centred around squares 421E 791N (n=133) and 419E 786N (n=103). These localised concentrations were surrounded by several moderate density squares. The same general distribution is evident in Figure 22, namely two localised higher density zones at 421.5E 790.5N (n=69) and 419.5E 785.5N (n=74) surrounded by moderate density squares. Five of the smaller 0.5m x 0.5m units did not contain artefacts, although when averaged out as per Figure 21 there were no negative squares in OA1.

Plate 50. B54 Open Area 1 and surrounds, view to north with Badgerys Creek to left beyond trees

Raw materials were similar to other sites investigated during the salvage program, with silcrete being the most common raw material comprising 72.7% of the assemblage (n=753), followed by quartz (n=157, 15.2%) and tuff (n=105, 10.1%). A wider variety of materials were recovered during the Phase 4 excavations, including small numbers of chert, petrified wood, Igneous material and unidentified FGS (fine grained siliceous). These were all located at OA1 apart from one dark grey chert at OA4 420.5E 794.5N.

Table 56. B54 Phase 4 Reduction Types

Reduction Types	Core	Whole Flakes[1]	Proximal frag.	Medial frag.	Distal frag.	Angular frag.	Total
Silcrete[2]	17	200	72	64	326	74	753 (72.7%)
Tuff	1	48	7	3	35	11	105 (10.1%)
Quartz	0	32	5	10	58	52	157 (15.2%)
Chert	1	5	0	0	5	1	12 (1.2%)
P. Wood	1	1	0	0	2	1	5 (0.5%)
FGS	0	0	1	2	0	0	3 (0.3%)
Igneous	0	0	0	0	0	1	1 (0.1%)
Total	**20 (1.9%)**	**286 (27.6%)**	**85 (8.2%)**	**79 (7.6%)**	**426 (41.1%)**	**140 (13.5%)**	**1,036**

[1]includes bipolar and split flakes; [2]heat shatter/crenate fracture not included (total n=4)

All squares at site B54 were excavated in 10cm spits in accordance with the WSA ACH CEMP, with most squares having three spits. The vertical artefact distribution (Table 57, Figure 23) shows that Spit 2, with a depth of between 10-20cm, yielded the highest concentration of artefacts and contained 61.5% of the assemblage (n=667). Spit 3, with a depth of >20cm (to sterile basal clay layer) yielded 31.1% of the assemblage while the uppermost Spit 1 (0-10cm depth) had the lowest number of artefacts (n=81, 7.5%).

This vertical distribution of artefacts is typical given the landform context and location of the site, with a broad band or zone of artefact concentration in the more stable portion of the A unit, between 10-20cm depth. At B54 this corresponded an increase in Fe/Mn staining and gravels, an indicator of frequent waterlogging and sufficient stability of soils for this characteristic to develop in situ.

The top 10cm of the profile tends to suffer more disturbance particularly from erosion, flooding and modern land use (vehicle and cattle movements, grazing, mowing etc.). The inclusion-free silty upper A unit is likely the result of low-energy deposition associated with flooding and water movement. Meanwhile, vertical movement of objects down through the profile from the surface is encouraged by bioturbation, trailing off as the clay content of the A unit increases and stopping short of basal clay.

Separately charting the individual raw materials shows no significant differences in vertical distribution (Figure 23). All follow the same pattern as the overall assemblage, with the exception that the rarer raw materials are mostly found in the upper two spits. However, this is likely due to the small sample size rather than showing differences in material usage over time or other features of site use and human behaviour.

Table 57. B54 Spit distribution of raw materials (Phase 1 and 4)

	Silcrete	Tuff	Quartz	Chert	P. Wood	FGS	Igneous	Total
Spit 1 (0-10cm)	47 6%	3 2.8%	26 15.6%	2 16.7%	0	2 66.7%	1 100%	81 7.5%
Spit 2 (10-20cm)	464 58.8%	78 72.2%	111 66.5%	8 66.7%	5 100%	1 33.3%	0	667 61.5%
Spit 3 (>20cm)	278 35.2%	27 25%	30 18%	2 16.7%	0	0	0	337 31.1%
Total	**789**	**108**	**167**	**12**	**5**	**3**	**1**	**1,085**

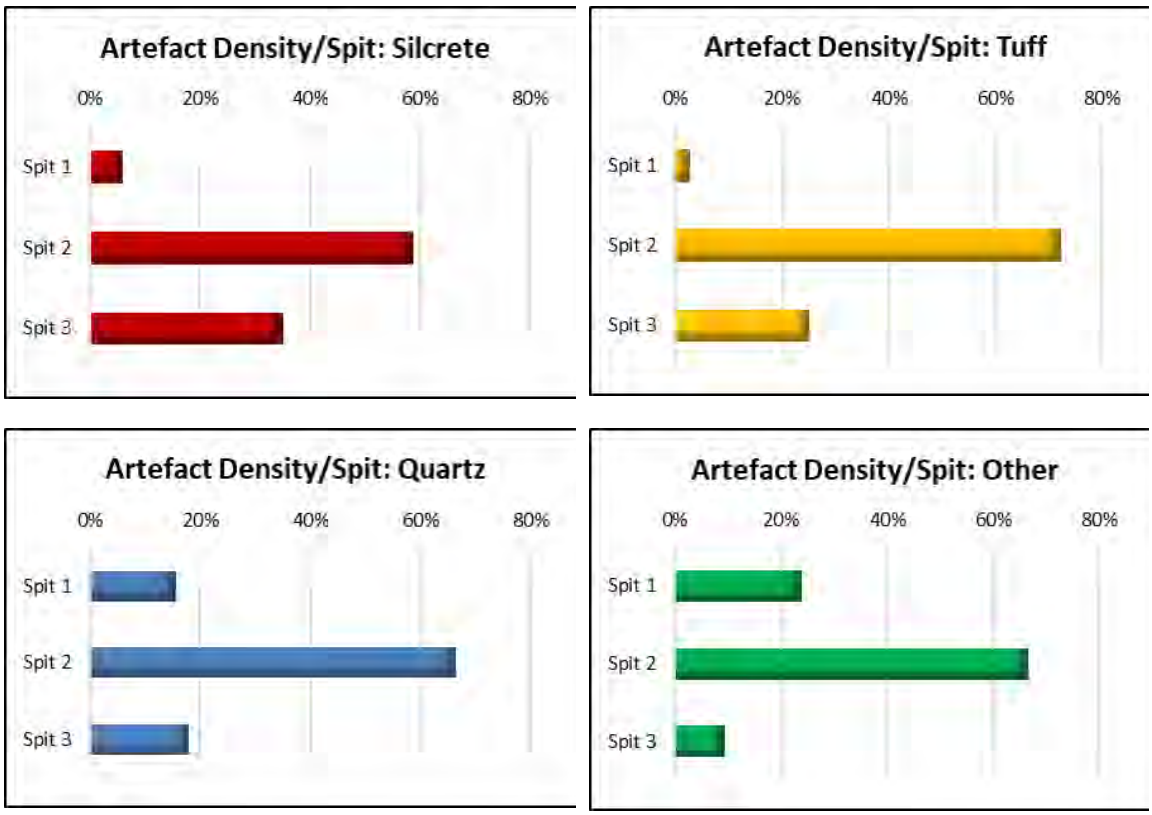


Figure 23. B54 Distribution of raw materials per spit

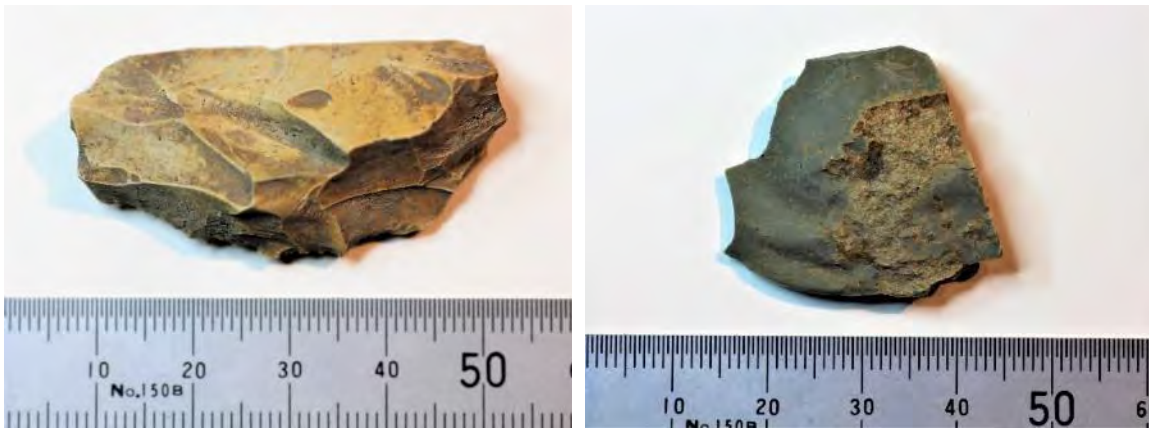


Plate 51. Various Tuff types – (L) #375 retouched flake, (R) #709 grey/green flake

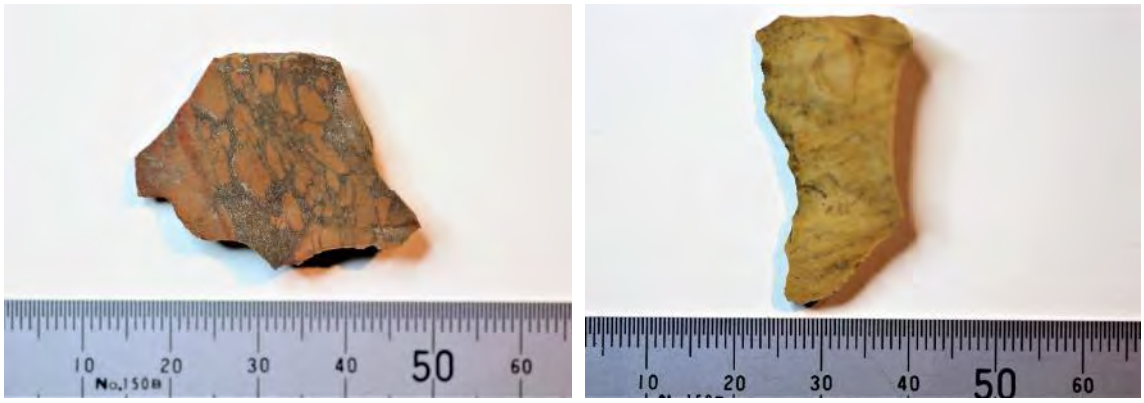


Plate 52. More material types – (L) #375 Chert flake, (R) #376 Tuff retouched flake

The most common raw material was silcrete which comprised 72.7% of the total assemblage, dominating both the Phase 1 and Phase 4 excavations. Unlike the Phase 1 excavation, Phase 4 recovered a wider variety of raw material, including chert, petrified wood, FGS and igneous material, although these sample sizes were small (Table 58).

Complete flakes comprised a relatively high 27.1% of the assemblage (n=293), although there was a significant variation in the ratios of the Phase 1 and 4 excavations. This is likely due to the larger excavation sampling undertaken during OA1 intersecting medium to high intensity knapping events. The most common reduction types were flake fragments, including proximal, medial and distal fragments, comprising 57.4% of the site assemblage while angular fragments comprised a low 13.5%. A total of 22 cores were identified at the site, 20 from the Phase 4 excavation at OA1, comprising 2% of the total site assemblage.

Table 58. B54 Phase 1 & 4 raw material summary

Raw Material	Silcrete	Tuff	Quartz	Chert	P. Wood	FGS	Igneous	Total
Phase 1	32 71.1%	3 6.7%	10 22.2%	0	0	0	0	45 4.1%
Phase 4	757 72.8%	105 10.1%	157 15.1%	12 1.2%	5 0.5%	3 0.3%	1 0.1%	1,040 95.9%
Total	**789** **72.7%**	**108** **10%**	**167** **15.4%**	**12** **1.1%**	**5** **0.5%**	**3** **0.3%**	**1** **0.1%**	**1,085**

Table 59. B54 Phase 1 & 4 reduction summary

Reduction Types	Complete flakes	Flake fragment	Angular fragment	Cores	Total
Phase 1	7 15.6%	30 66.7%	6 13.3%	2 4.4%	45 4.2%
Phase 4*	286 27.6%	590 56.9%	140 13.5%	20 1.9%	1,036 95.8%
Total	**293** **27.1%**	**620** **57.4%**	**146** **13.5%**	**22** **2%**	**1,081**

* Silcrete – 3 heat shatter & 1 crenate fracture not included

Flake sizes were generally small, with the majority, just over 75%, being 20mm or less in maximum size. Around 19% of complete flakes were less than 10mm, providing another indicator of deposit integrity (smaller artefacts not removed via flooding). The remaining complete flakes ranged between 20mm to 60mm in maximum dimension, with the largest being a chert flake with a percussion length of 54.7mm and a weight of 6.29g.Other larger flakes (over 50mm) included a tuff retouched flake with a percussion length of 41.6mm and weight of 11.09g, and a broken silcrete flake, conjoined with two other pieces (ID #886, #887 & #888) with a percussion length on 51.9mm and weight of 18.2g.

Table 60. B54 Flake size ranges

Size	0-5mm	6-10mm	11-15mm	16-20mm	21-25mm	26-30mm	31-35mm	36-40mm	>40mm	Total
Phase 1	1	2	3	1	0	0	0	0	0	7
Phase 4	2	51	113	51	35	13	15	2	4	286
Total	**3 1%**	**53 18.1%**	**116 39.6%**	**52 17.7%**	**35 11.9%**	**13 4.4%**	**15 5.1%**	**2 0.7%**	**4 1.4%**	**293**

Cortical artefacts comprised 17.4% of the total assemblage. The highest ratio of cortical artefacts was evident within the chert and quartz assemblages, which were 25% and 24% cortical respectively. Silcrete had a relatively low proportion of cortical artefacts with just 15.3% (n=121). Where artefacts did retain cortex this was generally a low amount between 1-30% (n=109, 57.7%) followed by moderately cortical 31-69% (n=58, 30.7%) and fewer 70-99% cortical artefacts (n=22, 11.6%). No primary artefacts were identified within the assemblage (flaked artefacts with 100% cortex). Half of the core assemblage (n=11) was cortical, although with generally low levels.

Table 61. B54 Cortical artefacts

Raw Materials	Silcrete	Tuff	Quartz	Chert	P. Wood	FGS	Igneous	Total
All Artefacts Phase 1 & 4	789	108	167	12	5	3	1	**1,085**
Artefacts with cortex	121 15.3%	24 22.2%	40 24%	3 25%	1 20%	0	0	**189 17.4%**

A total of 22 cores were identified, comprising 2% of the total site assemblage across both phases of salvage. Three of these were classified as fragments although one (silcrete) had three partial scars visible. All but three of the cores were silcrete with one each of chert (bipolar), petrified wood (fragment) and tuff (multidirectional).

Flaking patterns varied, although the most common types were unifacial (n=6), unifacial rotated (n=5) and multidirectional (n=5). Other flaking patterns included bifacial (n=2) and bipolar (n=1). Core sizes were generally small with a maximum size range of between 16-45mm. The two largest examples included a silcrete unifacial core with a size range of 40-45mm and weight of 24.15g with one negative scar, and a silcrete multidirectional core with a size range of 40-45mm, a weight of 24.2g and five negative scars.

Reduction intensity varied, with 11 cores (not including fragments) having between 1-3 negative scars with eight having between 4-5 negative scars. Three of the unifacial rotated cores (all silcrete) were identified as blade cores with between 3-5 negative scars each, with a further unifacial core exhibiting one blade or elongate scar.

Plate 53. Cores – (L) #920 silcrete unifacial rotated 'blade' core, (R) #1051 silcrete bifacial 'blade' core

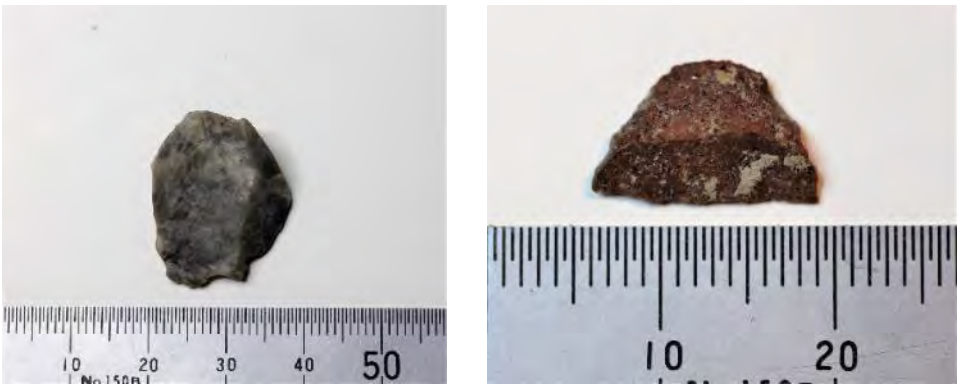


Plate 54. (L) #895 chert bipolar core, (R) #299 silcrete geometric microlith

Plate 55. (L) #711 Silcrete distal blade fragment, (R) Backed artefacts #746 & #747, Tuff and silcrete backed blades

A total of 26 modified artefacts were recovered during the excavation, one from Phase 1 420E 744.5N and the remainder from Phase 4 OA1. Combined, they comprise 2.4% of the site assemblage. The majority of the modified artefacts were backed (n=18) and were found within the silcrete assemblage (n=13) and the tuff assemblage (n=5). Backed artefacts included four complete backed blades, 11 blade fragments and three geometric microliths. Two of the blade fragments were found within the same square and conjoined to form a complete blade (ID #931 & #932). The weathering pattern on the artefacts suggested this was an old break.

