CSR Lands at Erskine Park

Archaeological Subsurface Testing Program

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A Report to CGP Management Pty Ltd
on behalf of CSR Limited

EXECUTIVE SUMMARY

- CSR Limited owns a large parcel of land on Lenore Lane at Erskine Park in western Sydney that has been identified for sale and will be developed for various industrial purposes.

- This report documents the results of a program of archaeological subsurface testing conducted within Test Areas 3 to 11 across the CSR Erskine Park lands. Previously recorded Aboriginal sites EPQ1, EPQ2, EPQ3, EPQ 4, EPQ 5, EPQ6 and 'Isolated find' are located within these test areas.

  A program of subsurface testing was conducted in Erskine Park Test Areas 1 and 2 in January 2005. This investigation is documented in a separate report (Navin Officer Heritage Consultants [January] 2005).

  These two investigations were conducted under Preliminary Research Permit #2076.

- A total of two hundred and fifty six (256) pits were excavated at Erskine Park CSR Lands. Pits were excavated by a backhoe using a straight-edged 1500 mm toothless (mud) bucket

  Twenty one (21) test pits were excavated in Test Area 1.
  Seventeen (17) test pits were excavated in Test Area 2.
  Two hundred and eighteen (218) test pits were excavated in Test Areas 3-11.

- A total of two hundred and eighty five (285) lithic items were recovered from 88 of the 256 test pits excavated within the Erskine Park CSR Lands.

  A total of forty nine (49) lithic items were recovered from 20 of the 38 test pits excavated in Test Areas 1 and 2 at Erskine Park.

  A total of two hundred and thirty six (236) lithic items were recovered from 68 of the 218 test pits excavated in Test Areas 3-11.

- Eight petrological or geological types have been identified in the lithic assemblage retrieved from Test Areas 3-11. In the order of frequency these are silcrete and tuff which together comprise 81% of lithic items, and minor components (less than 10%) of quartz, quartzite, chert, chalcedony, and two unidentified stone types - one a fine-grained siliceous stone and the other a metamorphic stone.

- Seventeen types and categories of lithic items have been identified in the lithic assemblage from Test Areas 3-11. These are: lithic fragment; flake; flaked piece; flake fragment; flake portion; bipolar flake; bipolar core; compression flake; microblade; microblade portion; microblade core; microblade core fragment; microlith backing flake; bondi point preform; bondi point portion; utilised flake and scraper.

  In general these items are small in size, and lightweight, as is typical for flaking debitage and heat fractured lithic items in recent prehistoric lithic assemblages. The large proportion of microdebitage in the stone assemblage is unremarkable in the context of microlithic debitage from the Cumberland Plain.

- Nondescript lithic fragments comprise nearly 46% of the assemblage, and nondescript flakes (flakes, flaked pieces, flake fragments, flake portions, compression flakes and bipolar flakes) nearly 40%, providing a total nondescript component of about 85%. The remainder of the collection comprised identifiable microblade and microlith knapping debris and the discard, and use of flaked stone implements.

- There is no identifiable stratigraphic change in the overall character of the lithic assemblage from the Erskine Park Test Areas. As far as can be ascertained, the assemblage in general is

'microlithic' in character (microblade knapping debris) and typical of the Late Phase in Australian prehistoric stone technology.

The ‘diagnostic' lithic items in the assemblage are microblades, microblade portions, bondi point preforms and portions, microlith backing flakes (discarded during the making of spear barbs), microblade cores and core fragments, and some flakes struck from a microblade core.

Given the presence of diagnostic elements, it is inferred that the assemblage accumulated at some time within the last 3,000 years, after microliths (stone spear barbs) had been adopted in the Sydney region

- Artefact densities are generally low, varying from 0 to 10.2 per square metre, with an average density of 1.2 artefacts per square metre.

- The artefactual remains are indicative of low intensity occupation suggesting transient camps and activities peripheral to a base camp or main occupation area.

- The subsurface archaeological deposits investigated within Erskine Park Test Areas 3-11 are assessed as having low archaeological significance within a local context only.

- **It is recommended that:**

  No further archaeological assessment is required for the CSR lands at Erskine Park.

  Application should be made to the Director General of the NSW DEC for a Section 90 Consent to Destroy (or Heritage Impact Permit) for the identified Aboriginal sites and associated archaeological deposits within the CSR industrial subdivision lands at Erskine Park.

  It is possible that relics remain undetected within the ‘untested’ areas of the CSR lands at Erskine Park. As a precautionary measure the Section 90 application should include the entire development area (not just the identified Aboriginal sites and relics within the area).

  Application should be made well before ground disturbance is anticipated in the areas where relics are known to occur. Disturbance to the known relics and deposits cannot occur until the Section 90 Consent has been issued by the DEC.

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1. INTRODUCTION

CSR Limited owns a large parcel of land on Lenore Lane at Erskine Park in western Sydney. (Figures 1.1 and 1.2). The land has been identified for sale and will be developed for various industrial purposes. The area forms part of the *Erskine Park Employment Area*.

The Erskine Park study area (or parts thereof) have been the subject of a number of archaeological assessments over the past twenty years. These previous investigations are summarised in Section 2, below. The studies identified a number of Aboriginal archaeological sites and areas of archaeological potential within the CSR lands. Recommendations were made regarding further investigation of the Erskine Park property, which included the conduct of a program of archaeological subsurface testing in the area.

This report documents the results of a program of archaeological subsurface testing conducted within Test Areas 3 to 11 within the CSR lands at Erskine Park. A program of subsurface testing was conducted in Erskine Park Test Areas 1 and 2 in January 2005. The results of these excavations have been documented in a previous report (Navin Officer Heritage Consultants January 2005) and data from the January report has been incorporated into the present report as necessary.

The reports were commissioned by CGP Management Pty Ltd on behalf of CSR Limited.

1.1 Report Outline

This report:

Documents consultation with the local Aboriginal community carried out in the course of the investigation;

- Describes the environmental setting of the study area;
- Provides a background of local and regional archaeology for the study area;
- Documents the methodology implemented for the study;
- Documents the results of the program of subsurface testing;
- Discusses the results and implications of the subsurface testing program;
- Defines statutory requirements relevant to the cultural heritage of the area; and
- Provides conclusions based on the results of the investigation and the potential impact of the proposed development on the Aboriginal archaeological resource.

1.2 Project Personnel

Fieldwork was conducted by Matthew Barber, Charles Dearling, Vanessa Myles, Kerry Navin, Karen Oakley, Kelvin Officer, Daniel Powell, Nicola da Santo, Lindsay Smith and Tom Taverner.

Aboriginal representatives who participated in the fieldwork were Sean Barker, Jason Boneham, Peter Knight, Henri Khan, Phil Khan, Jeff Hickey, Anthony Hunter, Daniel Hunter, Lester Roberts and Kane Morton (DLALC); Allan Evans, Matthew Morton and Alan Watson (DTAC); and Wayne Boney and Brad Pittman (DCAC).

Lithic analysis was conducted by Dr Johan Kamminga.

This report was prepared by Kerry Navin and Kelvin Officer.

Plant was provided by Alert Rental Centre.

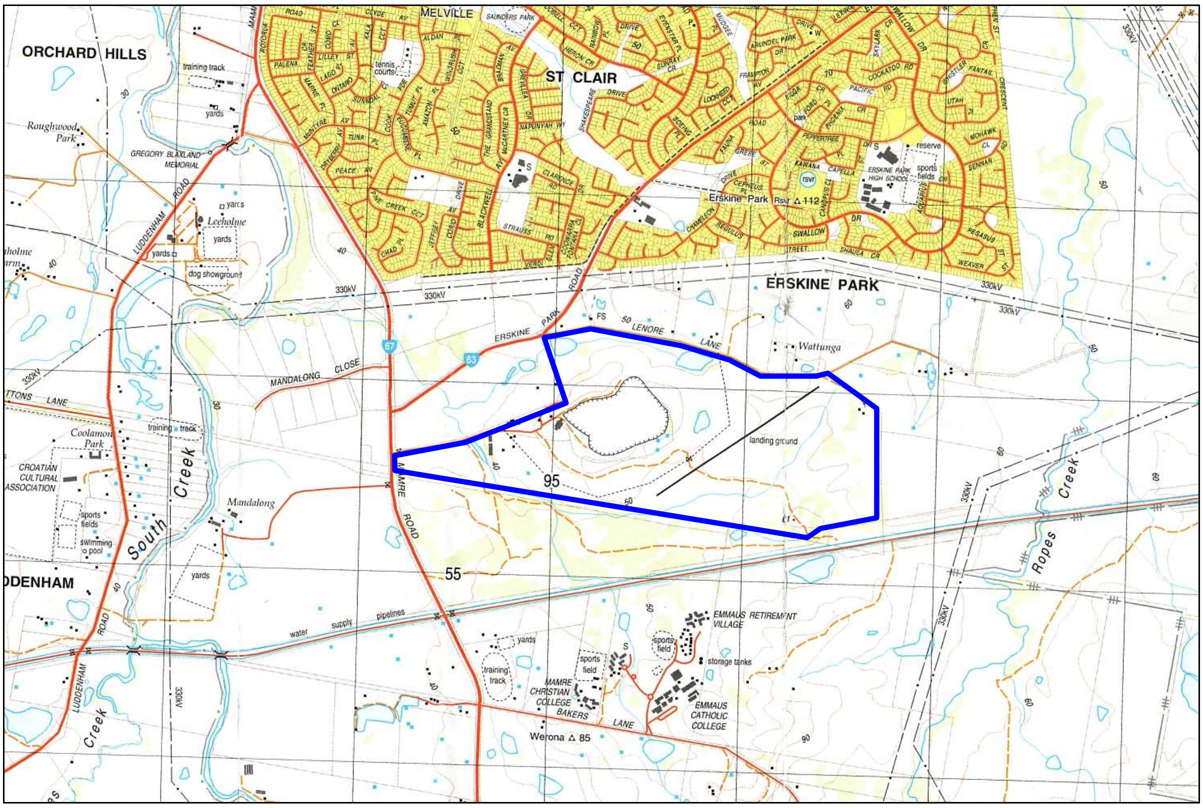


Figure 1.1 Erskine Park CSR lands
(Prospect 1:25,000 topographic map 2nd edition)

Figure 1.2 Erskine Park CSR lands
(aerial photo provided by CSR)

2. BACKGROUND TO THE SUBSURFACE TESTING PROGRAM

Several archaeological studies have been conducted in the Erskine Park study area.

In 1984 Susan McIntyre conducted a surface survey for Aboriginal sites in relation to an extension of the Erskine Park quarry (McIntyre 1984). McIntyre located one Aboriginal site (referred to as "EP" – NPWS Site # 45-5-450) and two isolated finds (not listed on NPWS Site Register). Site 45-5-450 is located in subsurface Test Area 1.

In 1998, Jo McDonald conducted a surface survey for Aboriginal sites within the Erskine Park lands (Jo McDonald CHM Pty Ltd 1998). McDonald identified six sites and one isolated find within the Erskine Park property. These are:

NPWS Site #	Site Name	Site Type
no site number	EPQI	open camp site (artefact scatter)
45-5-2512	EPQ2	open camp site (artefact scatter)
45-5-2513	EPQ3	open camp site (artefact scatter)
45-5-2514	EPQ4	open camp site (artefact scatter)
45-5-2515	EPQ5	open camp site (artefact scatter)
45-5-2516	EPQ6	open camp site (artefact scatter)
no site number		isolated find

McDonald provided an assessment of the potential archaeological sensitivity of the land, based primarily on previous landuse, site location models, and on vegetation cover. McDonald recommended that a program of subsurface testing be conducted, on a landscape basis, in the areas that she had identified as 'good archaeological potential'.

In 2003 McIntyre surveyed a proposed road easement that traverses the southwestern corner of the Erskine Park CSR study area (near the junction of Erskine Park Road and Mamre Road). McIntyre located one isolated find EPR7 (not on NPWS Site Register) in a shed or house location in the southwest corner of the CSR lands. This find is currently the subject of a section 90 application initiated prior to this subsurface testing investigation.

In 2004 HLA-Envirosciences was engaged to conduct an indigenous heritage assessment of CSR Lands at Erskine Park to support a Development Application (DA) for future works at the site (HLA-Envirosciences 2004). 'No additional archaeological materials were recorded by this survey. However, effective ground surface visibility was observed to be uniformly low throughout the study area (ibid:19). HLA-Envirosciences did not review McDonalds report.

Using two criteria, HLA-Envirosciences then assessed the probability of archaeological material occurring within the terrain units in the study area. These criteria were:

1. 'Previously recorded sites; and
2. Terrain units shown to contain subsurface deposits of archaeological material in the local area' (ibid:19).

Known site locations and alluvial deposits adjacent to watercourses were assigned a rating of *high* archaeological sensitivity. Areas covering terrain known to contain subsurface deposits of cultural material were considered to be of *moderate* sensitivity. Sections of the study area where the surface had been modified or sediments removed, such as the quarry, were considered to have *low or nil* sensitivity (ibid:19).

The study area was then divided into areas of high, moderate, low and nil archaeological sensitivity and these areas were mapped. Then HLA-Envirosciences recommended that areas of 'high archaeological sensitivity should be protected where possible … if the development plan cannot be modified to avoid these areas, salvage including subsurface testing should be undertaken to mitigate against this impact' (ibid:26). HLA-Envirosciences also recommended that 'areas of moderate sensitivity be subject to a sub-surface testing program ..' (ibid: 26).

There were major differences in the sensitivity mapping and recommendations provided by McDonald and HLA for the CSR lands at Erskine Park.