Seven retouched artefacts were recovered within the silcrete and tuff assemblages with only one formal tool identified (a silcrete scraper). One hammerstone was identified in OA1 square 418E 784N spit 1 (0-10cm). The hammerstone had a maximum size range of between 51-55mm and a weight of 67.4g and was made from grey igneous material.

Table 62. B54 Modified artefacts

Modified Artefacts	Backed			Retouched		Hammerstone / Axe Hatchet Frag.	Total
	Blade (F)	Geometric	Non. diagnostic	Non-Specific	Scraper		
Phase 1	0	0	0	1	0	0	**1 3.8%**
Phase 4	15	3	0	5	1	1 (Hs)	**25 96.2%**
Total	**15 57.7%**	**3 11.5%**	**0**	**6 23.1%**	**1 3.8%**	**1 3.8%**	**26**

7.9.5 B54 Summary

Site B54 was situated on a relatively flat alluvial bench adjacent to Badgerys Creek and despite modern commercial activities and historic pastoral uses retained a relatively intact archaeological assemblage. Artefact densities were generally moderate with two high density focal points interspersed within a low-density artefact scatter. Evidence of tool production was indicated by a number of blade cores and complete and fragmented backed blades. Tool use was also in evidence with a number of geometric microliths and retouched artefacts found during the Phase 4 excavations. Two retouched tuff artefacts shown in Plates 45 and 46 may indicate the curation or manufacturing of wooden implements. As with site B6, site B54 a was complex site consisting of specific individual activities, interspersed with an artefact assemblage generally connected with domestic activities. The flat landscape and access to water along with other resources would have made this area ideal for longer term and occupation.

8 Analysis and Discussion

8.1 Artefact Sample Sizes: Phase 1 & 2-4

A total of 5,204 artefacts were recovered from the excavation program. The Phase 1 excavations recovered 10.1% of the artefacts (n=528), while the majority (n=4,676) of artefacts were recovered during the Phase 2/3/4 open area excavations (referred to as 'Phase 2' for brevity in the following chapter). A total of 228m² was excavated during Phase 1 with an overall artefact density of 2.3/m², while 355m² was excavated in Phase 2 with an artefact density of 13.2/m². Artefact density across the whole TNR 4 excavation area was 8.9/m².

Phase 1 salvage excavation was designed to identify significant archaeological deposit as opposed to statistically investigate deposits. Phase 1 excavation ceased with the identification of a significant deposit (and Phase 2 started) or when it was determined that no significant deposit existed (hence no requirement for Phase 2).

At the end of the Phase 1 program for each site, a series of squares were selected and expanded to form Phase 2 open area excavations. A total of 16 individual open excavation areas were completed as part of the Phase 2 salvage across the TNR 4 salvage program with an additional seven 'open areas' at site B54. The size of the open areas was variable. The majority of Salvage Areas contained between one and three individual open area excavations (with the exception of site B54). No Phase 2 excavations were undertaken at sites TNR AFT 22 and 29 due to their low artefact density.

One site, B6, yielded over 50% of the artefacts recovered from the program (n=3,070) with an overall artefact density of 19.3/m², although it had a slightly higher density of 23.5/m² during the Phase 2 excavation. The two other larger yielding sites were B54 with 20.8% of artefacts (n=1,085) and TNR AFT 27 with 13.4% (n=696). Both of these sites had higher artefact densities per square metre than other sites in the program which all displayed mean densities of <3/m² (Table 64).

Table 63. TNR 4 Excavation summary

	Phase 1	Phase 2	No. Open Areas	Total Artefacts	% of Total
TNR AFT 22	6 (100%)	-	-	6	0.1%
TNR AFT 24	18 (56%)	14 (44%)	3 (4, 5 & 9)	32	0.6%
TNR AFT 26	40 (22%)	139 (78%)	2 (1 & 2)	179	3.4%
TNR AFT 27	66 (9.5%)	630 (90.5%)	3 (6, 7 & 8)	696	13.4%
TNR AFT 29	10 (100%)	-	-	10	0.2%
TNR AFT 30	7 (37%)	12 (63%)	2 (11 & 12)	19	0.4%
TNR AFT 31	20 (18.5%)	87 (81.5%)	1 (10)	107	2.1%
B6	316 (10.3%)	2,754 (89.7%)	5 (3, 13-16)	3,070	59%
B54	45 (4.1%)	1,040 (95.9%)	7 (1)*	1,085	20.8%
Totals	528 (10.1%)	4,676 (89.9%)		5,204	

* Excavation methodology differed from other sites; all Phase 4 assessed as 1 area

Table 64. Artefact numbers and densities for each site

	Phase 1 m²	Phase 1 Artefacts	Artefact density	Phase 2 m²	Phase 2 Artefacts	Artefact density ²	Total m²	Total Artefacts	Artefact density
TNR AFT 22	31	6	0.2/m²	-	-	-	31	6	0.2/m²
TNR AFT 24	35	18	0.5/m²	24	14	0.6/m²	59	32	0.5/m²
TNR AFT 26	25	40	1.6/m²	50	139	2.8/m²	75	179	2.4/m²
TNR AFT 27	25	66	2.6/m²	51	630	12.3/m²	76	696	9.1/m²
TNR AFT 29	15	10	0.7/m²	-	-	-	15	10	0.7/m²
TNR AFT 30	20	7	0.3/m²	16	12	0.7/m²	36	19	0.5/m²
TNR AFT 31	25	20	0.8/m²	50	87	1.7/m²	75	107	1.4/m²
B6	42	316	7.5/m²	117	2,754	23.5/m²	159	3,070	19.3/m²
B54	10	45	4.5/m²	47	1,040	22.1/m²	57	1,085	19/m²
Totals	**228**	**528**	**2.3/m²**	**355**	**4,676**	**13.2/m²**	**583**	**5,204**	**8.9/m²**

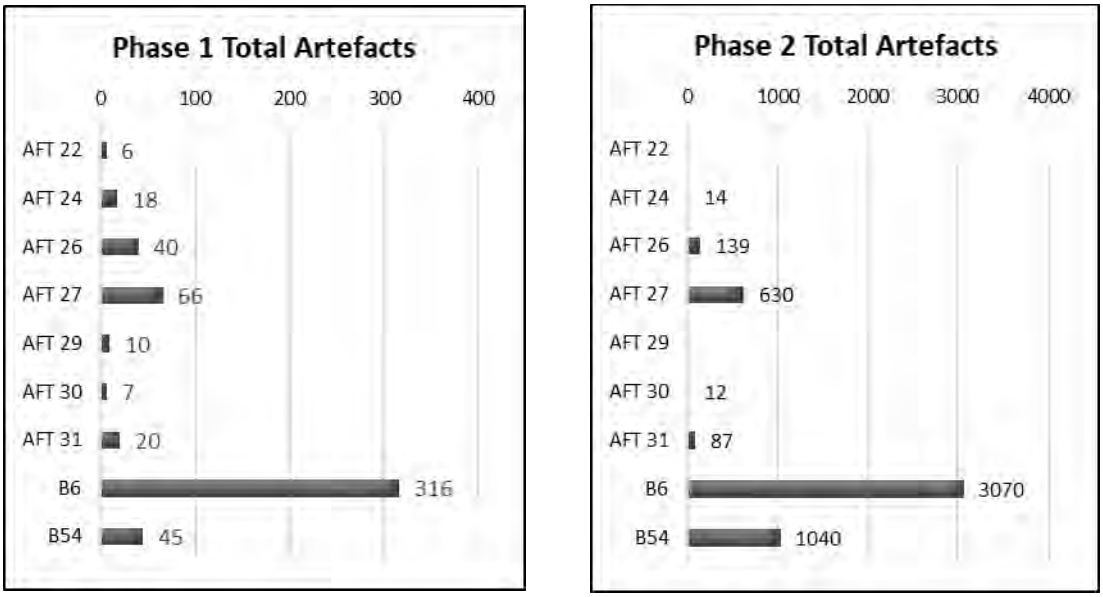


Figure 24. Phase 1 and 2 Total artefact numbers

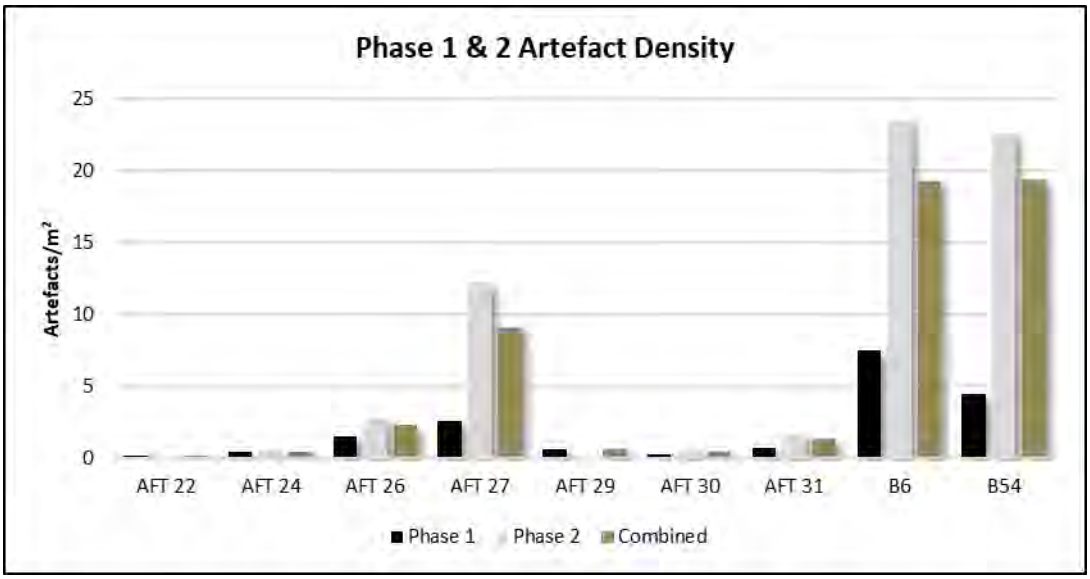


Figure 25. Phase 1 and 2 Artefact densities

The salvage program also included the investigation of 0.25m^2 units as a sample size in comparison to 1m x 1m (1m^2) units during the Phase 1 dispersed sampling. Each Phase 1 square was excavated in two separate parts – the initial north-western quadrant (0.25m^2) and a subsequent S-square extension of 0.75m^2 to create a 1m x 1m completed Phase 1 square. The two constituent units were sieved separately and separate artefacts tallies were kept, in order to examine the usefulness of the 0.25m^2 sample unit when conducting Phase 1 salvage or dispersed test excavation (both activities which seek to establish the spread of archaeological material across a given area and identify the presence/absence of artefacts at a given location).

The following analysis aims to establish a basic understanding of whether the presence/absence question is adequately answered by a 0.25m^2 sampling unit when compared to a standard 1m^2 sampling unit during dispersed unit excavation (i.e. not contiguous open areas). Data from site B54 is excluded as this was excavated using a different methodology and is not comparable to the TNR4 sites in this respect. Table 65 presents a basic summary of the agreement between unit types as to the presence/absence of artefacts at Phase 1 sample locations. For each Phase 1 square a positive or negative correlation was present between the NW quad unit and the subsequent S-square extension. The presence of artefacts in both the NW quad and the S-square (a positive/positive or +/+), or the absence of artefacts in both (negative/negative or -/-), was treated as a positive correlation (x/x). In cases where the NW quad contained artefacts and the S-square did not (or vice versa) a negative correlation was recorded (x/y).

Table 65. Artefact presence/absence agreement between units in Phase 1 squares

Site	Total Ph. 1 squares	Total +/+[1]	Total -/-[2]	Total x/x[3]	% x/x[4]	Total x/y[5]	% x/y[5]
TNR AFT 22	31	1	26	27	87.0%	4	13%
TNR AFT 24	35	1	20	21	60.0%	14	40.0%
TNR AFT 26	25	4	5	9	36.0%	16	64.0%
TNR AFT 27	25	4	9	13	52.0%	12	48.0%
TNR AFT 29	15	0	8	8	53.3%	7	46.7%
TNR AFT 30	20	2	16	18	90.0%	2	10.0%
TNR AFT 31	25	2	18	20	80.0%	5	20.0%
B6	42	22	4	26	62.0%	16	38.0%
Total	218	36	106	142	65.1%	76	34.9%

1 Phase 1 squares where NW quad and S-extension both contained artefacts (positive/positive); 2 Phase 1 squares where NW quad and S-extension both contained *no* artefacts (negative/negative); 3 Total number of Phase 1 squares where constituent units were in agreement (either +/+ or -/-); 4 Percentage of Phase 1 squares where constituent units were in agreement; 5 Total number of Phase 1 squares where constituent units were not in agreement (either +/- or -/+); 6 Percentage of Phase 1 squares were constituent units were not in agreement

The data indicates that the presence/absence of artefacts in the 0.25m^2 NW quad unit is a variable indicator of the presence/absence of artefacts in an expanded 1m^2 sample at that particular location. The sites with the most positive correlations were TNR AFT 30 (90% of squares) and TNR AFT 22 (87% of squares), but these sites both had very low numbers of artefacts recovered (n=6 and n=7 respectively), with the number of correlations increased by the high proportion of squares which contained zero artefacts.

For sites with a larger Phase 1 artefact sample (>40 artefacts), the percentage of Phase 1 squares where constituent units were in agreement ranged from 36-56%, increasing as artefact numbers increased. At B6, which had the largest Phase 1 artefact count and highest density, over half of squares had units that were in agreement about the presence/absence of artefacts (n=26, 62% of Phase 1 squares). The site with the lowest level of agreement within Phase 1 squares was TNR AFT 26, where just 36% of Phase 1 squares contained constituent units which shared a presence/absence determination.

Table 66. Artefact numbers and densities per sample unit type

	NW Quads (0.25m^2)			S-extensions (0.75m^2)			Phase 1 squares (1m^2)		
Site	**m^2**	**n**	**Mean density**	**m^2**	**n**	**Mean density**	**m^2**	**n**	**Mean density**
TNR AFT 22	7.75	2	0.3/m^2	23.25	4	0.2/m^2	31	6	0.2/m^2
TNR AFT 24	8.75	3	0.3/m^2	26.25	15	0.6/m^2	35	18	0.5/m^2
TNR AFT 26	6.25	6	1/m^2	18.75	34	1.8/m^2	25	40	1.6/m^2
TNR AFT 27	6.25	16	2.6/m^2	18.75	50	2.7/m^2	25	66	2.6/m^2
TNR AFT 29	3.75	2	0.5/m^2	11.25	8	0.7/m^2	15	10	0.7/m^2
TNR AFT 30	5	4	0.8/m^2	15	3	0.2/m^2	20	7	0.3/m^2
TNR AFT 31	6.25	2	0.3/m^2	18.75	18	1/m^2	25	20	0.8/m^2
B6	10.5	74	7.1/m^2	31.5	242	7.7/m^2	42	316	7.5/m^2
Total	54.5	109	1.6/m^2	163.5	374	1.9/m^2	218	483	1.8/m^2

A consideration of the mean artefact density indicated by the NW quad units compared to the S-square extensions is also a useful indicator of the efficacy of the smaller 0.25m^2 sampling unit. Table 66 shows the mean artefact density calculated based on the total NW quad sample, S-square sample and combined Phase 1 sample for each site in artefacts/m^2. It can be seen that in the majority of cases the 0.25m^2 sample size indicates a lower mean density than the expanded S-squares, except at TNR AFT 22 and TNR AFT 30 which again showed a different trend due to their small artefact counts and high number of zero squares. For most of the sites, the mean density calculated for the 0.75m^2 S-square extension was closer to the eventual mean Phase 1 density for the site, due to the larger sample size. The difference in density between the NW quad mean and the Phase 1 mean for each site ranged from 0.1-1.3 /m^2, while the difference between S-square mean and Phase 1 mean was smaller, ranging from 0.1-0.4/m^2. For both samples, the difference in mean artefact density was greatest for high density site B6.

Future investigation should aim to identify and analyse which variables may be responsible for differences in the effectiveness and appropriateness of each sample unit size. Potential factors influencing the utility of each sample size include landform, site type, artefact densities, nature of artefact distribution (localised or dispersed), and the nature and extent of disturbance.

8.2 Artefact Densities and Landforms

Past archaeological studies have shown evidence that Aboriginal people have patterned their occupation of Country. Within the collection of sites recorded, differences in assemblages appear to correlate with variation in their landscape setting. Site locations were classified as either being on lower slopes (terraces), mid slopes (benches), upper slopes or hill crests. Broad comparison of sites within and across these classes reveals that larger sites with more varied assemblages were located on lower slopes adjacent to creek lines. In contrast, the sites with fewest numbers of artefacts and the smallest range of artefact types were found on mid slopes. Sites on hill crests displayed a trend towards more specialised or selective artefact and raw material arrays, with generally low to moderate artefact densities. This pattern was suggested by the Phase 2 open area excavations in this study (Table 67).

Table 67. Landforms sampled by the Phase 2 open excavation areas

Landforms	Phase 2 squares	Artefact total
Lower slope	152 (49.4%)	3,467 (92.5%)
Mid slope	16 (5.2%)	12 (0.3%)
Ridge Crest	140 (45.4%)	269 (7.2%)
Total	**308**	**3,748**

*Site B54 not included

Archaeological studies over many years across the Cumberland Plain have tended to find this same pattern. It has been argued that it reflects variability in Aboriginal people's use of the landscape, and as such is an archaeological signature of deliberate land use strategies that reflected a structured way of inhabiting and utilizing the land. The presence of larger, more complex assemblages on lower slopes adjacent to creeks has been interpreted as the outcome of repeated occupation of these areas, often by larger groups, who were taking advantage of important characteristics in these areas. These multipurpose sites are domestic hubs, where many people gathered to undertake a range of activities. The TNR 4 project has two locations which fit this category, B6 and B54, both located in the southern section of the project area on Badgerys Creek. Site TNR AFT 27 displays some of these characteristics, mainly in the lower areas of the site adjacent to the creekline. The landscape features at these site locations include: ease of access to a good water supply; level ground for camping; an array of economic resources; and greater numbers of plant food resources associated with riparian and grassy woodland vegetation classes. The term "base camp" has been used for many years to label these types of sites in the region.

Over time, as these areas were the scene of repeated occupations, it is assumed that the variation in tasks and activities being carried out resulted in the presence of a diverse collection of artefact types. These tasks included stone and wooden artefact manufacture and repair, and food preparation and consumption. In some cases it is relatively easy to assign tool or artefact types to specific activities. A good example would be eloueras which were used for woodworking. In other cases a tool type might have been used to perform an array of different tasks. Sharp edged flakes, for example, could have been used for processing meat, hide and sinew, as well as wooden tool manufacture or even ritual activities. In contrast, the smaller sites discovered on mid and upper slopes are interpreted as signatures of possibly repeated, but shorter term occupation, often associated with transiting through a landscape to more favoured occupation areas or to facilitate specific activities (away from domestic base camps). Almost all sites within this study fit within this category, including portions of the larger sites B6, B54 and TNR AFT 27 which incorporate various landform types within their wider site extents. Disturbance levels within each site must also be considered, with many of the hill top/ridge crest sites displaying higher degrees of erosion and soil deflation compared to sites on lower slopes and alluvial benches, although these lower sites would also be subject to periodic flooding.

Importantly, it is also possible that associating the absence of larger assemblages with shorter term, and less frequent use of a location is potentially simplistic. A location could have been used regularly, and for extended periods but not necessarily resulted in the subsequent discard of artefacts. Sites used as a vantage point to observe Country or travel routes between locales are potential examples. In broad terms, the delineation of base camps or living areas, from these types of sites is premised on the positive occurrence, at the former, of both larger and more varied artefact assemblages. Their size and variability is interpreted as being the product of extended and repeated occupation of a site to carry out a broad range of activities associated with group life and behaviours.

8.3 Intra-site spatial patterning

The analysis showed that the occurrence of artefacts along the TNR 4 project area was generally consistent with that found at many similar large-scale archaeological investigations elsewhere in the region. This pattern of site distribution appears to hold true, even when factors of land disturbance and the statistical effects of variable sample size are taken into account. At a finer scale, intra-site spatial patterning at individual sites is inherently difficult to bring to light. Intra-site patterning concerns the differential distribution of artefacts, ideally, within a minimally dated horizon.

The delineation of individual occupation events at particular locations, where possibly thousands of years of occupation has occurred, is often prevented by taphonomy and subsequent spatial mixing of artefacts.

Only one site within this study, B6, showed clear evidence of individual knapping or occupation events within the generally mixed nature of the assemblage. A number of discrete events were identified during recording of the artefacts for this study. These events were identified due to the increased presence of a particular raw material type and a more complete reduction sequence within a limited area, although there was no indication of vertical stratigraphic integrity. The low artefact density at most of the other sites precluded the identification of specific activities, and the different methodology used at site B54 meant that identifying individual events within the open area was more difficult despite the apparent integrity of the soils.

8.4 Vertical distribution of Artefacts and Raw Materials

One site, B54, was excavated in arbitrary 10cm spits to the basal clay layer. In most cases this incorporated three spits. The majority of artefacts were located below 10cm, with the highest percentage found between 10-20cm. While there was some variation between raw materials, the concentration of materials in different spits remained consistent, effectively concealing any evidence of changing raw material use and accessibility over time. This pattern of artefact distribution within the soil profile is standard for many sites on the Cumberland Plain where the podzolic soils have deflationary tendencies, and bioturbation encourages the movement of artefacts down the profile.

Table 68. Vertical distribution of artefacts at site B54

Spit Density	Silcrete	Tuff	Quartz	Chert	P. Wood	FGS	Igneous	Total
Spit 1	47 6%	3 2.8%	26 15.6%	2 16.7%	0	2 66.7%	1 100%	81 7.5%
Spit 2	464 58.8%	78 72.2%	111 66.5%	8 66.7%	5 100%	1 33.3%	0	667 61.5%
Spit 3	278 35.2%	27 25%	30 18%	2 16.7%	0	0	0	337 31.1%
Total	**789**	**108**	**167**	**12**	**5**	**3**	**1**	**1,085**

8.5 Spatial distribution of Raw Materials

Artefact raw materials were classified into five categories, including silcrete (66.1%), silicified tuff (12.6%), quartz (16.1%), chert (4.2%) and other (1%), which incorporated rarer raw material types including petrified wood, quartzite, mudstone, medium and fine grained siliceous and igneous material. Artefacts from all of these categories were represented in both the Phase 1 and Phase 2 lithic assemblages.

Table 69. Phase 1 & 2 raw material summary

Raw Materials	Silcrete	Tuff	Quartz	Chert	Other	Total
Phase 1	325 61.6%	92 17.4%	71 13.4%	27 5.1%	13 2.5%	**528** **10.1%**
Phase 2	3,115 66.6%	565 12.1%	764 16.3%	194 4.1%	38 0.8%	**4,676** **89.9%**
Phase 1 & 2 Combined	**3,440** **66.1%**	**657** **12.6%**	**835** **16%**	**221** **4.2%**	**51** **1%**	**5,204**

Table 70. "Other" raw materials

Other Materials	P. Wood	Quartzite	Mudstone	MGS	FGS	Igneous
Phase 1 & 2	23	11	3	1	8	5

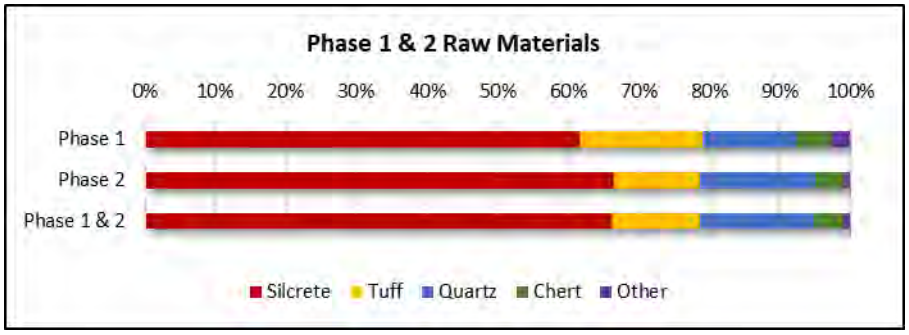


Figure 26. Phase 1 & 2 raw materials

The ratios of raw materials used varied between sites although in most cases silcrete was the most common material making up 66.1% of the combined assemblages. The most common silcrete type was what appeared to be a mixture of heated red/red-yellow/yellow silcrete making up almost 85% of the assemblage. Rarer silcrete types were also encountered, including low numbers of grey, white and black silcrete.

Table 71. Phase 1 & 2 silcrete colours

Colour	Red	Red/yellow	Yellow	Pink	Orange	Purple	Grey	White	Black	Total
All TNR 4	1,724	279	190	243	60	110	40	3	2	2,651
B54	585	89	34	49	1	22	7	1	1	789
Total	**2,309 67.1%**	**368 10.7%**	**224 6.5%**	**292 8.5%**	**61 1.8%**	**132 3.8%**	**47 1.4%**	**4 0.1%**	**3 0.1%**	**3,440**

Quartz was the second largest material assemblage, with a number of open areas at site B6 having discrete areas of highly concentrated quartz, although it was recovered in various quantities across most sites. Tuff and chert were the only two other materials located in significant numbers, and as with quartz were located in various quantities and concentrations across the study area, with both materials displaying highly varied material composition. The other material types were generally found in low quantities scattered throughout the study area. Most of the igneous material was identified as hammerstone/axe fragments or debris from their use.

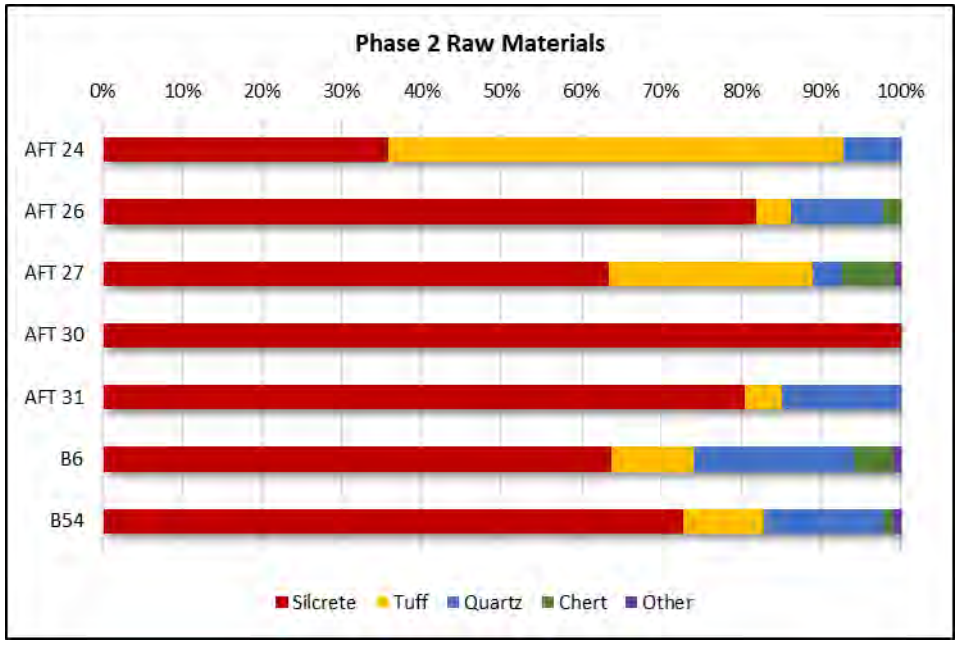


Figure 27. Phase 2 Raw material distribution

8.6 Size Range of Raw Materials

The vast majority of artefacts (86%) were under 20mm in length (maximum dimension) with the four main raw material types, silcrete, tuff, quartz and chert showing a peak in artefact numbers between 10-20mm size range, while the 'other' class shows a generally larger overall size range than the more common materials. This peak is followed by a steep reduction in artefact numbers between 20-30mm with few artefacts greater than 30mm. All materials show varying trends in size distribution, with tuff and chert having on average a larger size distribution of artefacts than silcrete and quartz. Quartz in particular had a much higher percentage of smaller artefacts, with just over 97% of the assemblage being less than 20mm in size with 44% less than 10mm.

Table 72. Phase 1 & 2 Size range of raw materials

Size Range	Silcrete	Tuff	Quartz	Chert	Other	Total
<10mm	1,171 34%	148 22.5%	365 43.7%	36 15.2%	8 15%	**1,728** **33.2%**
10-20mm	1,801 52.4%	359 54.7%	447 53.5%	126 56.7%	20 35%	**2,753** **52.8%**
21-30mm	359 10.4%	115 17.5%	22 2.6%	47 22.4%	10 22.5%	**553** **10.7%**
31-40mm	93 2.7%	25 3.8%	1 0.1%	8 3.8%	11 22.5%	**138** **2.7%**
>40mm	16 0.5%	10 1.5%	0	4 1.9%	2 5%	**32** **0.6%**
Total	**3,440**	**657**	**835**	**221**	**51**	**5,204**

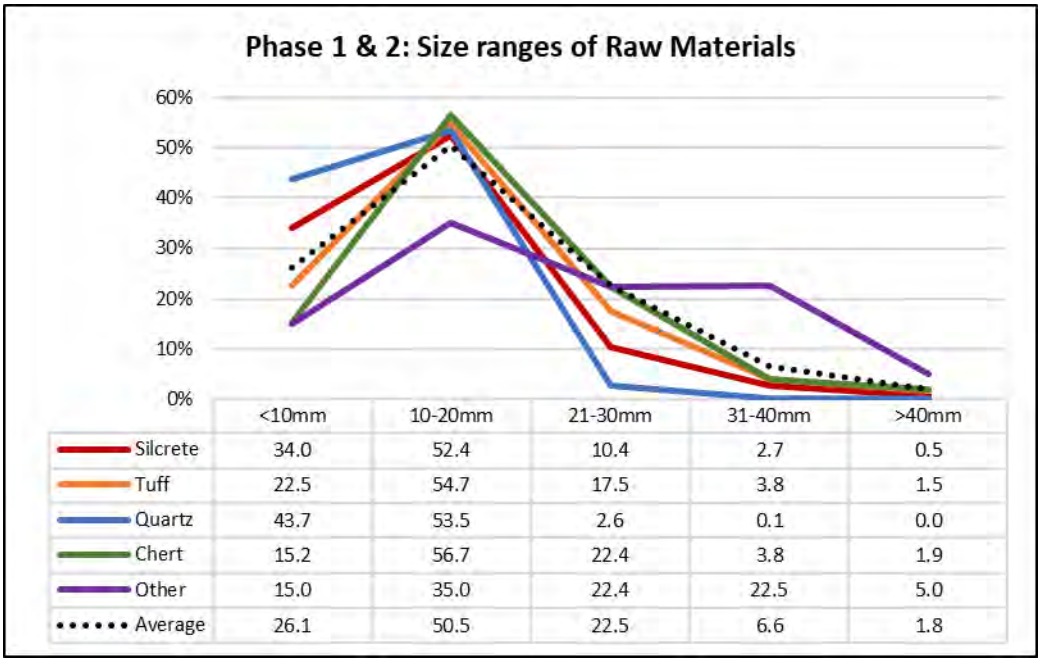


Figure 28. Phase 1 & 2 Percentage of raw materials by size category

8.7 Reduction Types: Phase 2 Program

During recording, artefacts were classified into eight separate ''reduction types": Flake, bipolar flake, split flake, proximal fragment, medial fragment, distal fragment, angular fragment and core. For statistical analysis, these reduction types have been merged to form four primary categories: **Flake & flake fragment** (flake, bipolar flake, split flake, proximal fragment, medial fragment and distal fragment), **Angular fragment** (angular fragment) and **Core** (whole core and core fragment).

Flakes and flake fragments were the most common reduction types across both the Phase 1 and Phase 2 assemblages followed in most cases by angular fragments. The exception to this trend was site TNR AFT 30 in Phase 1 and Phase 2, and TNR AFT 31 in Phase 2, where the percentage of cores within the assemblages was exceptionally high. However, it is important to factor in the low artefact numbers retrieved from TNR AFT 30 which does not even come close to representing a complete assemblage. The higher number of cores found at TNR AFT 31 is somewhat more intriguing given that the number of artefacts, while still low, was of a statistically viable size (n=87). It is evident that core material was being discarded at these sites without the higher quantity of flaked debitage normally associated with that proportion of cores in an assemblage.

By separating complete flakes from flake fragments, variation and similarities between salvage areas becomes evident. The two sites representing the bulk of the assemblage, B6 and B54, both display very similar percentages of reduction types, most likely due to the much higher numbers of artefacts representing complete reduction sequences. The assemblage at site TNR AFT 27 also has similar reduction type ratios, although there appears to be substantially higher levels of fragmentation within the assemblage than at B6 and B54. The other sites, predominantly located on crests, displayed a much higher variation in reduction type ratios, primarily due to low artefact. Phase 2 excavations at sites TNR AFT 27, B6 and B54 were primarily conducted on lower slopes and raised alluvial benches adjacent to major water sources, and displayed more intact soil profiles and thus archaeological assemblages.