Taking account of McDonald's:

- experience on the Cumberland Plain, and
- the fact that she did a fairly comprehensive survey of the lands,

whereas HLA:

- did not review McDonalds's report,
- did not document all the known sites on the property,
- had incorrect locations for a number of known sites on the property,
- only conducted a cursory inspection of the study area, and
- do not have McDonald's depth of experience on the Cumberland Plain,

Navin Officer Heritage Consultants consequently based their subsurface testing research proposal more closely on McDonald's conclusions and mapping than on HLA's conclusions and mapping.

In June 2004 archaeologists Kerry Navin and Kelvin Officer attended the CSR property at Erskine Park and conducted a reconnaissance level evaluation of the lands to further refine the subsurface testing research proposal.

Navin Officer Heritage Consultants then mapped:

– The location of previously recorded Aboriginal sites in the CSR lands at Erskine Park (Figure 2.1);

– Predictive archaeological landform categories relevant to the selection of archaeological test areas (Figure 2.2);

– Ground surface disturbance. (Figure 2.3); and

– The selected archaeological test areas relative to predictive archaeological landforms and lesser ground surface disturbance (Figure 2.4).

The predictive archaeological landform categories defined in this analysis are described in detail in section 5.5 of this report.

Based on the variables considered in this mapping process, and on previous data for the study area, it was proposed to conduct a program of archaeological subsurface testing in the areas shown on Figure 2.4 as '*Indicative areas in which subsurface test pits may be located'*. These areas were subsequently numbered Test Areas One to Eleven and incorporated previously recorded Aboriginal sites as follows:

Test Area 1: EP (NPWS Site #45-5-450)

Test Area 6: 'isolated find' (McIntyre 2003)

Test Area 7: EPQ2 (NPWS Site #45-5-2512)

Test Area 8: EPQ3 (NPWS Site #45-5-2513), EPQ 4 (NPWS Site #45-5-2514), EPQ 5 (NPWS Site #45-5-2515)

Test Area 9: EPQ1 (McDonald 1998), EPQ6 (NPWS Site #45-5-2516)

These test areas are described in more detail in section 6.3 of this report.

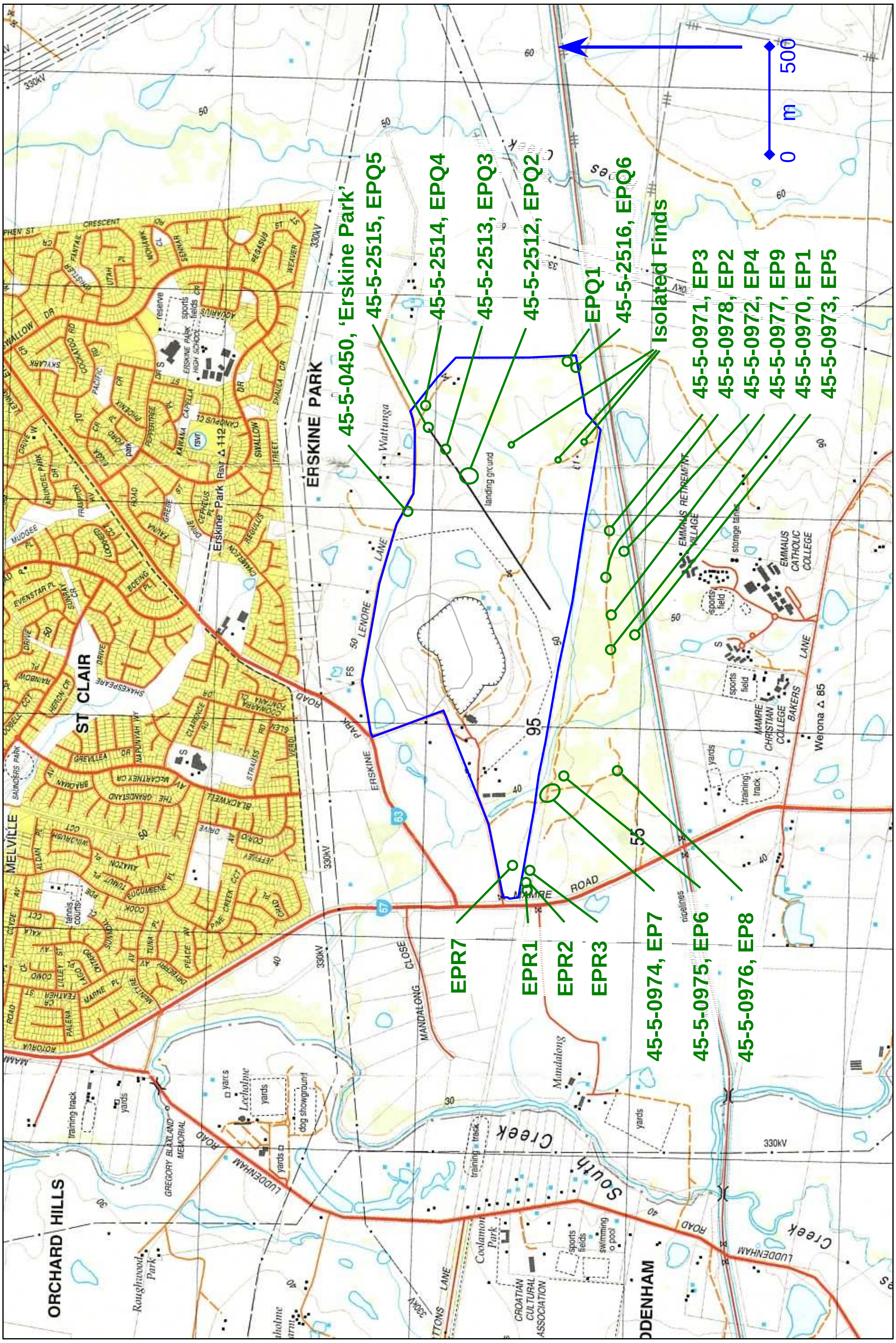
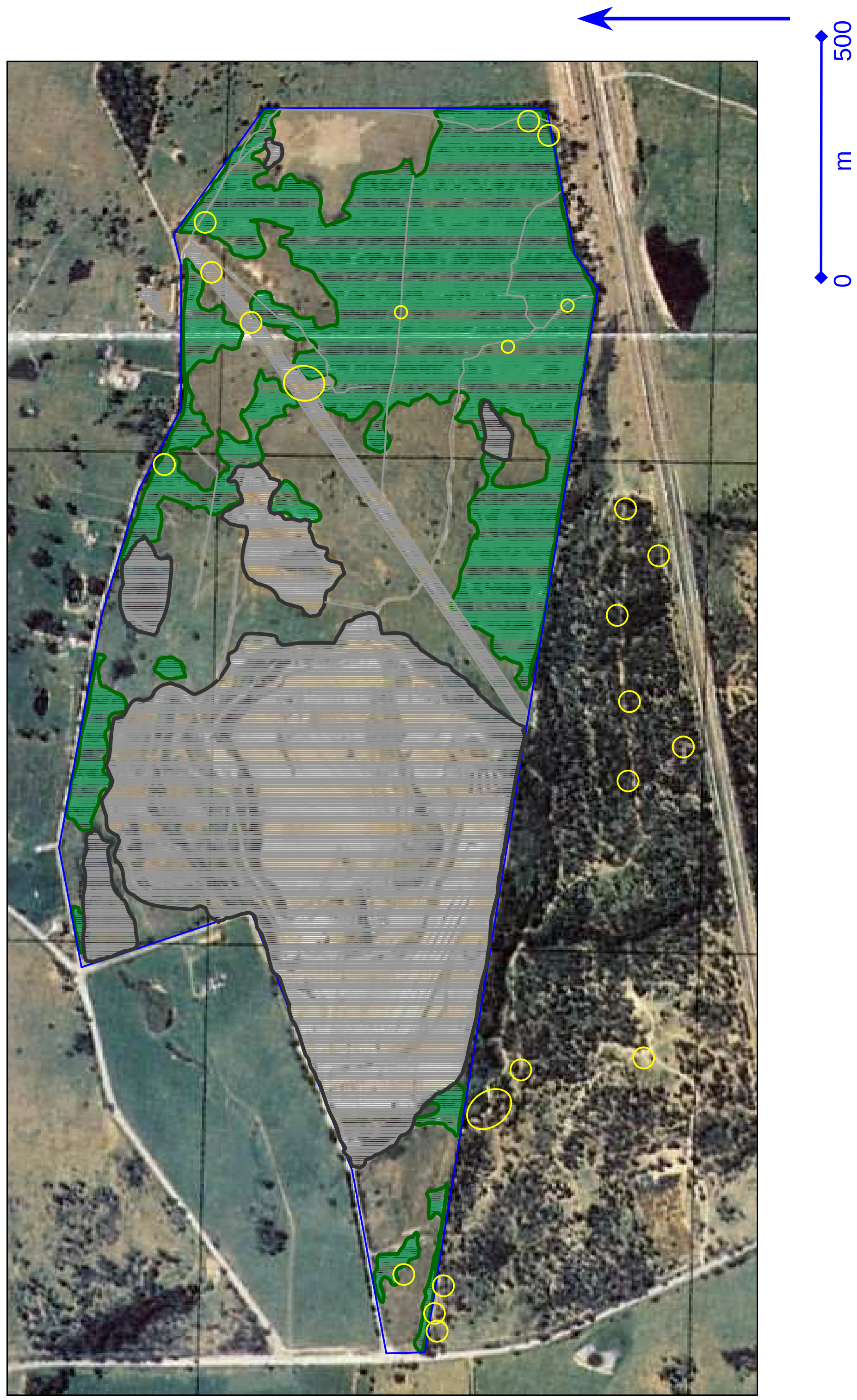


Figure 2.1: Previously recorded Aboriginal site locations within and near the Erskine Park study area. These locations are based on the primary site recordings and they differ slightly from the DEC [NPWS] AHIMS recordings. (Base map: Prospect 1:25,000 topographic map 3rd Ed L&PI 2001).

Landform	Potential for archaeological material to be present	Potential scientific value
Watershed ridgeline crest	High	Low - moderate
Spurline crest (excluding some steep gradients)	Moderate to high	Low - Moderate
Locally elevated, relatively level ground adjacent to a water course	High	High
100 m either side of watercourse (excluding upper catchment gullies)	Moderate	Low - High

Figure 2.2: Predictive archaeological landform categories relevant to the selection of archaeological test areas (base plan supplied by CSR)



Heavily disturbed ground

Native vegetation (indicative or lesser degree of ground disturbance)

Previously recorded Aboriginal site

Figure 2.3: Ground surface disturbance categories overlaid on aerial photo from Prospect 1:25,000 topographic map 3rd Edition L&PI 2001.

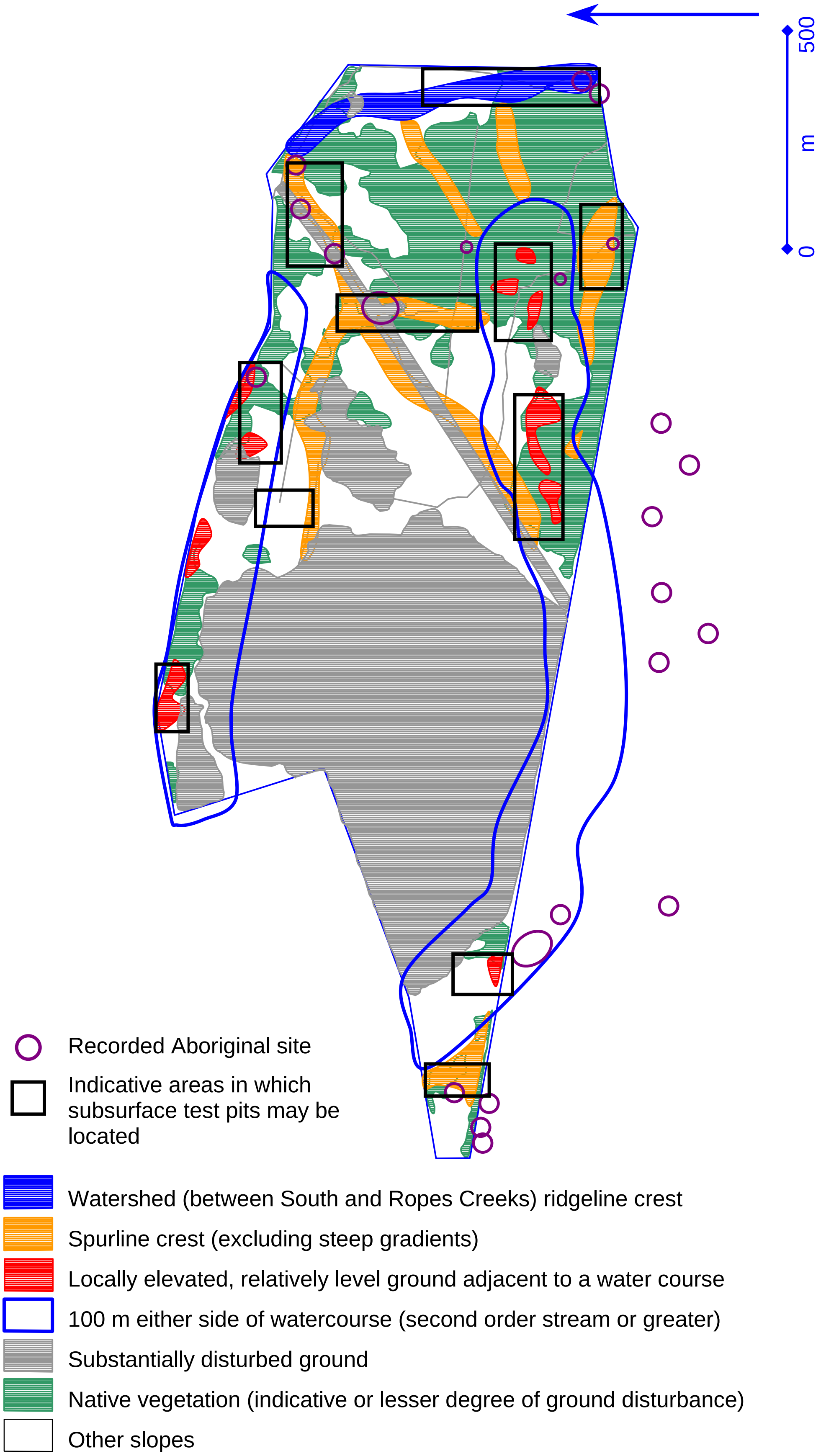


Figure 2.4: Landform categories relevant to the selection of archaeological test areas and indicative areas where subsurface testing may be conducted.