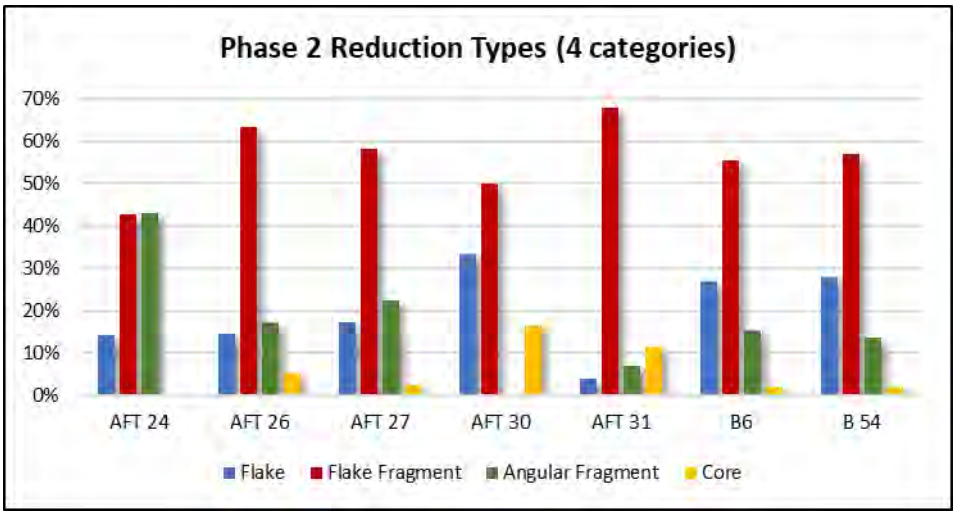


Figure 29. Phase 2 reduction types (four categories)

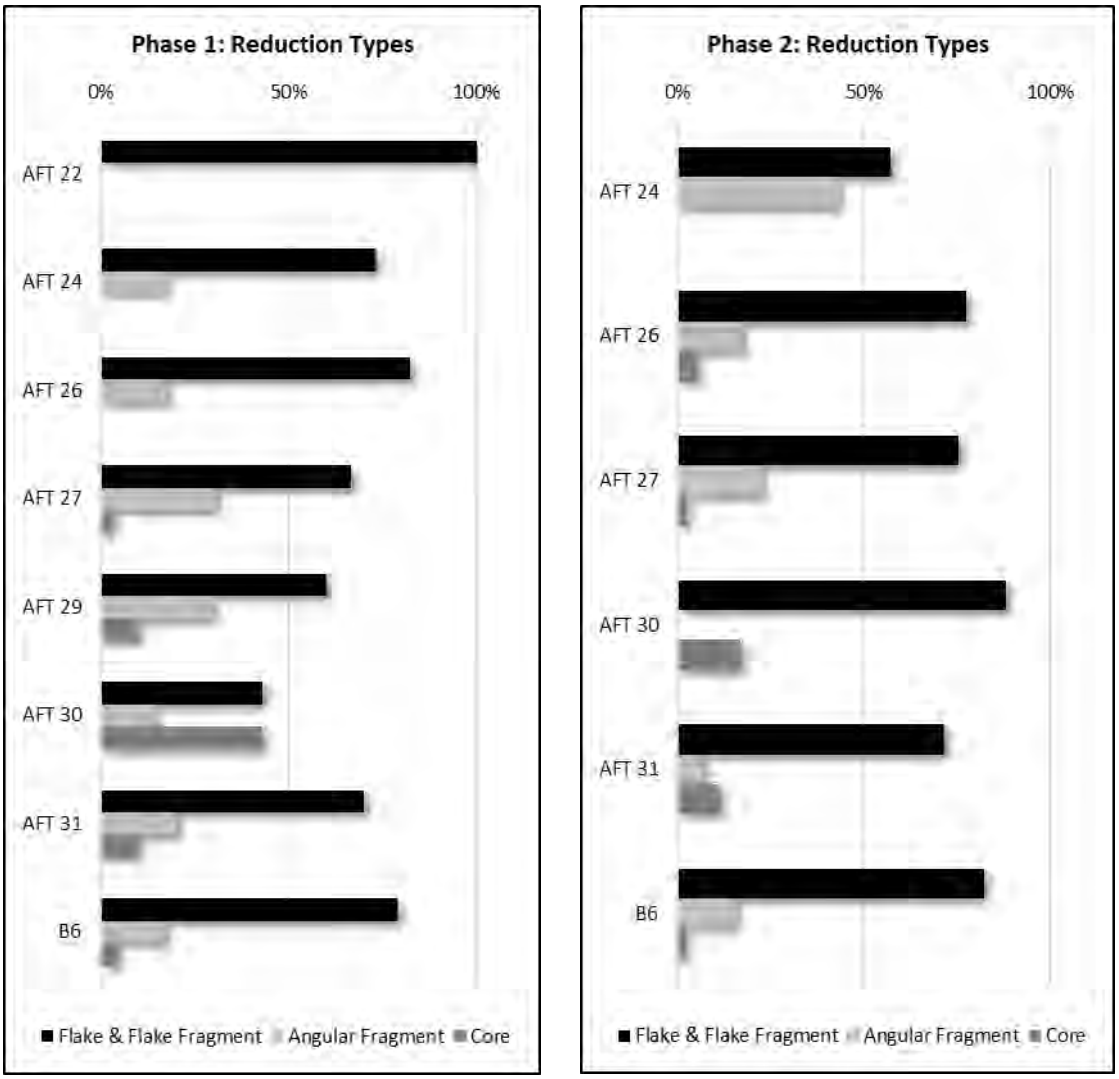


Figure 30. Relative proportions of reduction types – Phase 1 & 2

Table 73. Phase 1 reduction types

Reduction types		Flake	Flake Fragment	Angular Frag	Core	Total
TNR 4	AFT 22	0	6 100%	0	0	6 1.1%
	AFT 24	2 11.1%	13 72.2%	3 16.7%	0	18 3.4%
	AFT 26	9 22.5%	24 60%	7 17.5%	0	40 7.7%
	AFT 27	12 18.2%	32 48.5%	20 30.3%	2 3%	66 12.5%
	AFT 29	3 30%	3 30%	3 30%	1 10%	10 1.9%
	AFT 30	1 14.3%	2 28.6%	1 14.3%	3 42.9%	7 1.3%
	AFT 31	6 30%	8 40%	4 20%	2 10%	20 3.8%
	B6	83 26.3%	166 52.5%	53 16.8%	14 4.4%	316 59.8%
B 54		7 15.6%	30 66.7%	6 13.3%	2 4.4%	45 8.5%
Total		**123 23.3%**	**284 53.8%**	**97 18.4%**	**24 4.5%**	**528**

Table 74. Phase 2 reduction types

Reduction types		Flake	Flake Fragment	Angular Frag	Core	Total
TNR 4	AFT 22	0	0	0	0	0
	AFT 24	2 14.3%	6 42.8%	6 42.9%	0	14 0.2%
	AFT 26	20 14.4%	88 63.3%	24 17.3%	7 5%	139 3%
	AFT 27	107 17.1%	366 58.3%	140 22.3%	15 2.4%	628 13.5%
	AFT 29	0	0	0	0	0
	AFT 30	4 33.3%	6 50%	0	2 16.7%	12 0.3%
	AFT 31	12 3.8%	59 67.8%	6 6.9%	10 11.5%	87 1.8%
	B6	742 27%	1,529 55.5%	428 15.5%	55 2%	2,754 59%
B 54		286 27.7%	590 56.9%	140 13.5%	20 1.9%	1,036 22.2%
Total		**1, 173 25.2%**	**2,644 56.6%**	**742 15.9 %**	**109 2.3%**	**4,668**

8.8 Cortical Artefacts and Reduction Intensity

The number of cortical artefacts varied between the raw material assemblages. The highest proportion of cortical artefacts from the Phase 2 excavations were found within the silicified tuff assemblage (28.5%) followed by quartz (22.9%). Silcrete, the largest representative sample of raw material, had a slightly lower percentage of cortical artefacts at 20.6% with chert having the lowest (12.7%) number of cortical artefacts. Higher levels of cortex within a raw material type is often indicative of less intense reduction and also easier access to the raw material source. Characteristics within the tuff assemblage show larger sized flakes and flaked debitage, with increased evidence of primary and secondary reduction. Despite the quartz assemblage having relatively high levels of cortex, flaked artefacts were the smallest of the entire assemblage. Bipolar flaking was prevalent within the quartz assemblage, with use of smaller quartz pebbles being used as core material indicated. In this case higher instances of cortical artefacts coupled with smaller artefacts would be expected.

Lower levels of cortex indicate more intense reduction of materials and less access to the raw materials. In the case of this study, it is likely that silcrete sources were located outside the immediate local area and were being imported from the surrounding region. More intense reduction of core materials, smaller artefact sizes and primarily tertiary reduction with only small evidence of primary and secondary reduction, are all characteristics within the assemblage which support this. Contrary to this, however, the core assemblage had almost 50% of artefacts with cortex, although the cores themselves were generally smaller than average when compared to other sites in Western Sydney. The very low levels of cortex found within the chert assemblage indicate that these materials were being sourced some distance from the project area, likely from sources at the base of the Blue Mountains to the west.

There was no specific evidence of heat treatment of silcrete cobbles on any of the sites with the study area, with only small numbers of heat shattered silcrete recovered. Normally if cobbles are being heated on site large numbers of heat shattered material is found alongside knapped material. This was not evident at the TNR sites where heat shattered artefacts were infrequent. It is more likely that silcrete was heated at the source location and imported into the area. Non cultural heating may have also occurred such as periodic natural fire events.

Table 75. Phase 1 & 2 Cortical artefacts

Proportion of cortical artefacts		Silcrete	Tuff	Quartz	Chert	Other
Phase 1	TNR4	293 55 (18.8%)	89 16 (18%)	61 13 (21.3%)	27 2 (7.4%)	13 2 (15.4%)
	B54	32 1 (3.1%)	3 0	10 0	0	0
	Total	**325 56 (17.2%)**	**92 16 (17.4%)**	**71 13 (18.3%)**	**27 2 (7.4%)**	**13 2 (15.4%)**
Phase 2	TNR4	2,358 521 (22.1%)	460 137 (29.8%)	607 135 (22.2%)	182 21 (11.5%)	30 6 (20%)
	B54	757 120 (15.9%)	105 24 (22.9%)	157 40 (25.5%)	12 3 (25%)	9 1 (11.1%)
	Total	**3,115 641 (20.6%)**	**565 161 (28.5%)**	**764 175 (22.9%)**	**194 24 (12.7%)**	**39 7 (17.9%)**

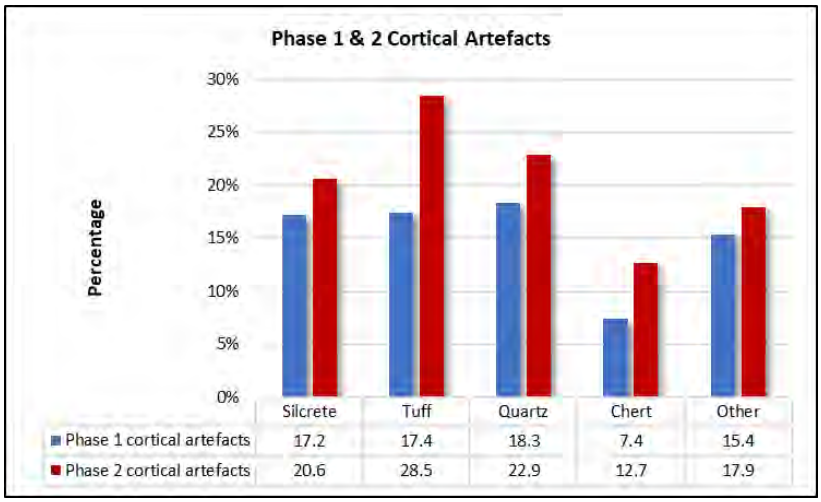


Figure 31. Phase 1 & 2 cortical artefacts

Table 76. Silcrete cortical artefacts by reduction type

Silcrete Artefacts	Flake	Flake fragment	Angular fragment	Core
Cortical artefacts	194	351	98	54
Total Artefacts	864	2,099	371	106
% of cortical artefacts	22.5%	16.7%	26.4%	50.9%

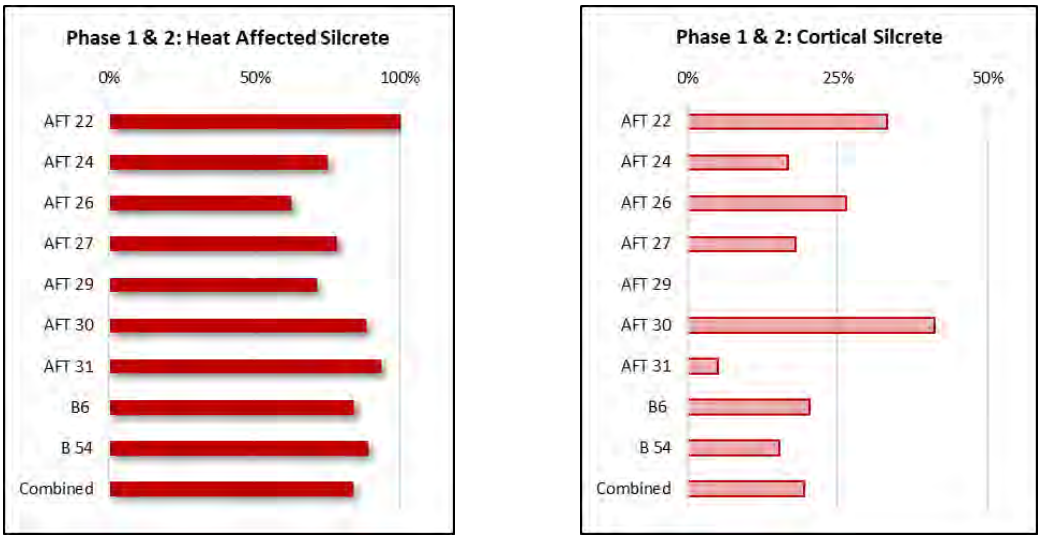
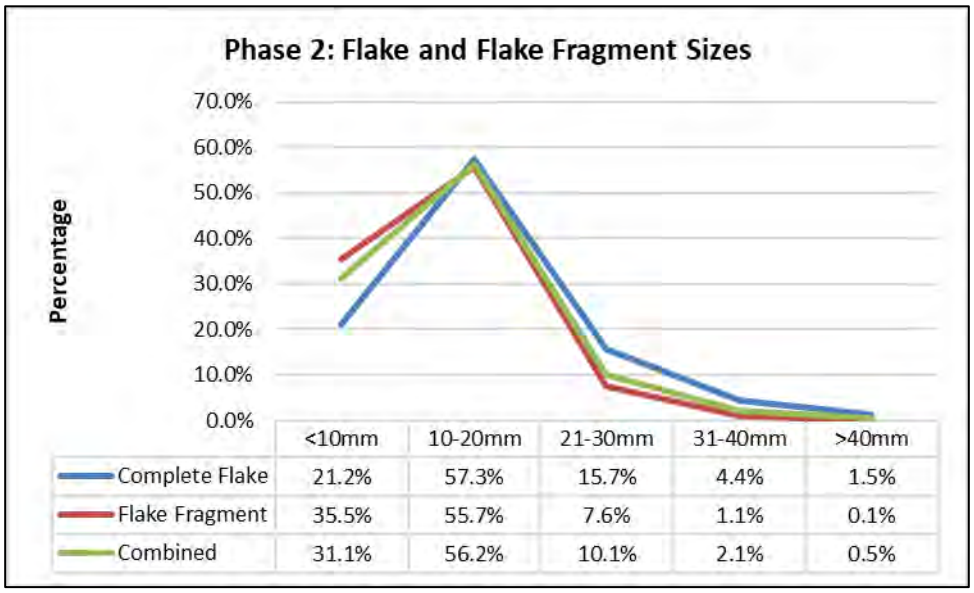


Figure 32. Phase 1 & 2 Heat Affected and cortical silcrete by site

8.9 Flake Assemblage: Phase 2 salvage areas compared

The vast majority of flakes and flake fragments were less than 20mm (maximum dimension). The majority of complete flakes were longer than wide in shape. These flakes represent the by-product of generalised core reduction and are not necessarily indicators of backed artefact production. Elongate shaped flakes make up a lower proportion of the flake assemblage and appear to be associated with more specialised production of tools. Production of backed blades was evident at sites B6 and B54 and to some extent at TNR AFT 27, each of which had a relatively high proportion of elongate flakes within the assemblage (Figure 35). Sites TNR AFT 26 and TNR AFT 31 also had a high proportion of elongate flakes, however there was little evidence of tool manufacturing within each individual assemblage.



	<10mm	10-20mm	21-30mm	31-40mm	>40mm
Complete Flake	21.2%	57.3%	15.7%	4.4%	1.5%
Flake Fragment	35.5%	55.7%	7.6%	1.1%	0.1%
Combined	31.1%	56.2%	10.1%	2.1%	0.5%

Figure 33. Flake and flake fragment size ranges

Methods of reduction varied between the raw material assemblages. Figure 36 shows the range of flake sizes by raw material type, as well as the overall trend between flake shapes. The linear trends show that flaking patterns were similar between the tuff and silcrete assemblages, with no major inclination towards longer flakes or expanding flakes. The quartz and chert flakes tend towards expanding flake shapes rather than longer or elongate shapes. It is not clear whether this indicates changing technology or simply practical application of force during the manufacturing of artefacts and the size and shape of the raw material being knapped.