3. ABORIGINAL PARTICIPATION AND CONSULTATION

This project was commenced in 2004 and the Section 87 for the archaeological works at Erskine Park was applied for in July 2004.

As of January 2005 Aboriginal consultation requirements have been changed by the DEC. These requirements relate only to applications for s87 and s90 permits. Based on advice received by Navin Officer Heritage Consultants from the DEC (17th January 2005) which indicates that projects that are already underway may be completed under the old consultation policy, these guidelines do not apply to this CSR Erskine Park project.

The Erskine Park study area falls within the boundaries and areas of custodial interest of the Deerubin Local Aboriginal Land Council (DLALC), the Darug Tribal Aboriginal Corporation (DTAC) and the Darug Custodians Aboriginal Corporation (DCAC). Written approval for the subsurface testing program was given by each of these groups prior to submission of the Preliminary Research Permit (PRP) application to the NSW DEC [NPWS].

Taking account of the situation that exists between these western Sydney Aboriginal groups it was decided that the groups would participate in fieldwork on alternate weeks.

The DLALC were represented in the field by: Messrs Shaun Barker, Jason Boneham, Peter Knight, Henri Khan, Phil Khan, Jeff Hickey, Anthony Hunter, Daniel Hunter, Lester Roberts and Kayne Morton. The DTAC were represented in the field by: Messrs Allan Evans, Matthew Morton and Alan Watson. The DCAC were represented in the field by: Messrs Wayne Boney and Brad Pittman.

The results of the subsurface testing program have been discussed with representatives of each group. A copy of this report will be forwarded to each of the participating Aboriginal groups.

Records of Aboriginal Participation are provided in Appendix 1.

4. ENVIRONMENTAL CONTEXT

4.1 The Region

The Erskine Park CSR Lands comprise approximately 172 ha of land located south of Lenore Lane and east of Mamre Road at Erskine Park (Figures 1.1 and 1.2).

The Erskine Park study area is located within the Sydney Basin, a large sedimentary basin that dominates the NSW central coast and its fluvial catchments. The Basin consists of various sedimentary facies, each approximately horizontally bedded, that accumulated during a marine transgression at the end of the Late Palaeozoic glaciation. This was subsequently followed by a marine regression during the Late Permian and Triassic. The physiographic region of the Basin that is relevant to the present investigation is the Cumberland Plain, also known as the Cumberland Lowlands.

The Erskine Park study area is located on the mid western section of the Cumberland Plain. The geology of the Plain is dominated by Triassic aged rocks belonging to the Liverpool Subgroup of the Wianamatta Group. These consist of the Bringelly Shale, the Minchinbury Sandstone, and the Ashfield Shale. These formations consist of shales, calcareous claystone, laminite and fine to medium grained quartz lithic sandstone. The even and erodible nature of these sediments have created a predominantly low to moderately graded and predominantly undulating landscape with little outstanding relief and a medium drainage line density. Soils derived from the Wianamatta Group of rocks consist of red and brown podsolic soils on crests and upper slopes, and yellow podzolics on lower slopes (Bannerman and Hazelton 1990:28). This combination of soils and topography has been classified as the Blacktown soil landscape (Bannerman and Hazelton1990:28). Within this unit, local relief ranges from 10-30 m with slopes of generally less than 5%, but up to 10%. Crests and ridges are broad (200 to 600 m) and rounded with convex upper slopes grading into concave lower slopes (Bannerman and Hazelton1990:28).

The original vegetation of most of the Cumberland Plain was open forest and open woodland, dry sclerophyll forest) in which the trees were widely spaced and the ground cover dominated by grasses (Perry 1963). Between Liverpool and St Marys these communities were dominated by white stringybark (*Eucalyptus globoidea*) and broad leaved ironbark (*E. fibrosa*), with woollybutt *(E. longifolia*) as an understorey species. Other dominant species on the Plain included forest red gum (*Eucalyptus tereticornis*), narrow leaved ironbark (*E. crebra*), grey box (*E. moluccana*) and spotted gum (*E. maculata*) (Benson 1981).

4.2 Erskine Park CSR Lands

The Erskine Park study area is located within the catchment of South Creek, a major north draining catchment that dominates the western Cumberland Plain. The study area extends from a watershed ridgeline in the east (at just over 60 m AHD) to basal valley slopes at its western end (at just under 40 m AHD), approximately 10 m above the level of South Creek some 900 m to the west. The watershed ridgeline at the eastern boundary separates small west draining tributary catchments from the Ropes Creek catchment, a major north draining tributary of South Creek. Two unnamed tributary drainage lines traverse the study area. Both streams are classed as intermittent and do not represent a permanent or near permanent water source. The northernmost drainage line is a first order stream and is situated just inside the northern study boundary and drains to the west. This drainage line has a limited catchment area that includes the northern margin, and approximately 20% of the study area. The larger, and southern drainage line is a first and second order stream which originates on higher gradient slopes in the southeastern portion of the study area and flows westward, close to and then outside of the southern boundary. It then passes across the eastern end of the study area before traversing the alluvial floor of the South Creek valley.

The watershed between these two tributary catchments follows a low, roughly east-west aligned spurline, before ascending a large broad hill that dominates the central eastern portion of the study area. The apex of the hill was the weathered remnant of a diatreme, a Tertiary aged volcanic intrusion of basalt. This deposit has been extensively quarried and the resulting void is now being used as landfill. Approximately one third of the study area has been disturbed to a high degree by the basalt quarry, its related activities and associated industrial areas. (Figure 2.3).

Most of the original native vegetation has been cleared from the study area and vegetation cover over much of the area now comprises grassland, open woodland and regenerating open forest. The current canopy appears to be the result of a number of phases of regeneration following fire or low grazing impact and is characterised by relatively young and even regrowth. Old growth trees occur only rarely. The area appears to have been heavily grazed for a long period, most recently by a very large (800+) herd of goats (Plates 4.1 and 4.2).

Plate 4.1 Recent grazing on CSR Lands (photo November 2004)

Plate 4.2 Recent grazing on CSR Lands (photo November 2004)

5. ARCHAEOLOGICAL CONTEXT

5.1 Ethno-history

References to the Aborigines of the Sydney region are found in the journals, diaries and general writings of the early colonists, explorers and settlers. The 'natives' were one of the main subjects of interest to those who arrived in the First Fleet and 'all the journals contain frequent references to them' (Fitzhardinge 1961:102).

Accounts written by early visitors to Australia which document the more obvious details of Aboriginal life include Bradley (1786), Collins (1798), Hunter (1793), Phillip (1789), Tench (1789, 1793, 1961) and White (1790). Although these early commentators were not trained in anthropology or linguistics they provided some useful information regarding the Aborigines around the Sydney region.

Tench (1789:79) describes the equipment of the Aborigines as 'Exclusive of their weapons of offence, and a few stone hatchets very rudely fashioned, their ingenuity is confined to manufacturing small nets, ...and to fish-hooks made of bone, neither of which are skilfully executed'. Tench also notes the use of bark canoes for fishing (Tench 1789:81-82).

Comments were made on the types of Aboriginal shelters observed. These were described as consisting 'only of pieces of bark laid together in the form of an oven, open at one end, and very low, though long enough for a man to lie at full length in … they depend less on them for shelter, than on the caverns with which the rocks abound' (Tench 1789:80). Collins observed that the huts were 'often large enough to hold six to eight people' (Collins 1798:555). These shelters were often grouped together.

Within a short period of time after white settlement the Sydney Aboriginal population was greatly reduced as a result of two epidemics (most probably) smallpox. The first occurred only a short time after settlement in 1789 and the second in 1829-1831 (Butlin 1983). The first outbreak of the disease is believed to have killed 50 percent of the Aboriginal population (Collins 1798:53, Ross 1988:49, Tench 1961:146, Turbet 1989:10). Loss of life on such a scale caused a major social reorganisation of Aborigines around the area (Ross 1988:49) with 'remnants of bands combining to form new groups' (Kohen 1986:30). Therefore the anthropological observations and other observations by chroniclers of the time do not depict the pre-settlement situation accurately.

There are other accounts dating from the early 1800s that provide more detailed references to Aboriginal life in the Sydney region. However the information must be interpreted and used with caution due to the immense changes that occurred in the Aboriginal population and society during the early years of settlement (McDonald 1994:34).

Detailed anthropological work focussing on a systematic documenting of Aboriginal society was not undertaken until the late 19th century, beginning with R.H. Mathews' work (Mathews 1895, 1898, 1901a, 1901b, 1901c, 1904, 1908, Mathews and Everitt 1900). His anthropological work was, however, undertaken with a greatly changed population of people after more than a hundred years of contact. It does not therefore represent the situation at the time of contact or reflect pre-contact society. He documented some myths and also vocabulary of Aboriginal groups around the Sydney region.

5.2 Tribal and Cultural Affiliations

The exact boundaries between Aboriginal groups that existed in 1788 are impossible to reconstruct because of the lack of reliable data available from that time. There have been numerous attempts at mapping the pre-contact and contact territories of Aboriginal people in the Sydney region (Capell 1970, Eades 1976, Kohen 1986, 1988, Mathews 1901a and b, Ross 1988, Tindale 1974). The primary data is limited, as the early observers (members of the First Fleet and settlers) did not document how Aboriginal people perceived of their own groups or how they differentiated themselves from one another.

Early anthropological work that was carried out is also not totally reliable. The population of Aboriginal people around Sydney was depleted by disease and aggression by Europeans and many of the survivors would have relocated and/or probably joined other groups.

The linguistic and tribal boundaries and size of areas attributed to the various Sydney region Aboriginal groups vary between different interpreters. Tindale (1974) places the Tharawal tribe in the area south from Botany Bay and Port Hacking to the Shoalhaven River and inland to Campbelltown, Picton and Camden. To the west of this tribal area, Tindale placed the Gandangara tribe, and to the north the Daruk tribe. Tindale has an Eora tribe, which was closely linked to the Tharawal tribe, extending from the northern shores of Port Jackson to the edge of the plateau overlooking the Hawkesbury River and south to Botany Bay and the Georges River. Tindale earlier referred to the Aborigines on the northern side of Botany Bay as the Kameraigal horde, while others refer to this group as the Cadigal or Biddigal.

5.3 The Sydney Basin

The Sydney Basin, has been the subject of intensive archaeological survey and assessment for many years. This research has resulted in the recording of thousands of Aboriginal sites and a wide range of site types and features. The most prevalent sites or features include: isolated finds, open artefact scatters or camp sites, middens, rock shelters containing surface artefacts and/or occupation deposit and/or rock art, open grinding groove sites, and open engraving sites. Rare site types include scarred trees, quarry and procurement sites, burials, stone arrangements, carved trees, and traditional story or other ceremonial places.

Archaeological studies in the Sydney Basin have generated hundreds of reports and monographs and a number of academic theses. Studies generally fall into four categories - projects which have been carried out within a research-oriented academic framework, larger scale planning and management studies (eg. regional heritage studies), archaeological surveys carried out by interested amateurs, and impact assessment studies which have been carried out by professionals within a commercial contracting framework. The latter deal with specific localities subject to development proposals and constitute a large proportion of the archaeological research carried out to date.

Aborigines have lived in the Sydney region for at least 20,000 years (Stockton & Holland 1974). Late Pleistocene occupation sites have been identified around the fringes of the Sydney Basin at Shaws Creek (13,000BP) (**B**efore **P**resent) in the Blue Mountain foothills, and at Mangrove Creek (11,000BP) at Loggers Shelter (Attenbrow 1987). Nanson et al (1987) have suggested that artefacts found in gravels of the Cranebrook Terrace indicate Aboriginal occupation over 40,000 years ago, however there is some doubt as to the contextual integrity of these artefacts.

The majority of both open and rockshelter sites in the Sydney region date to within the last 3,000 years. A similar trend in occupation age occurs in dated deposits in NSW coastal sites. This has led many researchers to propose that population and occupation intensity increased from this period (Attenbrow 1987, Kohen 1986, McDonald & Rich 1993, McDonald 1994). The increased use of shelters postdates the time when sea levels stabilised after the last ice age around 5000 years ago (the Holocene Stillstand). Following the stabilisation of sea levels, the development of coastal estuaries, mangrove flats and sand barriers would have increased the resource diversity, predicability, and the potential productivity of coastal environments for Aborigines. In contrast, occupation during the late Pleistocene (prior to 10,000BP) may have been sporadic and the Aboriginal population relatively small.

The stone technologies used by Aborigines within the Sydney Basin have not remained static and a sequence of broad scale changes through time have been consistently identified. This is known as the Eastern Regional Sequence and can be applied with various degrees of success and allowances for regional differences, to sites throughout eastern seaboard of Australia. McDonald notes that the introduction of ground implements around 4000 years BP and shell fishhooks in the last 1,000 years were major technological innovations (McDonald 1994:69).

5.4 The Cumberland Plain

The Erskine Park study area is located on the northern Cumberland Plain - defined as that area of the Wianamatta Shale Plain where the creeklines drain north and west to the Hawkesbury River (McDonald and Rich 1993). Hundreds of Aboriginal sites, predominantly open artefact scatters (also referred to as open camp sites) have been recorded within the Plain. The campsites vary greatly in size from small sparse scatters to large concentrations of artefacts, with the larger denser sites tending to occur in close proximity to stone source localities and permanent water sources. Stone materials used in artefact manufacture at the sites reflect this proximity. Sites adjacent to the Hawkesbury/Nepean River contain higher proportions of chert and other fine-grained rocks found in the river gravels, while sites further east and south contain higher proportions of silcrete. Other site types known include scarred trees, raw material extraction/procurement sites, stratified deposits and grinding grooves where there are exposures of Minchinbury sandstone in the Wianamatta shales and clays.