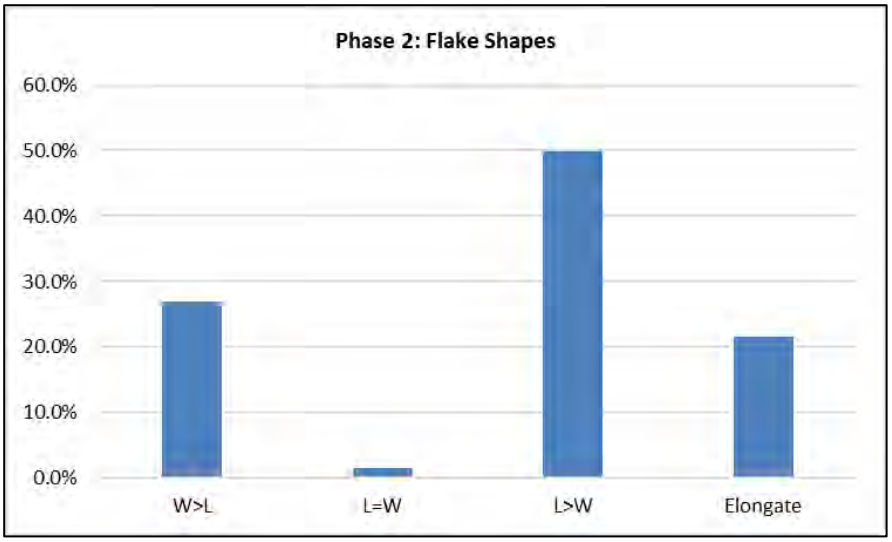


Figure 34. Flake shapes Phase 2

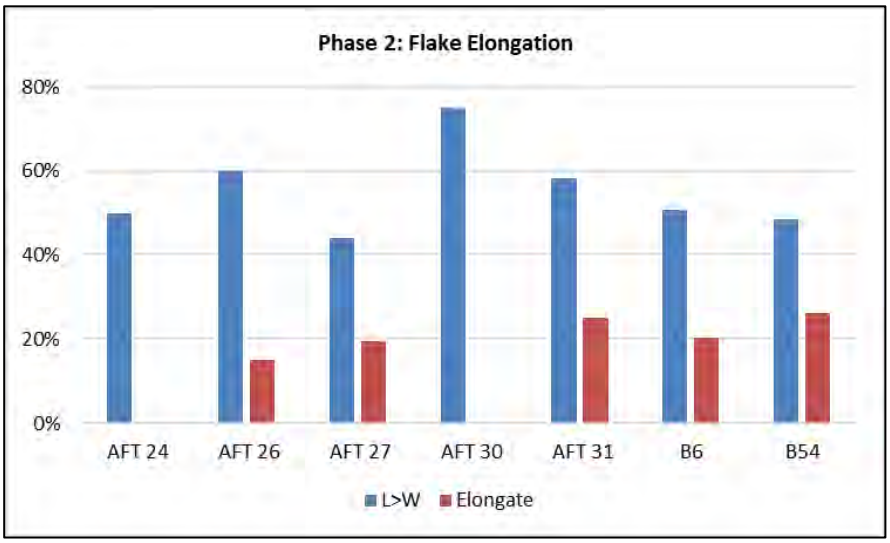


Figure 35. Flake elongation Phase 2

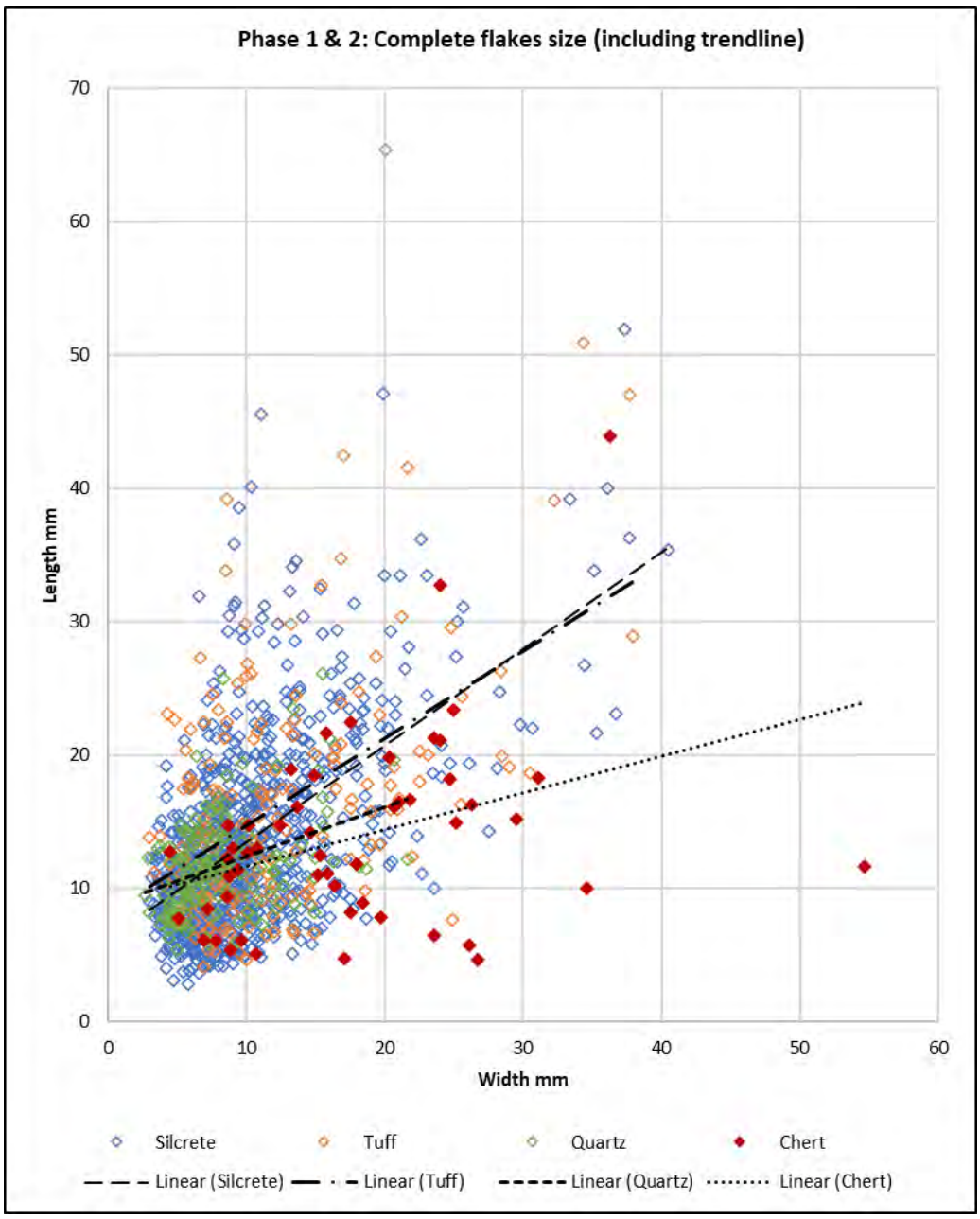


Figure 36. Flake sizes and trending shapes

8.10 Characteristics of Cores: Phase 1 & 2 Salvage Areas Combined

A total of 117 whole cores were recovered during the Phase 1 and 2 excavation programs with 17 core fragments also identified. Silcrete cores comprised 79.9% of the core assemblage, followed by tuff (6.7%), quartz and chert (both 5.2%). No quartz cores were identified at site B54, despite this raw material being the second largest assemblage on site. Two petrified wood cores fragments were identified, as well as single whole cores of FGS and quartzite. Sites TNR AFT 30 and 31 recorded a much higher frequency of cores than is common, although the number of artefacts at each site was low. The sites with higher numbers of artefacts, such as TNR AFT 27, B6 and B54 show a much lower ratio of cores to flaking debitage, between 2.2-2.3% of the assemblage at each site, which is more in keeping with sites with similar assemblage sizes in Western Sydney. The elevated percentages of cores on the two sites with smaller assemblages is unusual and may be due to loss of archaeological integrity at each site.

The most common whole core types were unifacial (31.6%) and multidirectional (28.2%). However, core flaking patterns were highly varied, with smaller numbers of unifacial-rotated, bidirectional, bifacial and bipolar cores identified (Table 78, Figure 37). Four flake cores and one tranchet core were also identified. Small numbers of bipolar cores were found within each of the main material assemblages, although predominantly within the quartz assemblage. A number of cores were also identified as 'blade' cores, indicating systematic manufacturing of blade flakes in conjunction with a higher number of backed blades found at sites B6 and B54. The one tranchet core identified points directly to the manufacturing of backed blades within the silcrete assemblage.

Core sizes were mostly small across the project area, with correspondingly low weights (Table 79). Quartz cores in particular were small with high levels of cortex and low reduction intensity, indicating bipolar reduction of small quartz pebbles. Concurrently, most of the main material assemblages display low reduction intensity (1-2 negative scars) and high percentages of cortical artefacts, despite the cores themselves being generally small. The exception to this is the tuff assemblage which has a higher percentage of cores with higher reduction intensities, although the level of cortex is high.

Table 77. Phase 1 & 2 – Cores & core fragments

Phase 1 & 2 Cores		Core Fragment (Count)	Whole Cores (Count)	Whole Cores (% of Assemblage)
TNR 4	AFT 24	0	0	0
	AFT 26	1	6	3.4%
	AFT 27	1	16	2.3%
	AFT 29	1	0	0
	AFT 30	0	5	26.3%
	AFT 31	2	10	9.3%
	B6	9	61	2.3%
TNR 4 total		**14**	**98**	**2.2%**
B 54		3	19	1.8%
Total		**17**	**117**	**2.2%**

Table 78. Phase 1 & 2 – Core types by raw material

Phase 1 & 2 Core Types	Silcrete	Tuff	Quartz	Chert	Other	Total
Unifacial	33	1	2	1	0	**37 (31.6%)**
Unifacial-Rotated	13	1	0	0	0	**14 (12%)**
Multidirectional	28	3	0	0	2	**33 (28.2%)**
Bidirectional	6	0	0	1	0	**7 (6%)**
Bifacial	10	0	0	1	0	**11 (9.4%)**
Bipolar	1	2	5	2	0	**10 (8.5%)**
Flake Core	3	1	0	0	0	**4 (3.4%)**
Tranchet	1	0	0	0	0	**1 (0.9%)**
Total	**95 (81.2%)**	**8 (6.8%)**	**7 (6%)**	**5 (4.3%)**	**2 (1.7%)**	**117**

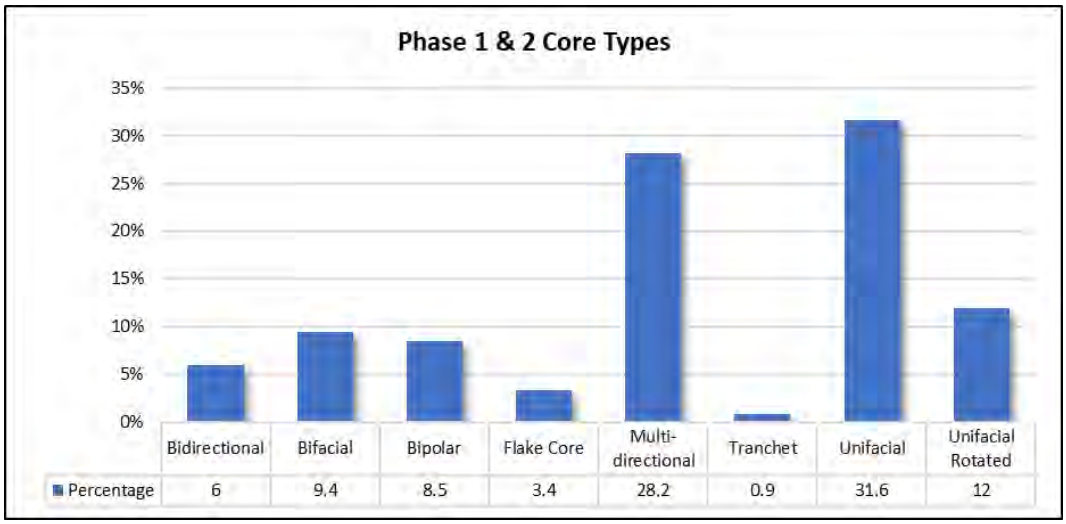


Figure 37. Phase 1 & 2 – Core types

Table 79. Core weights (whole cores)

Phase 1 & 2 Core Weights	Min Weight (g)	Max Weight (g)	Mean Weight (g)
Silcrete	0.74g	69.19g	8.1g
Tuff	1.23g	17.48g	11
Quartz	0.18g	6.49g	3.2g
Chert	2.69g	25.12g	9.1g
FGS	27.11g	27.11g	27.1g
Quartzite	5.01g	5.01g	5.01g

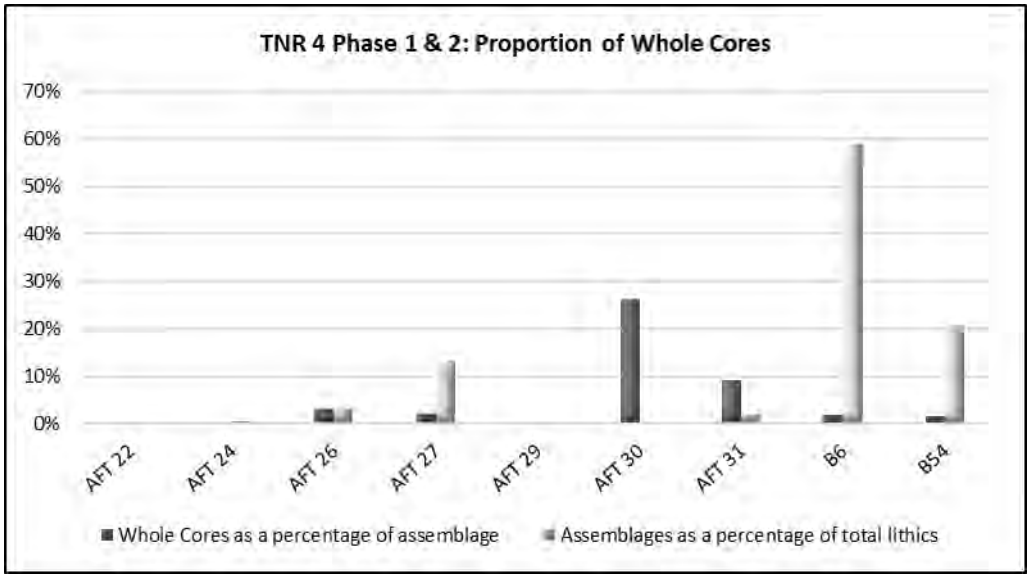


Figure 38. Proportion of whole cores by site

Table 80. Core reduction intensity

Core reduction intensity (no. scars)	1-2	3-4	5-6	7-9	Total
Silcrete	44 (46.3%)	33 (34.7%)	16 (16.9%)	2 (2.1%)	**95**
Tuff	3 (37.5%)	4 (50%)	1 (12.5%)	0	**8**
Quartz	7 (100%)	0	0	0	**7**
Chert	3 (60%)	1 (20%)	1 (20%)	0	**5**
Quartzite	0	0	1 (100%)	0	**1**
FGS	0	1 (100%)	0	0	**1**
Total	**57 (48.7%)**	**39 (33.3%)**	**19 (16.3%)**	**2 (1.7%)**	**117**

Table 81. Silcrete Core weights by flaking pattern

Phase 1 & 2 Silcrete Cores	Min. Weight (g)	Max. Weight (g)	Mean Weight (g)
Unifacial	1.23g	24.43g	6.6g
Unifacial-Rotated	2.53g	20.83g	9.9g
Multidirectional	0.74g	69.19g	11.1g
Bidirectional	2.21g	7.91g	4.4g
Bifacial	3.84g	13.29g	7.5g
Bipolar	3.22g	3.22g	3.2g
Flake Core	1.97g	2.18g	2.1g
Tranchet	6.62g	6.62g	6.62g

Table 82. Proportion of cortical cores by raw material

Phase 1 & 2 Cores with cortex	Silcrete	Tuff	Quartz	Chert	Other
AFT 26	50%	-	-	-	-
AFT 27	63.6%	50%	100%	0%	0%
AFT 30	40%	-	-	-	-
AFT 31	50%	0%	100%	-	-
B6	54.2%	50%	60%	66.7%	0%
B54	100%	100%	-	-	-

8.11 Backed Artefacts: Phase 1 & 2 Programs

Backed artefacts were recovered from six of the nine sites excavated during this project, with the majority located in sites situated on lower slopes with higher artefact numbers including TNR AFT 27, B6 and B54 (Figure 39, Table 83). A total of 88 backed artefacts were identified from the Phase 1 and 2 excavations comprising 1.7% of the total lithic assemblage. The majority (78.4%, n=69) of backed artefacts were made of silcrete, with silicified tuff backed artefacts (n=15, 17%) being the second most common. Small numbers of chert (2) and quartz (2) backed artefacts were also recovered.

The range of backed artefacts was fairly standard for Western Sydney comprising predominantly backed blades and geometric microliths. Four non-diagnostic backed fragments were also recovered. A large portion of backed blades were fragmented and may in most cases have been broken during use, with some artefacts showing use-wear along the working edge, or broken during the manufacturing process. Many blades were identified as 'Bondi points', however a wide range of shapes were encountered as well as varying levels of quality/finesse in backing. Many blades displayed only partial backing. It was noted that many of the geometric microliths were poorly formed with a number appearing broken or again with incomplete backing. Backed blade size ranges were standard, with most having a percussion length of between 15-35mm, with the largest being a tuff blade found at site B6 with a percussion length of 39.2mm. Geometric microliths were generally small and with one tuff exception at site B6, found within the silcrete assemblage. The majority of geometric microliths were between 10-15mm (maximum size) with the smallest being 8.9mm and the largest 18.2mm, both silcrete.

Where present, backed artefacts generally comprised between 1-3% of the assemblage, with the exception of TNR AFT 31. Sites with a higher density of artefacts, including TNR AFT 27, B6 and B54, and to some extent TNR AFT 26, tend to have a lower ratio of backed artefacts to the general assemblage, between 1-2%. The higher percentage of backed artefacts as well as retouched artefacts at site TNR AFT 31 likely indicates that this was an area being used for specific activities, such as butchering or other resource processing, despite the site having relatively few artefacts overall.