The picture of Aboriginal utilisation and occupation of the Cumberland Plain is constantly being revised and refined as archaeological methods improve and more archaeological data becomes available for the area. The archaeological data for the Plain is derived from a number of sources including impact assessment studies, archaeological planning and management studies and academic archaeological investigations.

Larger scale projects undertaken on the Cumberland Plain include

- Kohen's 1986 doctoral research on the western Cumberland Plain (Kohen 1986);
- Smith's major compilation and analysis of data for the northern Plain (Smith 1989);
- McDonald and Rich's investigations at Rouse Hill (McDonald and Rich 1993);
- Navin and Officer’s surveys at Badgerys Creek for the proposed Second Sydney Airport (Navin Officer Heritage Consultants 1996); and
- McDonald’s work at the ADI site at St Marys (Jo McDonald CHM Pty Ltd 1997).

Several predictive models have been formulated to explain Aboriginal site location on the Cumberland Plain. Haglund (1980) developed a predictive model of site location based on an early survey in the Blacktown area. She predicted that sites would most likely be located near water courses such as creeks and soaks, and on high ground near water. Kohen (1986:292) hypothesised that the availability of water was the most important factor influencing the distribution of sites across the landscape.

Other criteria that appear to play a role in site location are the proximity to a diversity of economic resources such as food and lithic materials and to a lesser extent, elevation. Smith supports the predictions made by Haglund and Kohen that sites will most commonly be found near water sources (Smith 1989).

5.4.1 Excavations on the Cumberland Plain

Prior to 1993 relatively few open sites had been excavated on the Cumberland Plain. Excavations at Plumpton Ridge, a major source of silcrete raw material, have provided evidence of extraction activity at this site at least 2,200 years ago (McDonald 1986). The stratified Power Street Bridge site on Eastern Creek at Doonside yielded a date of 5,957±74BP (NZA-3112) which is the earliest occupation date for the Cumberland Plain (McDonald 1993).

A deflated Aboriginal hearth site located on a sand dune at Randwick provides the earliest secure date, 7820±50BP (Beta 87211), for an open site in the Sydney Basin (Mary Dallas pers. comm. 1997). The site was located in the course of investigations of the Randwick Destitute Children's Asylum at the Prince of Wales Hospital.

The results of test excavations at Rouse Hill (McDonald and Rich 1993) have confirmed that Aboriginal archaeological sites occur widely across the landscape including areas such as hilltops and slopes and near creeks. Larger sites with higher artefact densities are more likely to be located near permanent water. Charcoal from two knapping floors located in sites in the Rouse Hill development area have provided Early Bondaian dates of 4,060±90BP (Beta 66450) and 4,690±80BP (Beta 66453) respectively (McDonald and Rich 1993). These dates are the earliest so far obtained for backed blade reduction sequences at open sites on the Cumberland Plain.

Findings from the Rouse Hill investigations that could be extrapolated to similar areas on the Cumberland Plain are:

- most areas which were the subject of subsurface investigations contained subsurface material;

- site patterning could be related to gross environmental factors, however, the relationship between sites and the environment is complex - sites on permanent water are more complex than sites on ephemeral drainage lines. Major confluences are prime site locations;

- depositional environments for example, alluvial terraces, contain the best potential for intact cultural material, although some hill slope zones may also have good potential;

- intact archaeological material may remain below the plough zone that is, the top 25 centimetres of soil;

- minor gullies tend to have low density sites; and

- fewer sites were located on ridge tops possibly due to greater disturbance of these areas.

A number of archaeological excavations have been carried out in areas around Erskine Park.

In 1989 Koettig conducted a limited program of subsurface test excavations within six locations in a proposed Eastern Creek waste disposal extension area. The testing program resulted in the location of a low density of stone artefacts in 50% of test holes in the southern part of Koettig's study area (ie in fifteen of the thirty backhoe pits). Artefacts appeared to be confined to the upper humic soil levels and they were generally located in clusters rather than evenly distributed throughout the soil. Raw material types included silcrete, indurated mudstone, chert, quartz and basalt (Koettig 1989:4)

Excavations of a site at West Hoxton provided evidence of artefacts present up to 80 m from a creekline, extending onto adjacent lower slopes (Rich and McDonald 1995).

In 2001 Waste Service NSW proposed to extend the existing Eastern Creek Waste Management Centre, off Wallgrove Road at Eastern Creek. A component of the redevelopment involved construction of a bridge across Eastern Creek. A program of archaeological subsurface testing was conducted in August 2001 at the location of the proposed bridge across the creek.

A total of 66 artefacts were retrieved from 16 excavated pits at Eastern Creek. The assemblage showed spatial and vertical patterning in the distribution of stone artefacts, with some variation noted between the eastern and western banks of the creek. The assemblage consisted predominantly of flakes and flaked pieces, although one small multi-platform core was also found. The assemblage was dominated (79%) by a dark red, fine-grained silcrete (Navin Officer Heritage Consultants 2001).

One area of possible archaeological sensitivity was identified in the area of the proposed Eastern Creek Dragway by some of the Aboriginal representatives who participated in the field survey of the area (Navin Officer Heritage Consultants 2002a). Six grader scrapes were subsequently made along a small spurline in the Dragway area and ten Aboriginal lithic artefacts were recovered from the scraped areas. These artefacts were collectively referred to as site 'ECD1'. This small assemblage belonged to the local region Late Phase stone industry and was representative of a classic microblade industry (Navin Officer Heritage Consultants 2002b).

The raw material (red silcrete) was similar to that which dominated the assemblage excavated from PAD1 in the nearby Eastern Creek Waste Management Facility in 2001 (Navin Officer Heritage Consultants 2001). The artefact density was so low at ECD1 (1 artefact/264m^2) that the artefacts were considered to represent background scatter, which is a term used generally by archaeologists to refer to artefacts that cannot be usefully related to a place or focus of past activity.

5.5 Predictive Archaeological Landform Categories in the CSR Lands

As part of the preparation of a (section 87) Preliminary Research Permit application for the conduct of this testing program, a number of predictive archaeological landform categories were identified within the study area (Figure 2.2). When combined with mapping of previously recorded surface sites and substantially disturbed ground (Figure 2.3), these divisions assisted in the selection of areas for archaeological testing.

The predictive archaeological landform categories consisted of the following:

Watershed Ridgeline Crest

This consists of a broad, north-south aligned ridgeline crest which marks the watershed between the Ropes Creek catchment and the rest of the South Creek catchment. It parallels the eastern boundary of the study area and includes the highest ground in the study area (just over 60 m AHD).

Major watersheds may have offered advantages as cross-country travel routes to Aboriginal people due to their broad and open character, and lack of water crossings. This amenity however is unlikely to have extended to camping activities due to the maximal distance from valley floor water sources.

The potential for archaeological material on this landform was considered to be high, but its incidence was likely to be discontinuous and only in low densities, reflecting multiple but small scale and interim occupation associated with through travel.

Spurline Crest

This category consists of the relatively flat and low gradient sections of the spurline crests situated between drainage valleys. The spurlines can be subdivided into major and minor categories according to the order of watershed catchment they define. Two major spurlines traverse the middle portion of the study area. The watershed of the northern tributary stream extends westward across the northern portion of the study area. Another spurline branches from the former and extends to the southwest. A private airfield has been constructed along the length of the latter, and also includes a portion of the former.

In the higher gradient and upper catchment sections of the study area, these crests represent the only substantial and well drained level ground suitable for Aboriginal camping. It is therefore conjectured that they may have been a focus for any occupation associated with upper catchment streamlines.

In lower catchment contexts such as at the western end of the study area, the crests of spurlines are low, very broad and ill-defined. As such, this ground offers no particular benefit or advantage for camping when compared to low gradient ground situated closer to the creeklines.

As a consequence, the potential for archaeological material on spurline crests was considered to range from moderate to high, depending on relative valley context. Given that these topographies were closer to major streamlines, it was considered probable that archaeological material would be present in higher densities than for the major watershed ridgeline in the east. Material may also be more focused according to the boundaries of the flat ground and the degree of relief in the surrounding terrain.

Locally elevated, relatively level ground adjacent to a water course

This category consists of locally elevated and relatively level ground in close proximity to watercourses. Landforms include creek banks, benches, alluvial fans and low gradient slopes. All of these landforms are situated on or close to the valley floor and some may include alluvial and colluvial deposits.

The potential for archaeological material on this landform was considered to be high, with material potentially occurring at higher densities than elsewhere in the study area. The incidence of material was predicted to reflect micro-topographic variation and to be focused on well drained level ground. These predictions were based on proximity to the creeklines and the current drainage regime. It was expected that larger sites would be associated with larger order streamlines.

An unknown factor was the degree to which valley floor drainage may have increased as a consequence of European landuse patterns. The present day incised nature of the drainage lines provide a well drained valley floor environment, however it is possible that prior to European landuse, the creeklines were less distinct and much of the valley floor was poorly drained.

100 m either side of a water course

This category was applied as an overlay across the other predictive categories and consists of a zone defined by a distance of 100 m on either side of major drainage lines. The upper most catchment gullies were excluded from this zone. This predictive category is based on previous Cumberland Plain findings that indicate that most larger surface sites occur within 100 m of a significant water source.

5.6 Erskine Park CSR Lands – Test Areas 1 and 2

A program of archaeological subsurface testing was conducted in two areas, Test Area 1 (including NPWS Site # 45-5-450) and Test Area 2, within the CSR Land at Erskine Park in January 2005 (Navin Officer Heritage Consultants 2005). The investigation was conducted under Preliminary Research Permit #2076.

Test Areas 1 and 2 were located near the northern boundary of the CSR lands adjacent to Lenore Lane. The areas included locally elevated ground adjacent to the upper reaches of a minor unnamed tributary to South Creek, and low gradient slopes associated with a (now largely quarried) ridgeline. A Bluescope steel facility is proposed for this area.

Twenty one (21) test pits were excavated in Test Area 1 and seventeen (17) test pits were excavated in Test Area 2 by a backhoe using a straight-edged 1500 mm toothless (mud) bucket.

A total of 49 lithic items were recovered from 20 of the 38 test pits excavated in Test Areas 1 and 2 at Erskine Park. A total of 34 lithic items were recovered from 11 of the 21 test pits excavated in Test Area 1 (including 45 NPWS Site # -5-450). A total of 15 lithic items were recovered from 9 of the 17 test pits excavated in Test Area 2., now referred to as site EPTA2.

Seven petrological or geological types were identified in the lithic assemblage. In the order of frequency were silcrete and rhyolitic tuff, which together comprised 80% of lithic items, and minor components (less than 10%) of chert, chalcedony, quartz and two unidentified stone types, one a fine-grained siliceous stone and the other a metamorphic stone.

Eight types and categories of lithic items were identified in the assemblage: lithic fragment, flake, flake fragment, flake portion, microblade, microlith backing flake, utilised flake, and flake from a utilised edge (both are implements). In general these items were small in size, and lightweight, as is typical for flaking debitage and heat fractured lithic items in recent prehistoric lithic assemblages. The large proportion of microdebitage in the stone assemblage was unremarkable in the context of microlithic debitage from the Cumberland Plain.

Nondescript lithic fragments comprised nearly 30% of the assemblage, and nondescript flakes nearly 60%, providing a total nondescript component of about 90%. The remainder of the collection comprised identifiable microblade and microlith knapping debris and the discard, and use of flaked stone implements.

There was no identifiable stratigraphic change in the overall character of the lithic assemblage from the Erskine Park Test Area 1 and 2 sites. As far as could be ascertained, the assemblage in general was 'microlithic' in character (microblade knapping debris) and typical of the Late Phase in Australian prehistoric stone technology.

The diagnostic' lithic items in the assemblage were a microblade, some microlith backing flakes (discarded during the making of spear barbs), and some flakes struck from a microblade core. The only other diagnostic element was probably a fragment of an elouera. This tool type is dated to within the last 2000 years.

Artefact densities were generally low, varying from 0 to 7.7 per square metre, with an average density of 2.45 artefacts per square metre.

In Test Area 1, greatest artefact densities were encountered on locally elevated and relatively level ground bordering the creekline. Despite a degree of elevation along the northern creek bank, the southern bank, being roughly one metre higher, had greatest density. Elevation, rather than aspect appears to be the active determinant. In Test Area 2 low artefact densities (between 1 and three artefacts per pit) were encountered in discontinuously across the whole spurline slope. Most testpits with artefacts were located on the basal slopes.

The artefactual remains were indicative of low intensity occupation suggesting transient camps and activities peripheral to a base camp or main occupation area.

The subsurface archaeological deposits investigated within Erskine Park Test Area 1 and 2 were assessed as having low archaeological significance within a local context only.

It was recommended that no further archaeological assessment was required for Erskine Park Test Area 1 and Test Area 2 and that application should be made to the Director General of the NSW DEC [NPWS] for a Section 90 Consent to Destroy for the identified Aboriginal archaeological sites/deposits which will be impacted by the proposed BlueScope development works.

6. STUDY METHODOLOGY

6.1 Objectives of the Subsurface Testing Program

The general aim of the subsurface testing program was to characterise the archaeological resource within the CSR lands at Erskine Park (the study area) by testing selected sample and representative areas (the Test Areas).

Specific aims were to:

- Determine if subsurface Aboriginal artefacts or 'Aboriginal Objects' (as defined by the NPW Act) were present within the defined Test Areas.
- Characterise the nature of any archaeological deposits encountered (within the limitations of the sampling and processing methodology).
- Identify the need for any further archaeological work, such as salvage excavation.
- Provide informed mitigative measures and management recommendations for any sites located within the areas.

6.2 Investigation Approach

The following approach was followed for the investigation of Test Areas at Erskine Park.

- Identify test areas based on a review of previous archaeological work, topographic variation and disturbance levels across the study area, and predictive models for the Cumberland Plain.
- Obtain a Preliminary Research Permit from the DEC [NPWS] (Permit #2076).
- Conduct initial surface survey of test areas and establish premium locations for a series of test pits.
- Excavate a series of backhoe test pits across the subject areas.
- Wet sieve a systematic sample of spoil recovered from successive spits (levels) from each test pit.
- Conclude test pits when bedrock, dense clay, or sediments which were indicative of an environment with low archaeological potential, were encountered.
- Backfill all test pits.
- Describe and analyse all recovered artefactual material.

6.3 The CSR Archaeological Test Areas

This section provides a brief description and rational for each selected archaeological test area. (Refer Figures 7.1-7.19).

Test Area 1 This area consists of a section of the valley floor of a tributary stream located adjacent to the northern study area boundary. It includes locally elevated and level ground situated along both banks of the creekline. The northern bank landforms are lower in elevation than those on the southern bank. A previously recorded surface exposure of artefacts (45-5-0450) occurs in this area next to the northern creek bank.

This area is representative of micro-topographic areas with predicted high archaeological potential in valley floor contexts associated with a relatively minor tributary streamline. The whole area occurs within 100 m of the drainage line.

The results of subsurface testing within this area were reported in Navin Officer Heritage Consultants (2005) and are summarised in section 5.6 of this report.

Test Area 2 This area is immediately downstream of Test Area One and consists of low gradient north-facing basal, mid and upper spurline slopes. The lower portion basal slopes fall within 100 m of the tributary streamline, and the upper margin is continuous with the crest of a watershed spurline.

The majority of this area includes spurline slopes that fall outside of landform units with predicted archaeological potential. Testing within this area therefore provides a test of the predictive model.

The results of subsurface testing within this area were reported in Navin Officer Heritage Consultants (2005) and are summarised in section 5.6 of this report.

Test Area 3 This area is situated on the northern bank and downstream end of the tributary stream associated with Test Areas One and Two. It consists of very low gradient, valley floor deposits which rise gradually from the creekline. Unlike the creek-side deposits tested in areas one and two, the locally elevated ground is not clearly defined by a break-of-slope or other local gradient change.

This area is representative of relatively level and locally elevated ground which is poorly differentiated from the adjacent low lying valley floor, adjacent to a tributary stream line.

Test Area 4 This area consists of a section of the valley floor associated with the larger tributary stream which drains the majority of the eastern study area. It includes locally elevated and level ground situated along the southern bank of the creekline. The bank is locally elevated and provides the highest micro-topographic unit on the valley floor. northern bank landforms are lower in elevation than those on the southern bank.

This area is representative of micro-topographic areas with predicted high archaeological potential in a valley floor context associated with upper to middle catchment of the largest tributary streamline in the study area. The whole area occurs within 100 m of the drainage line.

Test Area 5 This area includes a number of micro-topographic valley floor landforms situated at the confluence of a number of first order streams. Area 5A includes continuous north facing basal slopes that form a low bench adjacent to the streamline below the confluence of the first order streams. Area 5B includes a fan-like valley floor topography just upstream of the confluence of a south draining tributary. Area 5C consists of a descending low gradient spurline situated between two converging first order streamlines.

This area is representative of micro-topographic areas with predicted moderate to high archaeological potential in a valley floor context associated with an upper catchment confluence of first order streamlines. The whole area occurs within 100 m of the main drainage line.

Test Area 6 This area consists of a well defined spurline shoulder crest in an upper catchment context. This landform is surrounded by low, and low to moderate, gradients. Compared to adjacent spurlines, Test Area 6 is more elevated and closer to the main drainage line. The area is situated more than 100 m from a main drainage line. An isolated find was previously recorded within this area.

This area is representative of level spurline crest topographies with predicted moderate to high potential situated in undulating upper catchment contexts. Due to its relatively greater elevation and proximity to the main drainage line, this topography is considered to have greater potential than adjacent spurline crests, such as area 7.

Test Area 7 This area consists of an extensive section of spurline crest, inclusive of a knoll situated at the intersection of multiple spurlines, and an extensive level shoulder area. The spurline descends gradually to the south and ends adjacent to area 5b. Previously recorded site 45-5-2512 occurs on the apex of the knoll and extends down the spurline crest for approximately 100 m. Only the far southern downslope end of the spurline occurs within 100 m of a main drainage line.

This area is representative of spurline crest topographies with predicted moderate to high potential situated in undulating upper catchment contexts. The knoll is also representative of elevated ground at the intersection of multiple spurline crests.

Test Area 8 This area consists of a broad spurline crest in an upper catchment context which forms the watershed between two tributary catchments. It includes a broad crestline saddle which ascends at its southwestern end to the Area 7 knoll, and in the northeast to the main watershed ridgeline crest at the eastern end of the study area. This area includes three previously recorded sites (45-5-2513, 2514, and 2515), one at the base of the saddle, and the others on the higher northern slopes. All portions of this area occur more than 100 m away from a main drainage line.

This area is representative of broad spurline crest topographies which from tributary watersheds in upper catchment contexts. The predicted potential for archaeological material to occur subsurface is moderate to high.

Test Area 9 This area consists of the broad ridgeline crest and upper slopes of the watershed between South and Ropes Creek. The ridgeline crest is clearly delineated on its western side by a clear break-of-slope and moderate downslope gradients. On its eastern side, the upper slopes of the ridgeline grade evenly with adjacent slopes. Two previously recorded sites occur on the crest, at the southern end of the test area (EPQ1 and 45-5-2516).

This area is representative of major watershed spurline crest topographies The predicted potential for archaeological material to occur subsurface is considered to be high.

Test Area 10 This area is one of two test areas situated in the lower catchment portion of the study area, and is approximately one kilometre downstream of test area 4. It consists of gradually ascending, northeast facing basal slopes. These slopes grade relatively evenly to the main drainage line for the study area, which at this point forms a small wetland basin. The basin is thought to be the relatively recent result of downstream road construction. The whole area occurs within 100 m of the creek line. No previously recorded sites occur within this area, but a known site (45-5-974) is situated some 30 m to the southeast, beyond the southern study area boundary, and on the same landform.

This area is representative of basal slopes fringing the main lower catchment drainage line. Locally elevated ground in these contexts were predicted to have high potential to contain subsurface archaeological material.

Test Area 11 This area is situated 150 m downstream of area 10 and consists of a poorly defined, low and broad spurline crest, together with associated northeast facing slopes adjacent to the (modern) wetland basin. This low gradient topography forms part of the basal bedrock slopes adjacent to the South Creek valley floor. Only some of the northeast facing slopes occur within 100 m of the original drainage line (excluding the modern wetland basin). One previously recorded isolated find occurs in close proximity to the western boundary of this test area (EPR7).

This area is contains most of the surviving lesser-disturbed higher ground in the lower catchment portion of the study area. This land category was predicted to have moderate to high potential to contain subsurface archaeological material.

6.4 Excavation Methodology

The following excavation methodology was followed for backhoe pits (Plates 6.1 - 6.6).

1. *Mark out and record the required location of backhoe pits.*

2. *Excavate backhoe pit and record data*

Excavation was conducted using a backhoe with a straight-edged 1500 mm toothless (mud) bucket. A total of two hundred and fifty six (256) pits (including pits conducted in Test Areas 1 and 2) were excavated at Erskine Park CSR Lands. A breakdown of pits per test area is provided in Table 6.1.

Table 6.1 Number of Pits Excavated at Erskine Park CSR Lands

Test Area	Number of Pits Excavated
1	*21*
2	*17*
3	13
4	26
5A	16
5B	5
5C	11
6	30
7	38
8	41
9	21
10	6
11	11
TOTAL	**256**

Spit depths had an interval range of between 3 cm and 20 cm. with most being between 5 cm and 10 cm in depth. Pits had a final depth between 5 cm and 80 cm. Pits had a final length of between 1 m to 2.8 m.

The following excavation sequence was followed:

Excavation of spit one along an interval averaging 2.0 m in length.

Following removal of spoil, the section of pit where the pit one (and all subsequent spits) was excavated was widened by the removal of 10 cm from one side of the pit. This was done to ensure that the bucket did not touch the pit sides when excavating the next spit. This minimised the potential for contamination from upper levels.

Excavation of spit 2 (and all subsequent spits) begins approximately 200-300 mm from the far end of the previous spit. This was done in order to create a 'clean' end-wall and prevent contamination from sediments from upper levels.

Following spit 2 (and after all subsequent spits), the near end of the pit was extended by up to 300 mm in order to remove any fallen sediment from upper levels and to provide a 'clean' end point for the backhoe bucket.

Following each spit excavation, a sample of the removed sediment, consisting of at least 8 x 10 litre buckets of was taken from the middle of the backhoe bucket, prior to the emptying of the bucket. Removing the sample from the middle of the bucket further minimised the potential for contamination from sediments falling to lower levels from the pit sides. If artefacts were detected then a further two buckets (if available) were sieved to provide a ten bucket sample.

Excavation ceased according to an on-site appreciation of testing requirements.

Following cessation of excavation, the soil profile and characteristics were described and checked with the separately documented incremental spit descriptions. PH measurements were taken from representative pits at various locations in the profile.

3. *Sieve Spoil*

All sieving was conducted with the aid of pressurised water from a water truck. All material was sieved through 3 mm mesh, with use of a top 5 mm mesh.

All identified or suspected cultural material recovered from sieving was retained, bagged and labelled. In addition a reference collection of natural gravels was collected to aid in lithic interpretation, where appropriate.

4. *Backfill Pits*

All pits were backfilled with the remaining excavated and sieved spoil.

Plate 6.1 Initial grass and topsoil removal

Plate 6.2 Pit excavation

Plate 6.3 Removing deposit from backhoe bucket

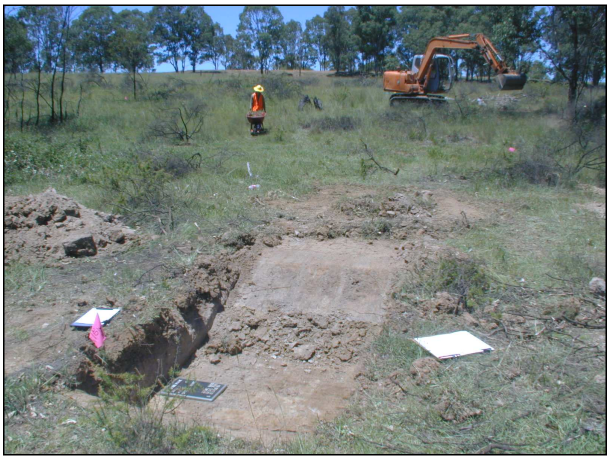


Plate 6.4 Transporting deposit

Plate 6.5 Sieve station

Plate 6.6 Sieving deposit

6.5 Lithic Analysis Methodology

The primary aim of the analysis of the lithic items retrieved from the Erskine Park Test Areas was to assist in the assessment of the significance of the site/s in terms of information potential and contribution to archaeological research.

The lithic identifications and data entry was undertaken in February 2005 by Dr Johan Kamminga, assisted by Karen Oakley who entered the data into a Microsoft Excel spreadsheet. This spreadsheet was the basis of the lithic inventory presented in Appendix 2.

Lithic items were examined under low magnification under reflected light using a modified Wild Leitz stereoscopic M3 microscope. The primary aim of this routine examination was to accurately identify lithic items and stone materials, and detect use-wear and potential tool-use residues. In particular, the task of identifying artefact types was accorded a high priority. Samples of background stone detritus also were microscopically examined to ensure an adequate discrimination between lithic items and naturally occurring stone fragments.

In this report the term *'lithic item'* denotes a very general category. This category comprises stone pieces of a geological type used by Aborigines in prehistoric times and which exhibit fracture surfaces not immediately attributable to natural or other non-Aboriginal causes. This category includes artefacts, manuports and manuport fragments and sometimes also non-cultural pieces of stone. In the normal course of analysis of a lithic collection, the items are examined in detail to determine a more specific status within this general category.

In practical terms, lithic items are classified in a general hierarchy, in terms of the degree to which an item can be specifically identified (see below). Lithic fragment is at the lowest level in this hierarchy. The term denotes 'nondescript' lithic items that do not have sufficient intrinsic morphological attributes to identify them with certainty as unbroken or portions of artefacts. However, an identification of artefact or manuport fragment status may be inferred with varying levels of confidence from spatial association with other lithic items recovered by excavation, the absence in the sediment of natural background siliceous stone of this type, and by other kinds of contextual evidence. Some categories of lithic item are specific in nature, such as for example microblade portion or bondi point, and for the purposes of analysis may usefully be combined with other categories. Other categories represent more general groupings, such as for example flake or step-terminated flake, and may be further subdivided for descriptive or analytical purposes.

6.5.1 Standard recording of properties and variables

Four basic variables were recorded in the excel database:

1. Size class, in one centimetre units (see Table 6.2, and details below).

2. Weight, as measured with an ISCO balance (precision of ±0.005 grams). Lithic item weights less than 0.01 grams were accorded the nominal value of 0.01 gram.

3. Stone material type or category (see Appendix 3). To the extent possible, specific stone types were identified including, in some cases, colour and fabric characteristics. The specific stone material type could not be positively identified for seven of the lithic items, even when inspected under low magnification. The category ‘Unidentified stone type' is used to describe these items.