Manufacturing of backed artefacts was evident primarily at sites B6 and B54, both of which had a medium to high artefact density, as well as core types indicative of blade production. Bothe of these sites displayed complex site usage and extended occupation events and were located close to a permanent water source (Badgerys Creek). Site B6 in particular had evidence of individual knapping events and along with other characteristics of the assemblage is comparable to other sites on the Cumberland Plain displaying evidence of intense on-site artefact production.

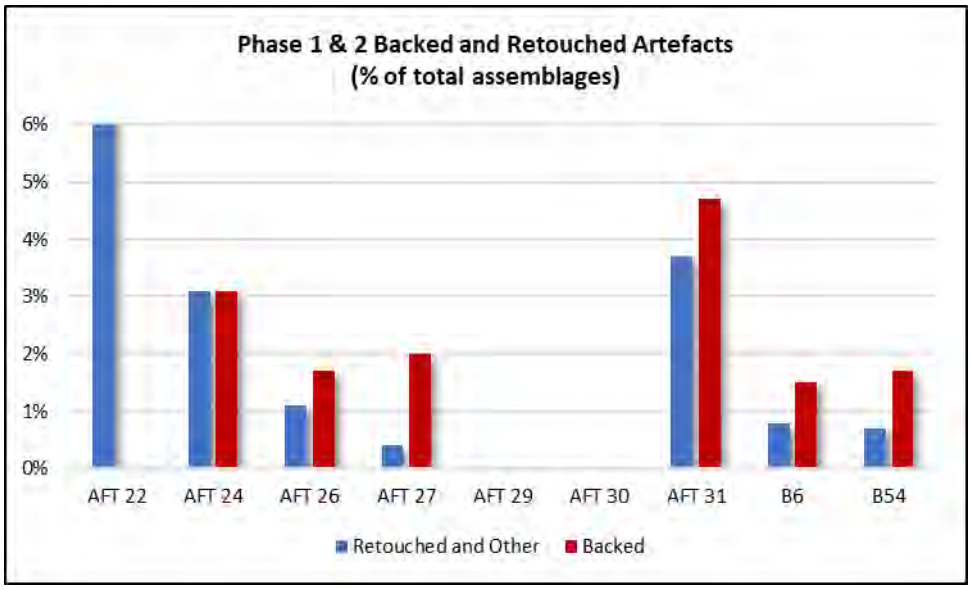


Figure 39. Phase 1 & 2 – Backed and retouched artefacts

Table 83. Phase 1 & 2 Backed artefacts

Phase 1 & 2 Backed Artefacts	Backed Blade	Blade Fragment	Geometric Microlith	Non-diagnostic	Total (% of assemblage)
AFT 22	0	0	0	0	0
AFT 24	0	1	0	0	**1 (3.1%)**
AFT 26	0	1	2	0	**3 (1.7%)**
AFT 27	2	8	4	0	**14 (2%)**
AFT 29	0	0	0	0	0
AFT 30	0	0	0	0	0
AFT 31	1	3	1	0	**5 (4.7%)**
B6	14	21	8	4	**47 (1.5%)**
B54	4	11	3	0	**18 (1.7%)**
Total	**21 (23.9%)**	**45 (51.1%)**	**18 (20.5%)**	**4 (4.5%)**	**88 (1.7%)**

8.12 Retouched Artefacts: Phase 1 & 2 programs

A total of 44 retouched artefacts were recovered from the Phase 1 and Phase 2 excavations (Table 84) comprising a low proportion of 0.8% of the entire lithic assemblage. Other tool types included one ground edge axe/ hatchet fragment, identified as a 'utility' flake, likely struck of the main artefact during use, located at site TNR AFT 24. One relatively small hammerstone, with a size range of 51-55mm was also located at site B54. Retouched artefacts were found at almost all sites within the study area although in generally low numbers. Only a small number of retouched artefacts were 'formal', typified by various scraper types (n=10) including five end scrapers, and one Tula adze. The majority of retouched artefacts were non-formal flaked tools with a wide range of shapes and sizes and varying amounts of retouch, with many of these appearing to be single use tools. The largest concentration of retouched artefacts was found at B6 (n=24). B54 had the second highest concentration (n=7).

The majority (79.5%) of retouched artefacts were recovered from the silcrete assemblage, with small numbers of tuff (n=7) and chert (n=1). The Tula adze was from the tuff assemblage located in the Phase 2 excavation at site B6 and had a maximum size range of between 51-55m, a percussion length of 50.9mm and weighed 32.41g. The average size of retouched artefacts was 21.8mm with a range of between 7.67mm – 50.9mm. Termination shapes of retouched artefacts (complete flakes and distal fragments) were primarily convex or straight, although two artefacts had concave edges (including 1 silcrete end scraper), suitable for smoothing spear shafts.

Retouch was most likely to be present on flaked and angular fragments (n=23, 52.3% of retouched artefacts), with complete flakes comprising the remaining 47.7%. The Cumberland Plain is a region where stone materials were relatively abundant, meaning that flaked stone was easy to come by. In many cases an implement was selected for immediate use from a mass of freshly knapped stone on the basis that it possessed a suitably sharp edge and fitted the hand well. This was a highly flexible approach to tool production that was well adapted to a highly mobile hunter-gatherer lifestyle.

Importantly, people were not wasteful of stone resources as evidenced here by the recycling and reuse of broken flakes. Some of the larger flaked stone implements were also recycled, possibly years, or even generations, after they were discarded.

As already stated, retouched artefacts comprise only 0.8% of the total lithic assemblage, however variation in the proportion of retouched artefacts occurred across the project area. Sites with medium to high density assemblages (over 500 artefacts) had a low retouched artefact ratio of less than one percent; these include sites TNR AFT 27, B6, B54 and to some extent TNR AFT 26. All of these sites were located geographically on low lying sites near or adjacent to water sources. Low density sites located on crests and ridgetops had a statistically higher presence of retouched artefacts, although numbers are correspondingly low; these sites include TNR AFT 22, AFT 24 and AFT 31. No retouched or backed artefacts were located at sites TNR AFT 29 and AFT 30. Site TNR AFT 26 incorporated excavations on both crests and lower slopes, which seems to reflect a hybrid low density site, although with more complexity than simple crest and ridgetop areas. The contrasting characteristics of the lithic assemblages recovered from these sites suggest that different activities were undertaken at these locations.

Table 84. Phase 1 & 2 retouched artefacts

Phase 1 & 2 Retouched Artefacts	Retouched (non-specific)	Scraper	Tula Adze	Axe/Hatchet (Frag.)	Hammerstone (Frag.)	Total (% of assemblage)
AFT 22	0	1	0	0	0	**1 (16.7%)**
AFT 24	0	0	0	1	0	**1 (3.1%)**
AFT 26	2	0	0	0	0	**2 (1.1%)**
AFT 27	2	1	0	0	0	**3 (0.4%)**
AFT 29	0	0	0	0	0	0
AFT 30	0	0	0	0	0	0
AFT 31	4	0	0	0	0	**4 (3.7%)**
B6	16	7	1	0	0	**24 (0.8%)**
B54	6	1	0	0	1	**8 (0.7%)**
Total	**30 (69.8%)**	**10 (23.3%)**	**1 (2.3%)**	**1 (2.3%)**	**1 (2.3%)**	**43 (0.8%)**

8.13 Regional Comparisons

Comparative analysis at a local and regional scale helps to define assemblage variability across landscapes, which has been caused by past human behaviour. Archaeological analysis attempts to identify variability as the basis for classifying site types such as quarries, base camps and secondary activity areas. The assemblages from a number of major archaeological excavation programs, located outside the study area, were compared to the TNR 4 sites. These were located at varying distances from the project area. In summary, they include:

- Five archaeological sites at The Northern Road Upgrade Stage 6 (TNR 6) (KNC written concurrently with this report) located 5-10km to the north of the current project area.
- Three archaeological sites from the M4 Smart Motorway project. Sites SC1 and SC2 were located on alluvial terraces near South Creek 10-15km to the north-east and Clyburn Avenue was located on an upper slope/ridgeline 10km to the north-west (KNC 2019)

The comparative analysis also includes artefact data from a number of individual sites located in the Cumberland Plain. These sites derive from both large and small excavation programs. All of the sites selected for comparative analysis had the following features:

- They capture a range of landforms across the Cumberland Plain;
- The assemblages were recovered by excavation and consist of a significant number of stone artefacts; and
- Artefact data was available in a form that was comparable to the TNR 4 sites.

How do the TNR 4 sites compare to other excavated assemblages from the Cumberland Plain? To address this question, some of the key assemblage characteristics are compared and contrasted below. This discussion is supported by a series of tables listing the key features of individual sites.

8.13.1 Landform Type and Artefact density

The comparative analysis considers seventeen sites from two major creek catchment areas, Badgerys Creek and South Creek, salvaged by KNC under three different excavation programs. The sites excavated by KNC yielded just over 16,500 artefacts from an excavation area of 1,229m² (Table 85). Excavation methodology used a standard approach across a range of landforms to support the comparative analysis of the assemblages and to characterise the types of artefact assemblages that have been recovered. While one site, TNR 4 B54 used different excavation methods, the results were considered comparable for this analysis.

The sites included in this study were defined by landform types, primarily between sites situated on elevated geography such as ridgetops, crests and upper slopes generally at distance from water resources, and sites located on lower slopes and alluvial terraces closer to or adjacent to creeks or drainage systems. The characteristics of these landscape types would have had a strong influence on the type of past activities that occurred there.

Table 85. Artefact density comparison

Landform	Site	Area Excavated	Artefacts	Artefact Density/m²
Ridgetop/Crest & Upper Slope	TNR AFT 22	31m²	6	0.2/m²
	TNR AFT 24	59m²	32	0.5/m²
	TNR AFT 26	75m²	179	2.4/m²
	TNR AFT 27	76m²	696	9.1/m²
	TNR AFT 29	15m²	10	0.7/m²
	TNR AFT 30	36m²	19	0.5/m²
	TNR AFT 31	75m²	107	1.4/m²
	TNR AFT 14	75m²	220	2.9/m²
	TNR AFT 16	39m²	22	0.6/m²
	Clyburn Ave	43m²	184	4.3/m²
Total		**524m² (42.6%)**	**1,475 (8.9%)**	**2.8/m²**
Lower Slope/Alluvial Terrace	B6	159m²	3,070	19.3/m²
	B54	57m²	1,085	19/m²
	TNR AFT 17	85m²	1,132	13.3/m²
	TNR AFT 19	75m²	1,339	17.8/m²
	TNR AFT 20	40m²	25	0.6/m²
	SC1	237m²	6,550	27.6/m²
	SC2	52m²	1,855	35.7/m²
Total		**705m² (57.4%)**	**15,056 (91.1%)**	**21.4/m²**

8.13.2 Assemblage Totals

The charts below (Figures 40 & 41) show the artefact totals for sites within the comparative study separated by landform type. In almost all cases artefact totals were substantially higher among sites situated on lower slopes and alluvial terraces with SC1, situated adjacent to South Creek, having over twice the artefact numbers than was recovered from site B6, the largest site from this study. All other sites in this landform, apart from TNR AFT 20, displayed moderate to high density artefact densities with complex cultural activity including tool production and other domestic activities. These higher density sites share characteristics such as the relative availability of lithic material and fresh water. Together, these resources would have had a strong influence on hunter-gatherer behaviour with people being drawn to those locations where fresh water and/or different types of lithic material were available. Access to reliable water sources and lithic materials characterise the two South Creek sites (SC1 & SC2), while access to water and other fresh resources rather than lithic resources appear to be the primary attraction for sites within the TNR 4 and TNR 6 study areas.

Nearly 60% of the areas excavated have been on the tops of elevated landforms producing just over 9% of the artefacts recovered. The majority of these sites display low to very low artefact densities, often below one artefact per square metre, and low artefact totals. The exception to this was TNR AFT 27 from the current project, which was situated primarily on raised elevation, however excavation continued onto lower elevations where higher density artefacts were encountered during Phase 2 excavations.

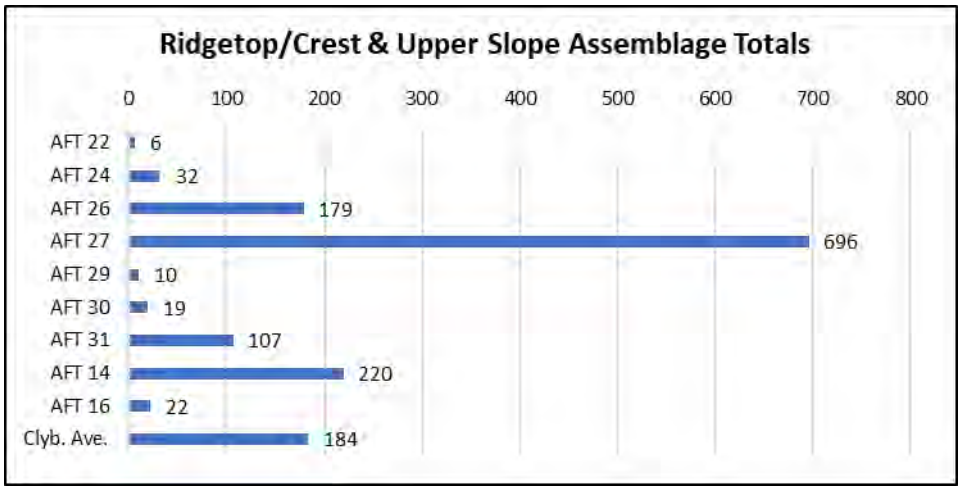


Figure 40. Ridgetop/Crest and Upper slope assemblages

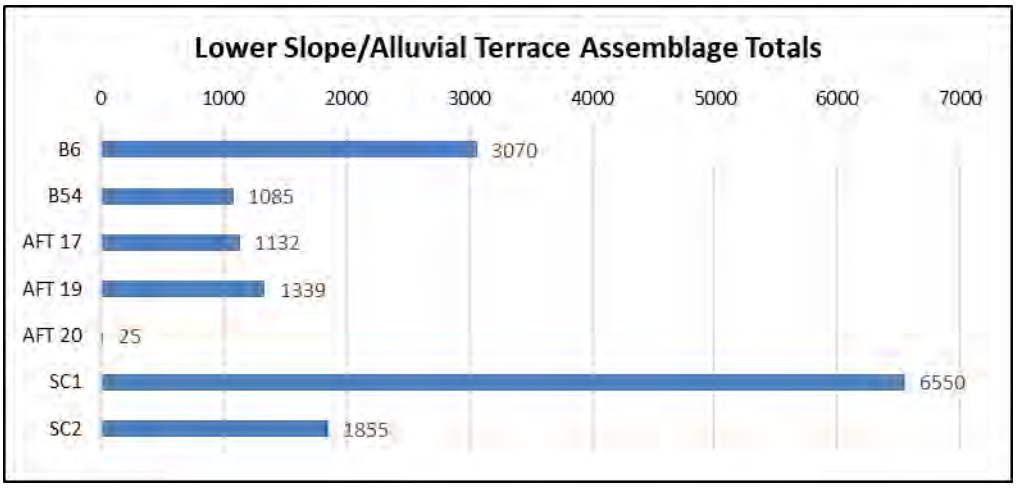


Figure 41. Lower Slope/Alluvial Terrace assemblages

One effective way to compare assemblages from across the Cumberland Plain is to examine mean artefact densities from a range of excavation programs. The graphs below (Figure 42 & Figure 43) show a high diversity in the mean artefact densities *within* each landscape class as well as *between* them. In other words, not all landforms were occupied nor used to the same extent over time and some were probably used infrequently. Impacts to archaeological deposits by flooding and land clearance have accentuated this patchy artefact density pattern.