4. Lithic item type or category (with further details entered into the comments section of the lithic database).

Observations about notable technological attributes and other pertinent data, such as specific characteristics of the stone material, any evidence of use-wear and potential tool-use residues, are recorded in the comments section of the lithic inventory.

6.5.2 Lithic item size class

Artefact size is recorded in standard categories numbered from 1 to 10+. The measurement represents the maximum size (diameter) in any direction as measured on a grid:

Table 6.2 Artefact size classes used in recording and analyses

CODE	SIZE CATEGORY (MM)
1	5<x≤10
2	11<x≤20
3	21<x≤30
4	31<x≤40
5	41<x≤50
6	51<x≤60
7	61<x≤70
8	71<x≤80
9	81<x≤90
10	91<x≤100
10+	x≥101

The size measure is a discrete form of the continuous variable diameter, which is the greatest distance in a straight line between any two points on the surface of a lithic item. The unit for size is the centimetre, as it is for diameter. The size class increments are whole centimetres. When applied to size the average function produces a continuous variable, also measured in centimetres. Therefore, the average may take on values that are intermediate between classes. Thus a group of artefacts ranging between size classes 1 and 2 may have hypothetically an average of 1.5 cm. It should be noted that maximum size as measured by this method does not necessarily reflect general plan shape characteristics of the artefact.

6.5.3 Rationale for lithic item classification

Polythetic classification

The artefact categories defined for this report constitute polythetic groupings, which are defined by a constellation of attributes and for which no single attribute is essential or sufficient for membership (Sokal and Sneath 1963:13; Clarke 1978:36; Hayden 1980:3; Kamminga 1985:10). Polythetic categories are not rigidly bounded. An artefact attributed to a type or category needs to have only some of the defining attributes of that category, such as a particular shape, presence of retouch on a certain part, or particular attributes of use-wear, and any such attributes may be shared with other artefacts categories.

Fragments of artefacts are often allocated to a general category because they do not have sufficient attributes for them to be allocated with confidence to a more specific category. Examples of this are microblade fragments that are identified only to the level of flake portion. In some instances an artefact may equally fit in two different categories. In such cases a decision has been made about priority of the categories in terms of their relative value in subsequent analyses. Some of the implement categories approximate functional types, but more precise identification of functions will only be possible after further progress in research on use-wear and tool-use residues.

The use of subjective criteria for classification is more common for quartz items. For instance, core fragments equally may be chunky flakes. Commonly quartz fragments during knapping so that a flake will break into three or more fragments while detaching because of pre-existing flaws in the stone. Quartz shatters during knapping. Commonly quartz does not exhibit typical conchoidal features or else exhibits subdued conchoidal features. Quartz flakes fragments are difficult to ascribe with certainty because often it is not known whether the flake terminated at a pre-existing flaw or whether it broke into two or more pieces a microsecond after the fracture had been created.

6.5.4 General principles in identifying stone artefacts

When pieces of natural 'background' siliceous stone or stone manuports are fractured by natural weathering processes, or by modern land-use activities such as cattle treadage or vehicles, some of the fragments may be indistinguishable from prehistoric artefacts. Bushfire also may play a role in natural fragmentation of siliceous stone such as silcrete, creating 'potlid' flakes and other artefact-like stone fragments. In particular, the presence of naturally fractured quartz fragments in a sediment often creates difficulties in identifying quartz artefacts.

Quartz is common and abundant in Australia, and was used by Aborigines throughout the continent for a wide range of cutting and scraping tasks. While the exact path of intentional fracture in quartz is often unpredictable because of anisotropy, the flakes and other fragments struck from this stone type often have sharp edges suitable for light-duty cutting activities.

A common type of fracture created during stone flaking is conchoidal fracture. This normally occurs when the edge of a stone core is struck with a hammerstone. Such fractures have a number of associated features that assist in their identification, such as ring cracks, Hertzian cones (most often a single ‘partial Hertzian cone’), bulb of force, lances, fracture-front undulations and a range of fracture termination types, such as step, hinge and feather terminations. These attributes indicate the nature of the applied load, the fracture initiation and fracture path. Other types of artefactual fracture are bending-initiated, which occurs occasionally, and bipolar flaking which also is a common method of hard-indenter flaking of quartz. These fracture types and fracture surface attributes are described in a number of publications (Cotterell and Kamminga 1979, 1987, 1992; Kamminga 1982), and definitions of technical terms are provided in the glossary for this report.

There is very limited experimental data to assist in distinguishing nondescript quartz artefacts from naturally fragmented quartz or from quartz broken during modern pastoral activities (such as by cattle or vehicles). It has been reported that as much as 85-90% of quartz artefacts produced by replicative bipolar flaking experiments can not be reliably distinguished on an individual basis as artefacts (Moore 1997:66). The identifications on which this estimate is based were guided by the presence of conchoidal markings such as bulb of force. Since bipolar artefacts are also identifiable by other fracture types and features (Cotterell and Kamminga 1987, 1992) it is likely that a larger proportion of quartz artefacts will normally be identifiable, especially when the quartz is of good flaking quality.

Often stone artefacts do not have such attributes and their identification is based on stratigraphic context and the identification of the stone type. Thus many quartz artefacts may be below the 'threshold of recognition' as artefacts. Vein or reef quartz presents particular problems of identification because usually it is less isotropic than small water-rolled pebbles. Intentional knapping of quartz tends to be much less predictable than for stone types such as silcrete, chert and even granular quartzite, and diagnostic fracture surface features often are not apparent. While sedimentary context may provides confidence in identifying quartz artefacts there is only very limited experimental data to assist in discriminating nondescript quartz artefacts from natural quartz fragments, or from quartz fragmented by pastoral and other modern land-use activities (Cotterell and Kamminga 1987, 2000; cf., Knudson 1978). The difficulty in accurately identifying quartz items is evident from the proportion of lithic fragments in the quartz component of an assemblage.

6.5.5 Analytical methodology

Conjoin analysis

Conjoining (or refitting) of stone artefacts has proven to be a robust analytical tool for assessing degree of site integrity. The method also has been successfully applied in reconstructing lithic reduction sequences and inferring reduction strategies. Conjoin studies have been undertaken on microlithic assemblages in particular. Conjoining of artefacts is highly labour intensive and is therefore only a preferred method of analysis when significant useful results are likely to be obtained. The potential of conjoin analysis significantly diminishes when artefacts are less than two centimetres in size. Most lithic items in the collection are small: 63 items are in size 1, and 38 in size 2 from a total of 234. In general, the method of analysis is therefore contra-indicated for assemblages comprising predominantly microdebitage (Koettig 1994/1:23; Schick 1986:34).

The assemblage was not recovered by broad area excavation, but from bucket samples from backhoe pits dug a spit at a time. These pits were not adjacent or in particularly close proximity to each other, and for these reasons the collection was not deemed suitable for conjoin analysis. No potential conjoins no general 'associations' (see below) between artefacts were identified during microscopic examination.

Association of lithic items

An alternative and complementary analytical method to conjoin analysis is 'lithic item (or artefact) association' (Kamminga 2000; Navin Officer Heritage Consultants 1998; Navin Officer Heritage Consultants 1999; JMCHM 1997, 1998). While this method has general utility, it is particularly appropriate for lithic assemblages comprising a high proportion of microdebitage. The fundamental difference between conjoin analysis and lithic item association is that a conjoin constitutes proof that the artefacts derives from a particular flaking or heat treatment event, and 'association' of a lithic item is inferential evidence and therefore less certain. Associations have been recorded in the comments section of the lithic inventory.

The criteria for association of a lithic item with one or more others are wide ranging, and are both intrinsic and extrinsic. These criteria include:

Contextual evidence of stratigraphic or spatial proximity of lithic items.

– Shared technological and typological attributes.

– Similarity of stone material (if not identical stone, then linked by attributes of cortex, matrix and inclusions).

– Correspondence in use-wear and/or tool-use residues (as occurs on edge-rejuvenation flakes).

The extent to which such associations are viable or meaningful depends on a wide range of factors, such as excavation method, rate of sediment accumulation and degree of site integrity, size of assemblage, technological and typological variability, range of stone materials, lithic item 'density' and intensity of lithic discard.

Inferences about meaningful associations between lithic items range between possible and highly probable. Sometimes associations are indicated by uncommon or very specific characteristics of stone composition. Examples of this may are distinctive cortex, colour gradation, and granularity or unusual mineral inclusions in the matrix. In general, the best circumstances apply when only a single flaking or tool-use event or episode has occurred within in an area completely excavated. In normal circumstances, repeated lithic discard over time within the same area tends to diminish the potential for inferring associations, particularly if there is little or no change in the nature of stone material and technology, and when the lithic discard is stratigraphically mixed.

Use-wear and residue analysis

Dr Kamminga examined all lithic items in reflected light with a low-magnification binocular microscope. Routine microscopic examination followed the procedures described by Kamminga for identifying use-wear and residues (Kamminga 1978, 1982; Cotterell and Kamminga 1987, 2000). Three artefacts were identified as tools (or tool fragment) from the evidence of use-wear. No tool-use residues were identified.

6.6 Curation of the lithic artefact collection

The lithic items after examination and measurement have been stored individually in standard resealable plastic bags. These containers are labelled in permanent black pen with the item's unique identification number and details of its provenance within the excavation. Following completion of the analysis of the assemblage, all the lithic items will be lodged with the Australian Museum, Sydney, or with a local representative Aboriginal group.

7. RESULTS

A total of 285 lithic items were recovered from 88 of the 256 test pits excavated within the Erskine Park CSR Lands. (Table 7.1).

A total of forty nine (49) lithic items were recovered from 20 of the 38 test pits excavated in Test Areas 1 and 2 at Erskine Park.

A total of two hundred and thirty six (236) lithic items were recovered from 68 of the 218 test pits excavated in Test Areas 3-11.

Table 7.1 Summary of Pit Data

Test Area	Number of Pits Excavated	Number of Pits with Lithic Items	Number of Lithic Items
1	21	11	34
2	17	9	15
3	13	11	26
4	26	8	20
5A	16	2	4
5B	5	1	1
5C	11	4	8
6	30	9	47
7	38	3	6
8	41	10	16
9	21	7	14
10	6	6	53
11	11	7	41
TOTAL	**256**	**88**	**285**

The locations of the test areas are shown on Figure 7.1.

The locations of the test pits, and numbers of artefacts within each test pit, are shown on figures 7.2 - 7.19.

Lithic items are described in Appendix 2.

7.1 Soil Profile

The soil profile was generally consistent across the CSR lands - soils were typical texture-contrast duplex soils.

All of the soil profiles subject to testing occurred within the biomantle, that is, they were subject to constant mixing through bioturbation. The more elevated slopes typically displayed varying degrees of truncation and erosion. This is especially evident on test pits located on the upper slopes of the study area (Test Areas 4, 5, 7 9) where the current ground surface is derived from the original clay substrate. The depth of the 'A' horizon was greatest in basal slopes and valley floor contexts. In these areas a leached 'A2' horizon was most evident. A summary of pit data and soil profile descriptions is provided in Appendix 7. Photographs of pit profiles are provided in Appendix 8.

7.1.1 Summary Soil Descriptions

Area 3	dark brown variously compact or friable loam to about 28 cm overlying dark brown/orange mottled clay.
Area 4	light brown friable loam over red/grey heavy clay. In some pits the soil was only 2-3 cm deep and appeared to be significantly truncated, indicating that these areas had been stripped of top soil and the upper soil profile.
Area 5A	light brown friable loam becoming darker with depth overlying light or dark brown heavily compact clay.
Area 5B	light brown friable loam grading quickly to mottled light brown and orange clay.
Area 5C	light brown friable loam grading to light brown and orange mottled clay.
Area 6	light brown sandy loam over orange/red podsolic clay layer at about 11-20 cm
Area 7	brown loam that grades quickly to a brown/red clayey layer with some dark staining then into red clay.
Area 8	orange brown mottled clay to base of pit. The soil profile in this area is clearly truncated.
Area 9	light brown to brown sandy loam with increasing clay content then yellow/orange and red/brown massive clay.
Area 10	light grey/brown silty clayey loam with increasing clay content with depth then yellow gravelly silty clay.
Area 11	dark yellow brown clayey loam grading to brown yellow silty clay.

7.2 Stone Materials Types and Categories

Eight petrological or geological types (Table 7.1) have been identified in the lithic assemblage. In the order of frequency these are silcrete and tuff which together comprise 81% of lithic items, and minor components (less than 10%) of quartz, quartzite, chert, chalcedony and two unidentified stone types, one a fine-grained siliceous stone and the other a metamorphic stone. Stone types are described in Appendix 3.

Colour difference was recorded as this is a major criterion for subdividing petrological types to assist in identifying potential relationships between lithic items (such as conjoins and lithic item 'associations'), technological processes, and for general descriptive purposes. It should be noted that similarity in colour within a geological type does not necessarily indicate that such lithic items found in close stratigraphic association are necessarily derived from the same core, or that colour difference indicates in all instances that artefacts are from different cores.

7.3 Classification of Lithic Items

Seventeen types and categories of lithic items were identified in the assemblage: lithic fragment; flake; flaked piece; flake fragment; flake portion; bipolar flake; bipolar core; compression flake; microblade; microblade portion; microblade core; microblade core fragment; microlith backing flake; bondi point preform; bondi point portion; utilised flake and scraper (see Table 7.3). In general these items are small in size, and lightweight, as is typical for flaking debitage and heat fractured lithic items in recent prehistoric lithic assemblages. The large proportion of microdebitage in the stone assemblage is unremarkable in the context of microlithic debitage from the Cumberland Plain.

Nondescript lithic fragments comprise nearly 46% of the assemblage, and nondescript flakes (flakes, flaked pieces, flake fragments, flake portions, compression flakes and bipolar flakes) nearly 40%, providing a total nondescript component of about 85%. The remainder of the collection comprised identifiable microblade and microlith knapping debris (13%), and the discard and use of flaked stone implements (1.7%).