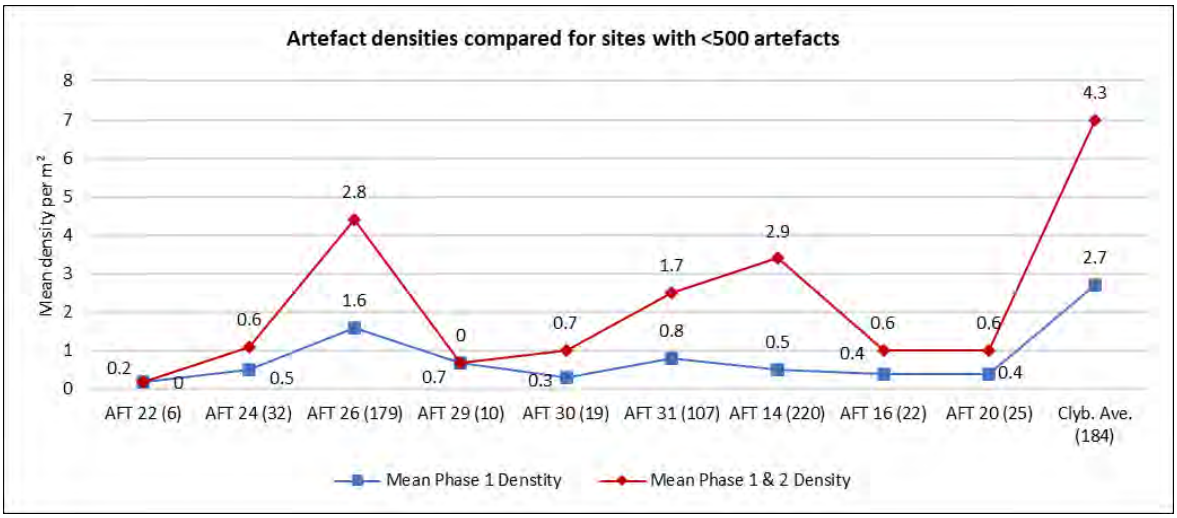


Figure 42. Artefact densities for sites with less than 500 artefacts

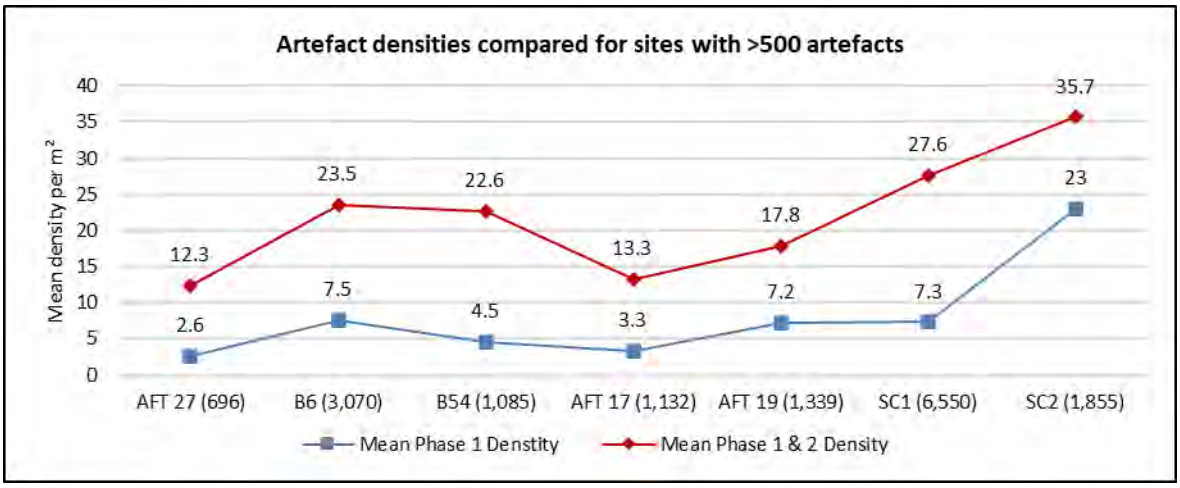


Figure 43. Artefact densities for sites with over 500 artefacts

The data indicates that sites located on the lower slopes of elevated features tend to yield higher artefact densities than their 'partner' sites situated upslope, on the crests. The more complete assemblages recovered from these higher density sites may also explain why there appears to be a trend for sites on the lower elevations to display higher proportions of complete flakes than sites on the crests. Sites located on higher elevations tend to have lower numbers of artefacts and a reduced opportunity to recover complete reduction sequences. This often leads to more varied assemblage types, including a more diverse concentration of lithic raw material and more erratic reduction characteristics, such as higher numbers of cores or angular fragments than is seen in the higher density. Different assemblage characteristics are also an indication of the type of activities that were occurring in an area, with marked differences observed between the lower density elevated sites and higher density Creekside sites.

8.13.3 Assemblage Characteristics

Raw Material

As with most excavated sites on the Cumberland Plain silcrete was the most common lithic material found on the TNR 4 sites. Within the wider comparative group, a number of exceptions occur, including a number of low-density elevated sites such as TNR AFT 24, TNR AFT 16 and Clyburn Ave. from the M4MM excavations. In each of these sites silicified tuff and other materials such as quartz and chert were found in higher quantities than silcrete indicating different preferential use of raw material or changing access to raw materials over time. In the main, however, silcrete comprises the majority of raw material within each assemblage, followed by quartz and tuff. Chert is present in smaller quantities across most sites although appears to be more prevalent the further west in the Cumberland Plain the sites are located.

Sites within the TNR 4 and TNR 6 study generally have higher percentages of chert within their assemblages than sites situated further east such as SC1 and SC2 (South Creek). In all likelihood, chert was being transported from the foothills of the Blue Mountains in small quantities and dispersed across sites. Sites in closer proximity to silcrete sources such as Plumpton Ridge and Riverstone often have much higher percentages of silcrete within the assemblage (over 90%) and less types of 'other' material. Small artefact size, including cores, as well as the more varied raw material types suggest that much of the raw material was being imported into the area rather than being sourced from nearby quarries.

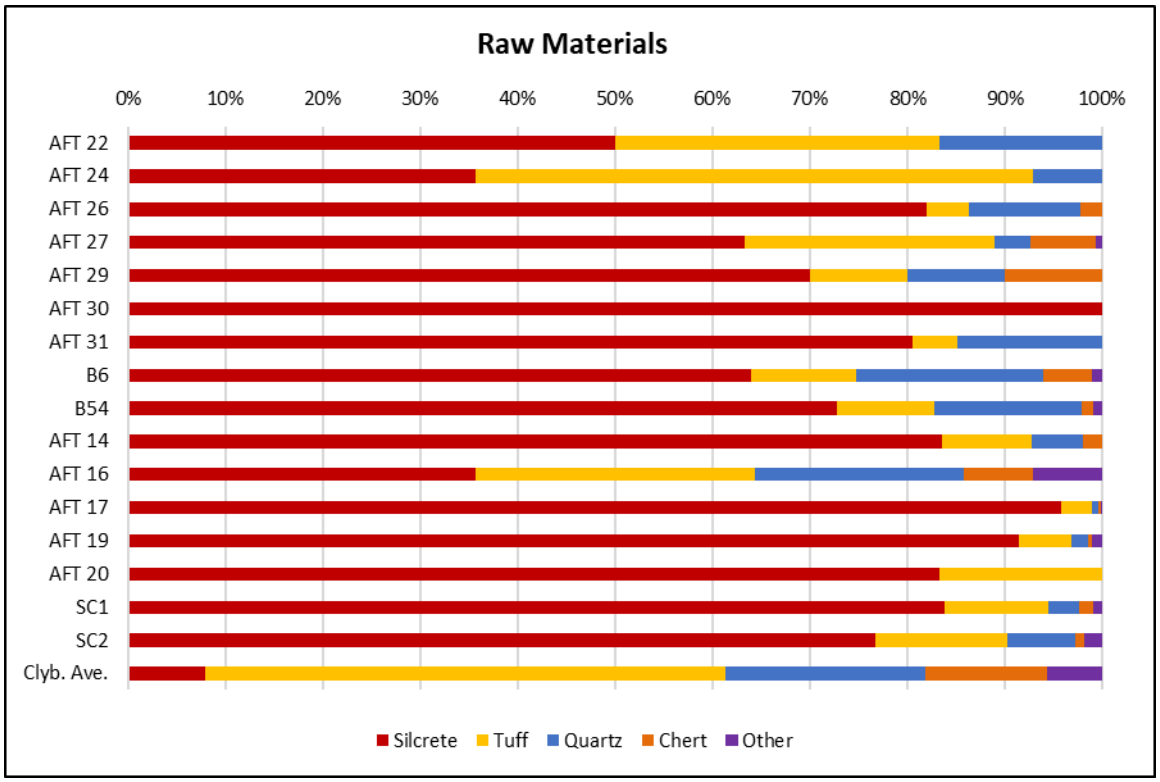


Figure 44. Raw material comparison

Lithic characteristics

In almost all sites within the study, flaked debitage constituted the primary reduction type within the various assemblages. These included complete flakes and proximal, medial and distal fragments. Sites where this was not the case were limited to low density elevated sites such as TNR 4 AFT 24, TNR 6 AFT 16 and Clyburn Ave, which have elevated numbers of angular fragments within the assemblage. The two high density sites located along South Creek, SC1 and SC2 also have a higher percentage of angular fragments than comparable sites within TNR4 and TNR6. These two sites had higher levels of primary and secondary reduction than is found within the current study, which featured primarily tertiary characteristics. Access to lithic materials appeared to be easier at SC1 and SC2, with artefact sizes generally larger and higher rates of cortex within the assemblage.

Core sizes also tended to be larger with more intense usage at SC1 and SC2 than found in the current study. Core sizes at sites within TNR 4 and TNR 6 tended to be small, although approximately 50% of all cores displayed some cortex. The cores in this study appeared to have been exhausted prior to being discarded with few exhibiting intense use, although some of the more intensely used cores exhibited characteristics suggesting microblade production. Some of the lower density sites showed highly elevated percentages of cores within the assemblage, more than is usually found within sites on the Cumberland Plain. In most sites, cores generally constitute between 2-3% of the entire assemblage, sometimes less. Two sites within the TNR 4 project area, TNR AFT 30 and AFT 31, and one within TNR 6, TNR AFT 20, had over 10% of cores and in the case of TNR AFT 30 over 15% in their respective assemblages. All three of these sites had less than 25 artefacts in their entire assemblages, so the high percentage of cores may simply be due to the low sample size, although it is possible that cores were being discarded at a higher rate on these elevated sites than was the case elsewhere.

The ratio (percentage) of complete flakes to cores within the assemblage is shown in Figure 47. The same disparity can be seen within the same three sites, with elevated numbers of cores to complete flakes apparent. Interestingly, Clyburn Ave, another low-density elevated site displays the lowest percentage of cores to complete flakes, indicating different past uses of similar landscapes.

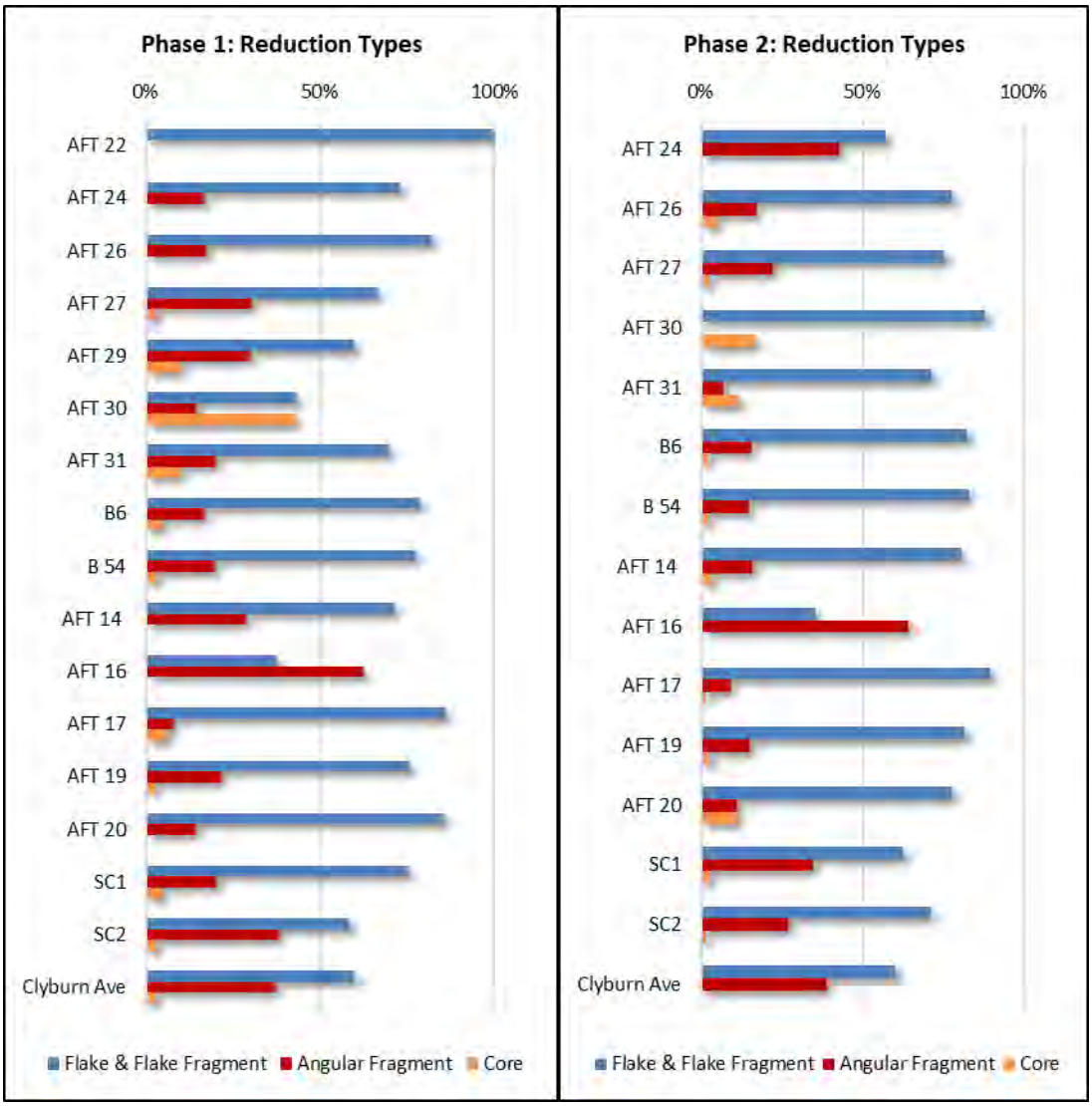


Figure 45. Phase 1 and Phase 2 Reduction types compared for sites within the comparative study (3 categories)

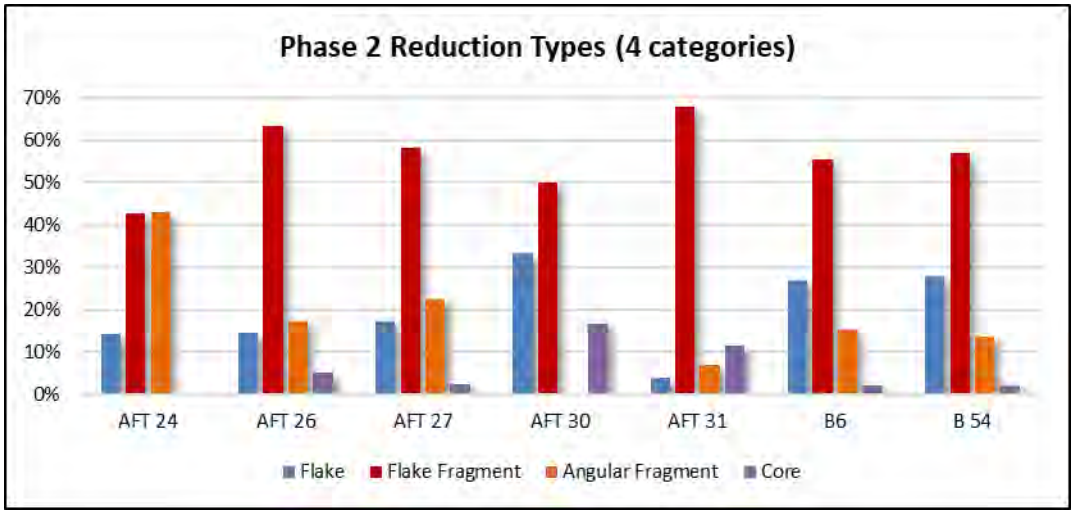


Figure 46. Phase 2 reduction types compared (4 categories)

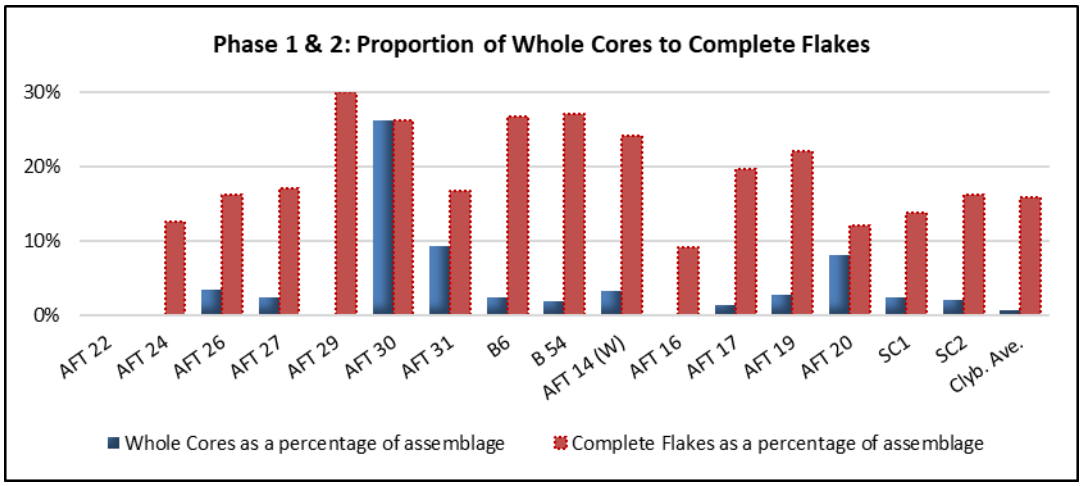


Figure 47. Comparison of cores to complete flakes as a percentage of the assemblage

Modified artefacts

Backed and retouched artefacts are found across most sites, however sites within the current study area, TNR 4 and TNR 6 show a higher proportion of backed artefacts than retouched when compared to the three sites from the M4MM excavations, with Clyburn Ave in particular having a very low percentage of backed artefacts.

Blade production and use were evident within the assemblages from B6 and B54 from TNR 4, and TNR AFT 17 and AFT 19 from TNR 6, with retouched tools being predominantly one off use types with very few showing specific formal uses, such as scrapers. This was also visible at SC1 and SC2 although the presence of a higher ratio of retouched artefacts suggest that processing of natural resources was occurring at a more intense and prolonged rate that is seen at sites in TNR 4.

The higher rates of backed artefacts, both blades and geometric microliths, suggest that activities associated with hunting were occurring more regularly than other forms of cultural activity normally found at domestic occupation sites.