The lithic item types and categories are described in the glossary (Appendix 4).

Table 7.2: Stone material types in the assemblages from Erskine Park Test Areas 3-11

	Area 3		Area 4		Area 5A		Area 5B		Area 5C		Area 6	
Stone Material Type	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
silcrete	12	46.15	16	80	4	100	1	100	8	100	46	97.87
rhyolitic tuff			1	5								
tuff												
chert	2	7.69									1	2.13
milky quartz	7	26.92	2	10								
quartz												
quartzite	4	15.38	1	5								
chalcedony	1	3.85										
unidentified stone (x2)												
Total	**26**	**100**	**20**	**100**	**4**	**100**	**1**	**100**	**8**	**100**	**47**	**100**

	Area 7		Area 8		Area 9		Area 10		Area 11		Combined	
Stone Material Type	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
silcrete	4	66.67	6	37.5	10	71.43	37	69.81	19	46.34	**163**	**69.06**
rhyolitic tuff	1	16.67	2	12.5	3	21.43	1	1.89			**8**	**3.38**
tuff							12	22.64	10	24.39	**22**	**9.32**
chert									1	2.44	**4**	**1.73**
milky quartz	1	16.67			1	7.14			2	4.88	**13**	**5.50**
quartz			1	6.25					1	2.44	**2**	**0.84**
quartzite							1	1.89	7	17.07	**13**	**5.50**
chalcedony							1	1.89	1	2.44	**3**	**1.27**
unidentified stone (x2)			7	43.75			1	1.89			**8**	**3.40**
Total	**6**	**100**	**16**	**100**	**14**	**100**	**53**	**100**	**41**	**100**	**236**	**100**

Table 7.3: Lithic item types recovered from Erskine Park Test Areas 3-11

	Area 3		Area 4		Area 5A		Area 5B		Area 5C		Area 6	
Lithic item type	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Indeterminate fragments	**(14)**	**(53.85)**	**(15)**	**(75)**	**(1)**	**(25)**			**(3)**	**(37.5)**	**(18)**	**(38.3)**
lithic fragment	14	53.85	15	75	1	25			3	37.5	18	38.3
Flake products	**(12)**	**(46.15)**	**(5)**	**(25)**	**(3)**	**(75)**	**(1)**	**(100)**	**(5)**	**(62.5)**	**(28)**	**(59.57)**
flake	4	15.38	1	5							7	14.89
flaked piece												
flake fragment	5	19.23			1	25			1	12.5	3	6.38
flake portion	1	3.85	2	10	2	50	1	100			5	10.64
bipolar flake												
bipolar core												
compression flake												
microblade			1	5					1	12.5	4	8.51
microblade portion	1	3.85	1	5					2	25	6	12.77
microblade core											1	2.13
microblade core fragment												
microlith backing flake	1	3.85							1	12.5		
bondi point preform											2	4.26
bondi point portion												
Implements											**(1)**	**(2.13)**
utilised flake												
scraper											1	2.13
Total	**26**	**100**	**20**	**100**	**4**	**100**	**1**	**100**	**8**	**100**	**47**	**100**

Table 7.3: Lithic item types recovered from Erskine Park Test Areas 3-11 (continued)

	Area 7		Area 8		Area 9		Area 10		Area 11		Combined	
Lithic item type	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Indeterminate fragments	**(1)**	**(16.67)**	**(13)**	**(81.25)**	**(4)**	**(28.57)**	**(22)**	**(41.51)**	**(18)**	**(43.9)**	**(109)**	**(46.19)**
lithic fragment	1	16.67	13	81.25	4	28.57	22	41.51	18	43.9	**109**	**46.19**
Flake products	**(5)**	**(83.33)**	**(3)**	**(18.75)**	**(10)**	**(71.43)**	**(29)**	**(54.72)**	**(22)**	**(53.66)**	**(123)**	**(52.12)**
flake	1	16.67			6	42.86	20	37.74	8	19.51	**47**	**19.92**
flaked piece					1	7.14					**1**	**0.42**
flake fragment			2	12.5	1	7.14	2	3.77	6	14.63	**21**	**8.90**
flake portion	1	16.67			1	7.14	2	3.77	5	12.20	**20**	**8.47**
bipolar flake	1	16.67							1	2.44	**2**	**0.85**
bipolar core			1	6.25							**1**	**0.42**
compression flake									1	2.44	**1**	**0.42**
microblade							3	5.66			**9**	**3.81**
microblade portion							1	1.89			**11**	**4.66**
microblade core	1	16.67					1	1.89	1	2.44	**4**	**1.69**
microblade core fragment	1	16.67									**1**	**0.42**
microlith backing flake											**2**	**0.85**
bondi point preform											**2**	**0.85**
bondi point portion					1	7.14					**1**	**0.42**
Implements							**(2)**	**(3.77)**	**(1)**	**(2.44)**	**(4)**	**(1.69)**
utilised flake							2	3.77	1	2.44	**3**	**1.27**
scraper											**1**	**0.42**
Total	**6**	**100**	**16**	**100**	**14**	**100**	**53**	**100**	**41**	**100**	**236**	**100**

7.4 Chronology of the Assemblage

There is no identifiable stratigraphic change in the overall character of the lithic assemblage from the Erskine Park Test Areas 3-11. As far as can be ascertained, the assemblage in general is 'microlithic' in character (microblade knapping debris) and typical of the Late Phase in Australian prehistoric stone technology. The ‘diagnostic' lithic items in the assemblage are microblades, microblade portions, bondi point preforms and portions, microlith backing flakes (discarded during the making of spear barbs), microblade core and core fragments, and some flakes struck from a microblade core.

Given the presence of diagnostic elements, it is inferred that the assemblage accumulated at some time within the last 3,000 years, after microliths (stone spear barbs) had been adopted in the Sydney region.

7.5 Activities

Evidence for stone knapping is present in 68 of the 218 test pits in Test Areas 3-11. A limited range of activities is represented by the recovered lithic assemblage. A breakdown of activity per test pit is provided in Appendix 5. Activities per test area are summarised in Table 7.4, below.

Almost 60% of the total number of lithic items were retrieved from three test areas - 6, 10 and 11.

The largest numbers of lithic items (53) occur in Test Area 10. Red silcrete is the most common raw material (47%). Indeterminate lithic fragments comprise 41% of the assemblage and 20% of the material exhibited thermal fractures (fractures cause by heating the stone, either from natural causes, a campfire, or intentional heat treatment). Two utilised flakes were retrieved from this test area.

Forty seven (47) lithic items were identified in Test Area 6. Red silcrete is also the most common raw material (89%) in this test area. Indeterminate lithic fragments comprise 38% of the assemblage and 40% of the material exhibited thermal fractures. One implement (a scraper) was retrieved from this test area.

Forty one (41) lithic items were identified in Test Area 11. Red silcrete comprises 39% of the raw material and 44% of the lithic items were indeterminate lithic fragments. One utilised flake was retrieved from this test area.

The results for test areas 10, 6 and 11 indicate that this stone flaking was probably associated with encampment.

Microblade production is evident in eight test areas (3, 4, 5C, 6, 7, 9, 10 and 11). Implement discard is evident in four test areas (6, 9, 10 and 11).

Very low lithic item numbers (<20) are indicated for Test Areas 5A, 5B, 5C, 7, 8, 9 and low lithic item numbers (<50) are indicated for Test Areas 3, 4, 6 and 11.

On the basis of general ethnographic analogy from the Australian desert it is inferred that both males and females knapped stone to fashion and resharpen a range of both general tool types and gender-specific tool types. The flaking methods or strategies represented by the small lithic assemblage are those standard for the region. Two stone flaking strategies, microblade and microlith knapping, and bipolar flaking, were identified in the assemblage. The range of knapping methods is typical for the Late-Phase in the region as a whole.

The main flaking activities evident from the collection are the production of microblades and microliths. Delicately shaped microliths are commonly identified as spear armatures, and regarded as indicators of men's subsistence equipment (Mulvaney and Kamminga 1999:235-36). The evidence for this inference of microlith function is persuasive. While identifiable elements of microlithic technology (microblade; microblade portion; microblade core; microblade core fragment; microlith backing flake; bondi point preform; bondi point portion, are few they are widely dispersed in the pits across the study area.

There is no evidence from the lithic assemblage for long-distance procurement of stone material for flaking, and the stone materials in the assemblage appear to come from local sources. Notably, a few of the lithic items retain remnant area of pebble cortex. Siliceous pebbles are common in the gravels of the Hawkesbury-Nepean River and in relict river gravels elsewhere in the Cumberland Plain and probably all the lithic materials were obtained from very local sources.

A proportion of the lithic items in the assemblage is heat effected. Most of these items are rhyolitic tuff or silcrete. Other red lithic items include one quartzite item, two chalcedony items and one unidentified material. The exact causes of this heat fracturing is not known, but it often the result of bushfires as well as cultural agencies such as hearths within encampments.

It can be assumed that heat treatment of silcrete occurred in the area and that some of the stone from the pits may have been subjected to this technological process. A common trait of heat-treated silcrete is that trace amounts of iron compounds in the original stone turn red, purple or pink. Although the majority of silcrete items in the general assemblage (127 items; 60%) are red in colour, it provides only slight evidence for intentional heat treatment of silcrete. There is no colour signature for the local geological sources of silcrete to allow a meaningful comparison and silcrete can turn red as a result of intense heat from bushfires. Therefore the Erskine Park assemblage does not add new knowledge about heat treatment of siliceous stone in the Sydney Basin.

Tool-use activities and activity areas

In simple terms, the range of site types with stone discard away from a stone quarry or stone procurement place can be represented as:

1. Individual or small-party travel between sites.
2. Stopovers (without camping) during hunting and/or gathering and special purpose activities.
3. Camps inhabited by small hunting and/or gathering groups.
4. Larger community base-camps;
5. Camping areas for larger congregation of groups.
6. Ceremonial sites.

Potentially, the cultural material recovered from the test pits may represent a single episode of occupation or more likely multiple episodes of one or more of the above types of occupations. Such episodes of occupations could have occurred at different times over the entire time-span of occupation. Each episode of occupation could also have been for a different duration of time. Unless the archaeological evidence for individual activity events is readily identifiable, it can be very difficult to establish the nature of occupation(s) represented by the lithic assemblage. Suitable circumstances are rarely present in open sites, due to stratigraphic mixing of artefacts by post-depositional processes. These factors are a constraint on the interpretation of the evidence provided by samples from the backhoe pits.

The number of identified artefacts in the pits is generally low to very low, with a very small proportion of implements (the discard of which would ordinarily suggest encampment rather than less sedentary human presence). The range of activities indicated by the lithic items is also relatively low.

The artefact numbers and variety and their spatial distributions in the test areas are not indicative of long term or repeated encampment, and they may indicate only very occasional prehistoric human activity over a long period of time. The higher artefact numbers in Test Areas 6, 10 and 11 indicate that these were probably areas of ephemeral habitation. All other test area revealed relatively low numbers of artefacts, suggesting transitory camping.

Table 7.4: Human activities indicated by the lithic items recovered from Test Areas 3-11

Nature of Human Activity	Test Area										
	3	4	5A	5B	5C	6	7	8	9	10	11
human presence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
generalised stone knapping	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
microblade production	✓	✓			✓	✓	✓		✓	✓	✓
discard and probable on-site use of stone implement						✓			✓	✓	✓

7.6 Artefact density

The density of artefacts for each pit (containing lithic items) was calculated as a measure of the number of artefacts per surface area of test pit (ie as if all artefacts were a lag deposit on the surface). This provides a figure that is comparable across pits, regardless of the total depth of testing in each pit that varied according to soil conditions. However, given that spit depths varied, but the sample of sieved spoil per spit was mostly consistent (50 litres per spit), the consequential difference in sampling was accounted for by calculating the volume of sieved material as a proportion of the total pit excavation. The sample recovered from each spit was equivalent to an area of 1 x 0.9 m, given an average spit depth of 8 cm.

Artefact densities are generally low, varying from 0 to 10.5 per square metre. Artefact densities are tabulated in Table 7.5. The average artefact density across Test Areas within the Erskine Park CSR lands is 1.2 artefacts per square metre. This figure is the same, irrespective of whether Test Area 1 and 2 are included in the calculation.

Tables showing artefact density per pit are provided in Appendix 6.

7.7 Vertical and horizontal artefact distribution

The sample of lithic items (Table 7.3) is relatively small and any interpretations about site integrity are subject to potential problems of sample bias. However, the bulk of the assemblage is concentrated in uppermost spits 1 and 2 across all test areas except Test Area 10, where a number of artefacts were present in Spit 3. Also, there is no evidence of any difference in artefact or stone material types according to stratigraphic distribution. It can assumed that in sandy and silty sediments there will be a proportion of downward movement of lithic items as a consequence of bioturbation, which is widely reported for open sites on the Cumberland Plain as well as in southeast Australia generally.

Figures 7.3. 7.5, 7.7, 7.9, 7.11, 7.13, 7.15, 7.17, and 7.19 show the number of artefacts recovered from each pit relative to their micro-topographic position.

The three test areas located in first order stream valley floor contexts (Test Areas 3, 4 and 5) all displayed similar artefact distribution patterns. In all cases, the distribution of artefacts was discontinuous (or 'patchy') and limited to low to very low densities (maximum density in three pits only of 6 artefacts per pit). Two trends in the micro-topographic distribution of artefacts can be discerned. In Test Areas 3 and 5, pits with artefacts tend to be closer to the streamlines, but only where locally elevated ground, such as low rises or benches, occur. This trend is less marked in Test Area 3 where there is less micro-topographic differentiation. In all cases, low lying ground in or near the streamlines was found not to contain artefacts. In Test Area 4, only two of ten pits located on the locally elevated creek bank contained artefacts. The remaining six pits with artefacts are located on basal slopes that are continuous with the adjacent spurline slopes. This is indicative of the second trend where higher level ground, not situated on the valley floor, and continuous with adjacent bedrock and spurline basal slopes, are more likely to contain artefacts, and in greater density than locally elevated ground situated on the valley floor. It is conjectured that this may relate to wetter and more poorly drained valley floor environments in the past. This would have made the lower and valley floor contexts less conducive for camping for a substantial proportion of the year. It is theorised that hydrological changes caused by historic landuse practices have caused streambed incision with the consequential effect of greater drainage of the adjacent valley floor environment.