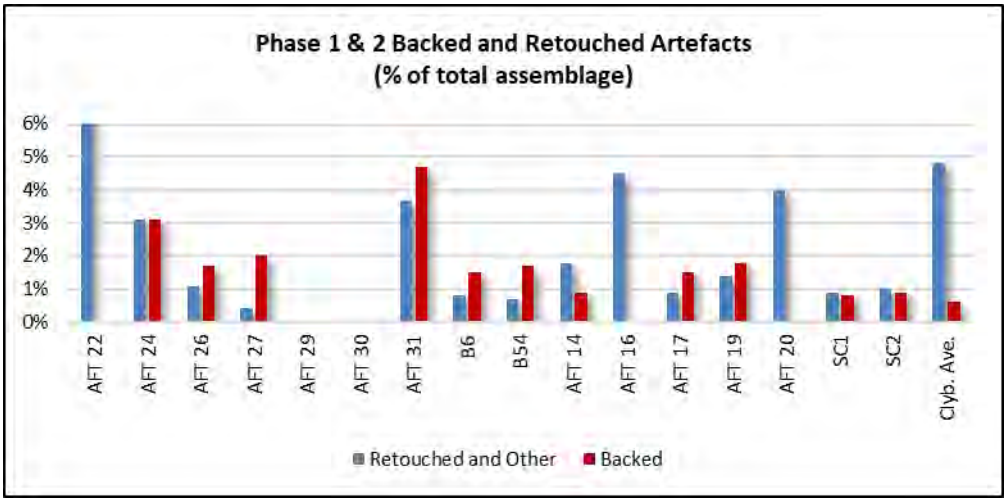


Figure 48. Proportion of backed and retouched artefacts as a percentage of total assemblage

8.14 Archaeological conclusions

Sites within the TNR 4 study area showed a distinct difference in past landscape usage. Elevated sites, situated on ridgetops and crests, display low artefact densities and a more mixed assemblage, with little indication of long-term occupation. Sites situated on lower landform types such as lower slopes and alluvial terraces, in this case sites B6 and B54, show a more complex pattern of occupation. These two high density sites have assemblage characteristics which indicate domestic use and include: moderate to high numbers of backed artefacts and exhausted microblade cores, the use of a variety of lithic materials, multiple knapping floors and a high percentage of flaked debitage.

The absence of these indicators at sites TNR AFT 22, 24, 26, 29, 30 and 31 suggests that these sites were not occupation areas but were likely intermittently used locations along corridors for movement across the landscape and/or short-term hunting camps. A good example of differing landscape use can be seen at site TNR AFT 27 which encompassed both elevated areas and low-lying areas. Elevated areas at this site were comparable to other elevated sites with low artefact density, while the low-lying area closer to water resources showed a more complex artefact assemblage, similar to although not as dense as B6 and B54. Easy access to reliable water sources and the various economic resources associated with such areas, added to a relatively flat stable physical environment, appears to be a necessary basis for sites within this area. Easy access to lithic resources does not appear to be a principal factor in the location of longer-term occupation for sites within this study, with the characteristics of the artefact assemblage suggesting the importation of most lithic material from outside the area.

Allowing for land use disturbance and differing excavation methodologies, there is a pattern of artefact discard within the study area that reflects differences in human behaviour. These differences most likely relate to the way Aboriginal people were accessing and using different resources across the individual landform types and the wider landscape bisected by the Northern Road corridor.

The archaeological sites associated with the project represent an important extended type of connectivity, where all of the sites are located on or near the spine of a low north-south ridge (The Northern Road) stretching over 16 kilometres. The reason The Northern Road was built on the ridgeline was the same reason the Aboriginal sites are located on the ridge – the landform itself facilitates intrinsic transitory movements suitable for cultural activity. This naturally formed cultural highway enables an assessment of past transitory behaviour through the study of Aboriginal sites (representing past movements on the ridgeline over several thousand years). Moreover, the collection of archaeological sites has a greater scientific and socio-cultural assessment value than piecemealed assessments. In effect the en masse archaeological information represents a higher information value than each individual site – the group is more valuable than any individual part. In this regard the project's collection of impacted archaeological sites are a valuable assessment group, because the group offers a statistically significant level of information about an area (the south west Cumberland Plain) where little large scale, connectable or representative information exists.

Information obtained through the salvaging of artefacts at key locations along this continuum (road corridor) has enhanced our cultural and archaeological understanding of the area and allows for significant interpretation of past events and better management of Aboriginal heritage. Improved management will then allow for future conservation outcomes, where culturally and statistically significant archaeological sites can be identified and their value empirically established in advance of proposals, thus enabling informed planning. The information exhibited and collected by salvaging The Northern Road's Aboriginal archaeological sites contributes to the baseline for understanding, interpreting and conserving the region's Aboriginal cultural heritage.

9 Conclusion

9.1 Archaeological salvage complete

The archaeological salvage program has been completed in accordance with the conditions of project approval (SSI 7127) and approved salvage methodology outlined in the CHAR for the following ten Aboriginal archaeological sites.

- TNR AFT 22 (AHIMS 45-5-4793) (archaeological salvage required)
- TNR AFT 23 (AHIMS 45-5-4794) (no archaeological salvage required)
- TNR AFT 24 (AHIMS 45-5-4795) (archaeological salvage required)
- TNR AFT 25 (AHIMS 45-5-4791) (no archaeological salvage required)
- TNR AFT 26 (AHIMS 45-5-4798) (archaeological salvage required)
- TNR AFT 27 (AHIMS 45-5-4799) (archaeological salvage required)
- TNR AFT 29 (AHIMS 45-5-4801) (archaeological salvage required)
- TNR AFT 30 (AHIMS 45-5-4797 (archaeological salvage required)
- TNR AFT 31 (AHIMS 45-5-4802) (archaeological salvage required)
- B6 (AHIMS 45-5-2636) (archaeological salvage required).

All conditions related to the excavation and collection of Aboriginal objects within sites TNR AFT 22, TNR AFT 23, TNR AFT 24, TNR AFT 25, TNR AFT 26, TNR AFT 27, TNR AFT 29, TNR AFT 30, TNR AFT 31 and B6 within the Northern Road Upgrade - Stage 4 area as shown on Figure 49 are complete and no further mitigation is required for the sites. Remnant parts of the above sites are shown in Figure 49.

Salvage mitigation for site B54 (AHIMS 45-5-2790) where the TNR 4 project area crosses within the Western Sydney Airport lands is complete in accordance with the requirements of the WSA ACH CEMP (WSA Co 2018). The portion of B54 falling within the TNR4 project area has been salvaged with no further mitigation required.

Salvage excavation was completed prior to any pre-construction or construction activities which may have harmed Aboriginal objects at these site locations.

9.2 Aboriginal Site Impact Recording Forms (ASIRFs)

Site card updates and ASIRFs have been completed for all impacted sites and submitted to the AHIMS Registrar.

9.3 Management of Aboriginal objects

The Aboriginal objects recovered during the salvage excavation program have been moved to the following temporary storage location:

Kelleher Nightingale Consulting Pty Ltd offices
Level 10, 25 Bligh St, Sydney, NSW 2000
Objects are kept in a secure storage location within a locked office

A description of the nature and types of Aboriginal objects which are now at this location is available in the salvage excavation lithics database (Appendix A). In accordance with the CHAR and conditions of Project Approval, the long term management of salvaged Aboriginal objects from the TNR 4 sites will be determined in consultation with project RAPs:

- Requirement 26 "Stone artefact deposition and storage" in the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (24 September 2010, available online at: http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf) must be complied with.

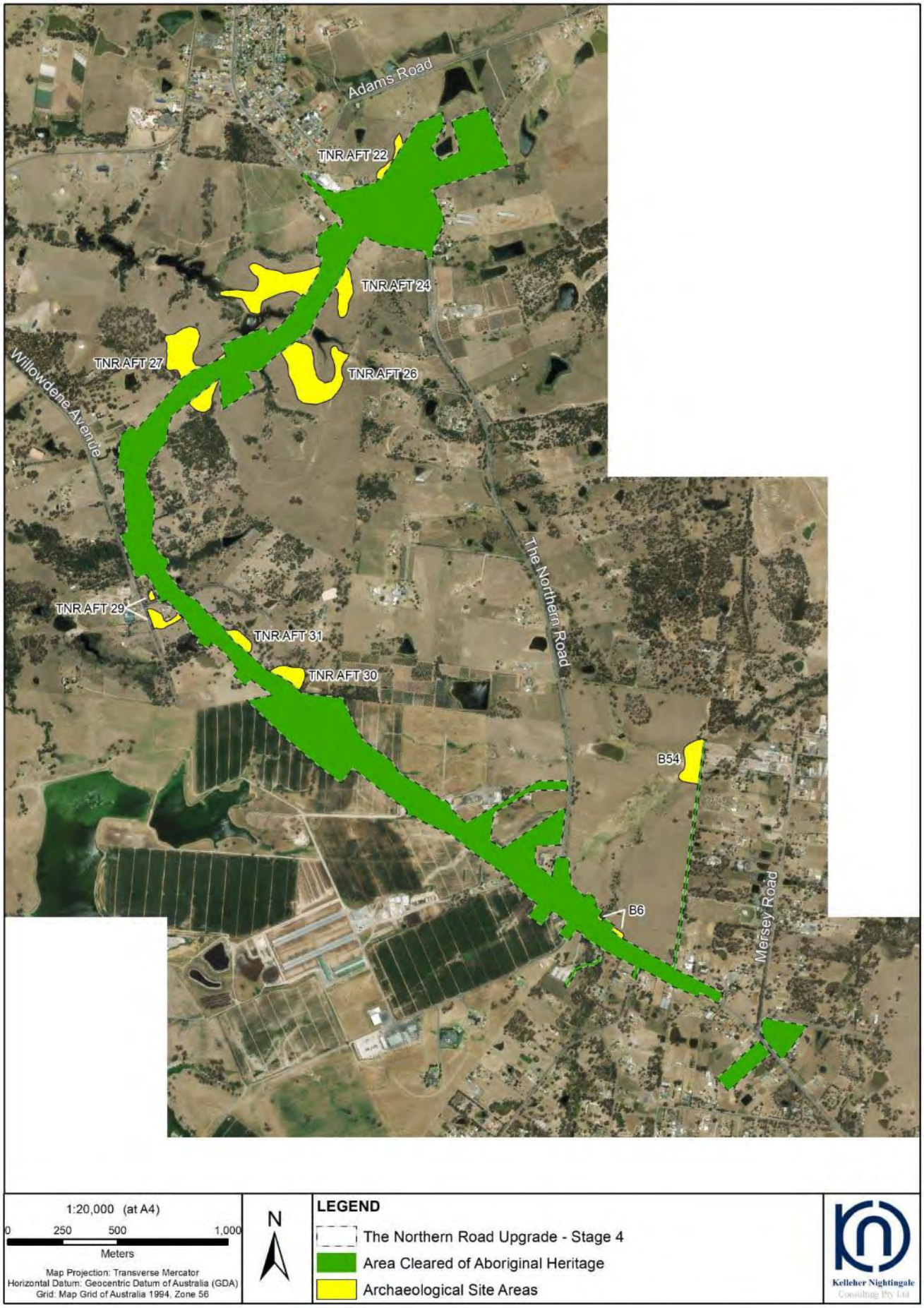


Figure 49. Area cleared of Aboriginal heritage within The Northern Road Upgrade – Stage 4

References

Andrefsky, W. 1998. *Lithics: Macroscopic Approaches to Analysis.* Cambridge University Press, New York.

Artefact Heritage, 2012. The Northern Road upgrade from The Old Northern Rd, Narellan, to Mersey Rd, Bringelly: Aboriginal Archaeological Survey Report. Report to Roads and Maritime Services (RMS).

Attenbrow, V., 2002. *Sydney's Aboriginal Past: Investigating the Archaeological and Historical Records*. University of New South Wales Press, Sydney.

Bannerman, S.M., Hazelton, P.A. and Tille, P.J., 1990. *Penrith 1:100,000 Soil Landscape Series Sheet 9030*. Soil Conservation Service of NSW, Sydney.

Brayshaw, H.C., and Haglund, L., 1996. M4 Upgrade, Archaeological Survey for Aboriginal Sites for Proposal to Upgrade the M4 Motorway from Church Street Parramatta to Coleman Street Mays Hill and Prospect to Emu Plains. Unpublished Report for SWR Constructors Pty Ltd through Environmental Planning Pty Ltd.

Brook, J. and J Kohen, 1991. *The Parramatta Native Institution and the Black Town: A History*. NSW University Press, Kensington NSW.

Clark, N.R. and Jones, D.C., (Eds) 1991. *Penrith 1:100,000 Geological Sheet 9030*. New South Wales Geological Survey, Sydney.

Dallas, M., 1981. An Archaeological Survey of the South Penrith Development Site. Report to NSW Housing Commission Roads.

Dallas, M. and Steele, D., 2001a. Aboriginal Archaeological Survey and Assessment Report: Southern Deferred Lands Part Lot 6800 DP 1013970, Glenmore Park, NSW. Report to Proust & Gardner Consulting Pty Limited on behalf of Lensworth Glenmore Park Pty Limited.

Dallas, M. and Steele, D., 2001b. Archaeological Excavations of the 'Southern Deferred Lands' at Surveyors Creek, Glenmore Park NSW. Report to Lensworth Glenmore Park Pty Ltd.

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

Holdaway, S. and Stern, N. 2004. *A Record In Stone: The Study of Australia's Flaked Stone Artefacts*. Aboriginal Studies Press, Canberra.

Kelleher Nightingale Consulting Pty Ltd (KNC), 2019. M4 Smart Motorway Project: Aboriginal Archaeological Salvage Excavation Report. Aboriginal Heritage Impact Permit #C0002113: Clyburn Avenue (AHIMS 45-5-1074, South Creek 1 (SC1) (AHIMS 45-5-1070) and South Creek 2 (SC2) (AHIMS 45-5-1071). Report to Roads and Maritime Services.

KNC, 2017. The Northern Road Upgrade between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park: Aboriginal Cultural Heritage Assessment Report. Prepared for Roads and Maritime Services.

KNC, 2016. The Northern Road Upgrade between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park: Aboriginal Archaeological Survey Report, Stage 2 PACHCI. Prepared for Roads and Maritime.

KNC, 2015. M4 Managed Motorway, from Lapstone (western end) to Church Street, Parramatta (eastern end) Review of Environmental Factors: Cultural heritage assessment report. Prepared for Jacobs Group (Australia) Pty Ltd on behalf of Roads and Maritime Services.

KNC, 2013. M4 Managed Motorway from Lapstone (western end) to Strathfield (eastern end) Review of Environmental Factors (REF) Aboriginal archaeological survey, Stage 2 PACHCI. Report to Sinclair Knight Merz Pty Ltd on behalf of Roads and Maritime Services.

Kinhill Stearns, 1985. *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement*. Prepared for the Department of Aviation.

Kohen, J.L., 1985. *Aborigines in the West: Prehistory to Present*. Power, J. and P. West (eds). Western Sydney Project, Seven Hills, Sydney.

Kohen, J.L., 1986. Prehistoric Settlement in the Western Cumberland Plain: Resources, Environment and Technology. PhD Thesis, School of Earth Sciences, Macquarie University, Sydney.

Kohen, J.L., 1993. *The Darug and Their Neighbours. The Traditional Aboriginal Owners of the Sydney Region*. Darug Link in association with Blacktown and District Historical Society, Sydney.

Mathews, R. H., 1901. The Thurrawal language. *Journal and Proceedings of the Royal Society of NSW* 35:127-160.

Navin Officer Heritage Consultants (Navin Officer), 2017. Initial Survey and Salvage Plan Western Sydney Airport - Enabling Activities. Aboriginal Cultural Heritage Management Program. Prepared for WSA Co.

Navin Officer, 2015. Western Sydney Airport: Aboriginal Cultural Heritage Assessment. Report to GHD.

Navin Officer, 2003. Glenmore Park Southern Release Area, Penrith, NSW. Cultural Heritage Assessment. Report to EDAW (Aust) Pty Ltd.

Navin Officer, 1997. Technical Paper No. 11 Aboriginal Cultural Heritage. Report to Commonwealth Department of Transport and Regional Development.

Nishiizumi, K., Lal, D., Klein, J., Middleton, R. and Arnold J.R. 1986. Production of 10Be and 26Al by cosmic rays in terrestrial quartz in situ and implications for erosion rates. *Nature 319 (6049)*: 134-136.

Nishiizumi, K. et al. 1993. Role of in situ cosmogenic nuclides 10Be and 26Al in the study of diverse geomorphic processes. *Earth Surface Processes and Landforms 18*: 407-425.

Office of Environment and Heritage (OEH) (formerly Department of Environment, Climate Change and Water), 2010a. *Code of Practice for the Archaeological Investigations of Aboriginal Objects in New South Wales.* Department of Environment, Climate Change and Water NSW.

OEH 2010b. *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Part 6 National Parks and Wildlife Act, 1974)*. Department of Environment, Climate Change and Water NSW.

OEH, April 2011. *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*. Office of Environment and Heritage, Department of Premier and Cabinet, Sydney.

Roads and Maritime Services (RMS). November 2011. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*. Roads and Maritime Services, Sydney.

Tench, W., 1793. *Complete Account of the Settlement at Port Jackson*. G. Nicol and J. Sewell, London.

WSA Co, 2018. Western Sydney Airport: Aboriginal Cultural Heritage Construction Environmental Management Plan. Prepared by WSA Co.

Appendix A Lithics Database