Test Areas 6, 7 and 8 are all situated on spurline crests in upper catchment contexts. Like the valley floor examples, the distribution of artefacts is discontinuous and generally low to very low in density. This is in keeping with the limited water resources associated with these upper catchment contexts. Artefacts were encountered across the crest topographies in Test Areas 6 and 8 but only at the far upper and lower ends of Test Area 7.

The spurline shoulder in Test Area 7 is the lowest of the three crest topographies, and of a lesser order in terms of the tributary catchments it defines. These two factors may explain the lack of archaeological material on the Test Area 7 crestline. Test Areas 6 and 8 occur on larger tributary watersheds and command a better view across the surrounding ground. They may therefore have been favoured as cross-country and access routes and transient camp location. In Test Area 6 most pits with artefacts were located on the uppermost apex of the shoulder crest, and just above the break-of-slope associated with a spurline descent. This suggests a preference for level ground with a view across the surrounding slopes. A similar preference for high ground with a commanding view occurs in Test Area 7 where two of the three pits with artefacts were located on the apex of a ridgeline knoll, itself situated at a nodal intersection of four spurlines.

Pit 16 in Test Area 6 included 33 artefacts and was located in a crest and break-of-slope context. This constitutes the highest pit density encountered in the study area, but is clearly an isolated and discrete occurrence, given that all surrounding pits fall back to very low densities (between 1 and 3 artefacts per pit). Just over half of these artefacts constituted thermal fracture.

In Test Area 8, four artefact distributions can be discerned, each reflecting the surface occurrence of artefacts previously recorded in the area. Artefacts occur both on the crest and on the northwest and southeast facing upper slopes on either side of the crest line.

The Test Area 9 ridgeline contained the broadest crest topography and forms a major watershed. Like the lesser spurline topographies tested, the archaeological material encountered occurs in very low densities and discontinuously. With the exception of the isolated high incidence in pit 16 in Test Area 6, the low density and discontinuous nature of the artefact distribution across all the upper catchment crests is similar across the whole study area.

Test Areas 10 and 11 are situated in lower catchment contexts and are both in relative proximity to a second order tributary streamline. Unlike Test Area 6, where the high artefact count was due to one pit, the distribution of artefacts across these two areas is more evenly spread across the test transects. All of the six pits conducted in Test Area 7 contained artefacts (between 6 and 15 artefacts per pit), and 7 of the 12 pits in Test Area 11. In Test Area 10 the transect topography consists of a gradual low gradient descent to the creekline. There is an overall trend for higher densities to occur closer to the creekline, however the actual creek margin could not be tested due to a former farm house site and sewer main easement in this area. Unlike the upper catchment valley floor test areas, where a discernible trend for higher densities closer to the creekline is significantly moderated by the availability and type of locally elevated ground, Test Area 10 displays an apparent simple preference for creekline proximity. This could be the result of local factors such as a preference for a northeasterly aspect or the lack topographic differentiation across the tested slope.

Test Area 11 is situated 150 m downstream of Test Area 10 and includes the eastern margin of a broad crest and its associated eastern spurline slopes. The distribution is discontinuous and most pits have lesser densities than those in Test Area 10 (between 1 and 9 artefacts per pit). This subsurface artefact distribution is similar to the discontinuous surface incidence of single and paired artefacts recorded previously by McIntyre (2003) in adjacent areas to the west and southwest (recordings EPR1, EPR 2, EPR 3 and EPR 7).

Test Area 10 also mirrors a surface artefact distribution of 12 artefacts for a previously recorded site situated just to the south and outside of the study area (‘EP7’ 45-5-0974). This site is located on a comparable landform on the western bank of the drainage line and the subsurface distribution of artefacts may be continuous between this site and Test Area 10.

The incidence and character of artefacts across Test Areas 10 and 11 suggests that the whole broad spurline, of which these areas are a part, was the location of repeated and ephemeral habitation involving transitory camp sites. These occupation events are manifest as small discontinuous distributions of lithic artefactual material, which merge to form continuous distributions in areas subject to a higher frequency of occupation, such as the margins of the creeklines. The higher artefact incidence on this landform is probably related to its basal slope valley context relative to the floor of the South Creek valley. Despite its broad and ill-defined relief, this terminal spur provides locally elevated well drained ground adjacent to a tributary streamline, just prior to its entry onto the South Creek valley floor and floodplain.

7.8 Conclusions

The presence of subsurface Aboriginal archaeological cultural material has been confirmed for each of the Erskine Park Test Areas (3-11). Within the tested areas, the sites consist of low-density subsurface artefact occurrences.

Artefact densities range from 0 to 10.5 artefacts per square metre, with most artefacts occurring in spits 1 and 2. The average density is 1.2 artefacts per square metre. The artefactual remains are indicative of low intensity occupation suggesting transient camps and activities peripheral to a base camp or main occupation area.

A limited number of activities are indicated by the artefact types including generalised stone knapping, production of microblades and microliths (spear barbs), and a low incidence of discard. Only two artefact types provide direct evidence of tool use other than hammer use in flaking stone.

The nature of the archaeological material detected, and the consequent low local archaeological significance assessment, indicate that the sites located within Erskine Park Test Areas 3-11 are unlikely to pose a long-term constraint to proposed development within Erskine Park.

Based on the analysis of the test area results, the predictive categories used in the initial assessment of archaeological potential across the study area can be revisited.

Artefacts were found to be present in all of the differentiated landform units across the study area, however some sub-categories with differing sensitivity can now be recognised.

The main watershed ridgeline was considered to have high potential for subsurface archaeological material. The potential resource was considered likely to have low to moderate scientific potential. The Erskine Park results suggest that the potential of this landform to contain subsurface archaeological material could be better characterised as moderate, given its low density and discontinuous nature. The scientific value of the Erskine Park material is low (refer section 8.2.1).

The spurline crest category was considered to have moderate to high potential for subsurface archaeological material. The potential resource was considered likely to have low to moderate scientific potential. The Erskine Park results provide a basis for further subdividing this category into minor and major spurlines according to the order of the catchments they subdivide. Those which are higher in elevation and define larger catchment areas appear more likely to contain archaeological material, albeit in discontinuous and low density distributions. The potential for subsurface material on these crest topographies is moderate. This pattern may only be applicable for upper catchment contexts in undulating terrain. It is considered probable that areas with low relief would display different patterns. The scientific value of the Erskine Park material in these spurline contexts is low (refer section 8.2.1).

The category for locally elevated ground adjacent to a watercourse was considered to have high potential for subsurface archaeological material. Potential deposits in these areas were considered likely to have high scientific potential. These predictive statements can now be further refined. For upper catchment drainage corridors, the archaeological potential is moderate, with the resource occurring only in low densities and discontinuously. Locally elevated and level ground on and within the valley floor is less likely to include artefacts or higher artefact densities, than similar ground on the basal slope margins of the valley floor. No substantial alluvial or aggrading deposits with the potential for conserving *in situ* archaeological remains were encountered in the valley floor test areas and the scientific value of the Erskine Park materials is low (refer section 8.2.1).

For lower catchment valley floor contexts the potential for subsurface archaeological material appears to be higher and could be classed as moderate to high, as in the original assessment. The Scientific value however remains low for the Erskine Park study area contexts.

The 100 m zone around significant drainage lines provided generalised and broad scale differentiation of the archaeological resource across the test areas. In most cases, test areas situated outside of this zone contained fewer recovered artefacts than adjacent areas within the zone. This contrast remains consistent for both upper and lower catchment contexts, but not across contexts. For example, Test Area 11 is located mostly outside of the 100 m zone and has fewer artefacts than the adjacent Test Area 10, which is mostly within. However, all of the upper catchment test areas within the 100 m zone have fewer artefact totals than the lower catchment areas.

There was one exception to the 100 m zone differentiation. This was Test Area 6, a spurline crest that included 47 artefacts from a total of 29 pits, compared with Test Area 5 in the adjacent valley with 13 artefacts from a total of 32 pits. This exception indicates that the 100 m zone provides a generalised pattern, but that localised topographic circumstances may provide exceptions.

7.9 Site Nomenclature

Aboriginal relics were located within each of the defined test areas at Erskine Park. Test Areas 6 and 7 have previously recorded Aboriginal sites located within them, consequently the Aboriginal relics located in the course of the subsurface testing program are considered to be part of the previously recorded site. Test Areas 8 and 9 have multiple previously recorded sites located with the test area. One of the relevant site numbers has been assigned to the newly identified cultural material.

Where artefacts were not previously known for an area, an EPTA (**E**rskine **P**ark **T**est **A**rea) number has been assigned to the site. These reflect the Test Area number, for example, the site in Test Area 4 will be referred to as 'EPTA4'.

The names for the Aboriginal sites in each test areas are as follows:

Test Area 3	**EPTA3**
Test Area 4	**EPTA4**
Test Areas 5A, B & C	**EPTA5**
Test Area 6:	**EPTA6** and an unregistered 'isolated find' recorded by McIntyre in 1984
Test Area 7:	**EPQ2 - NPWS Site #45-5-2512**
Test Area 8:	**EPQ5** - **NPWS Site #45-5-2515** EPQ4 - NPWS Site #45-5-2514 also in this area EPQ3 - NPWS Site #45-5-2513 also in this area
Test Area 9:	**EPQ6** - **NPWS Site #45-5-2516** EPQ1 also in this area
Test Area 10	**EPTA10**
Test Area 11	**EPTA11**

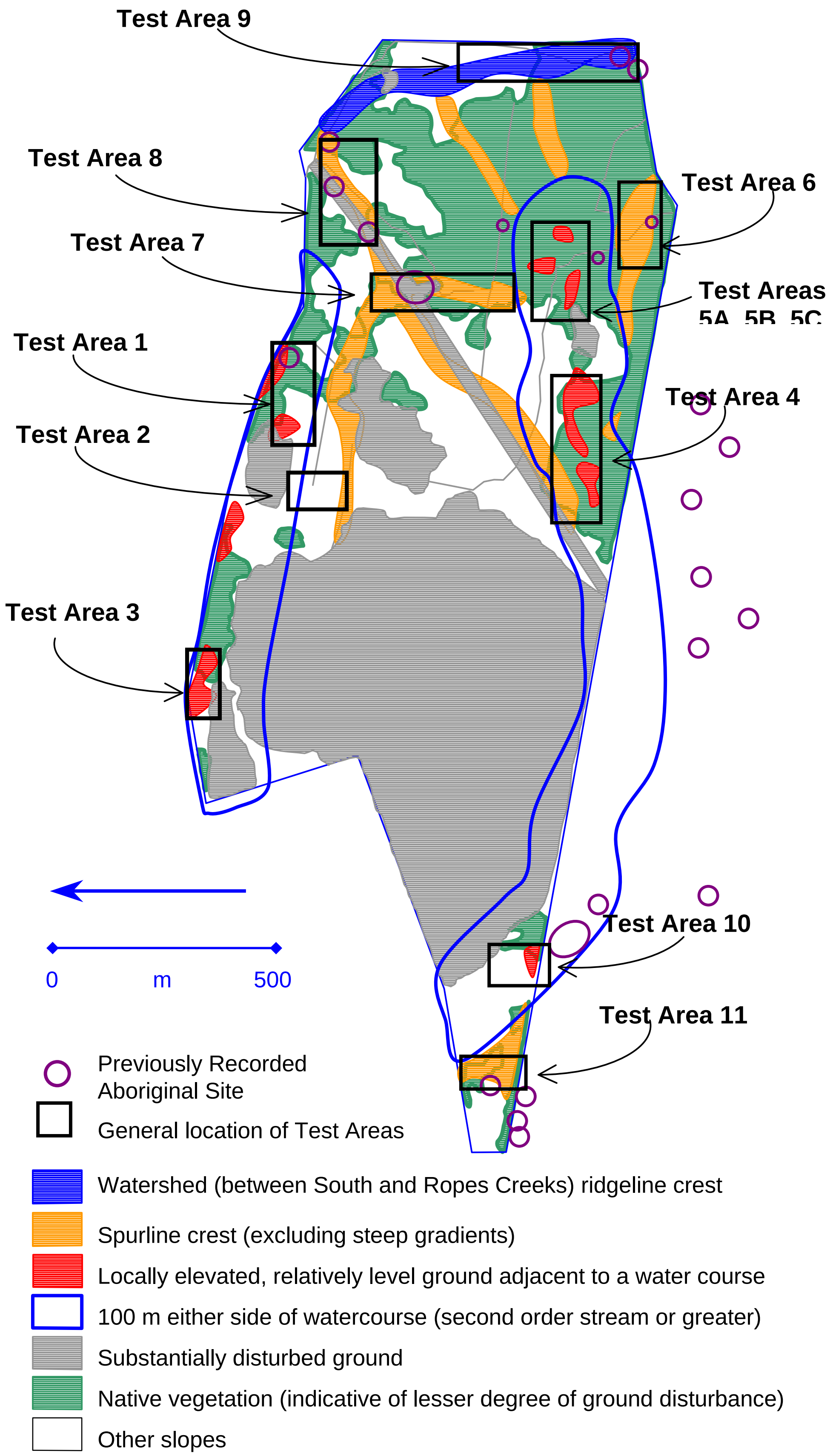


Figure 7.1: General Location of Test Areas at Erskine Park

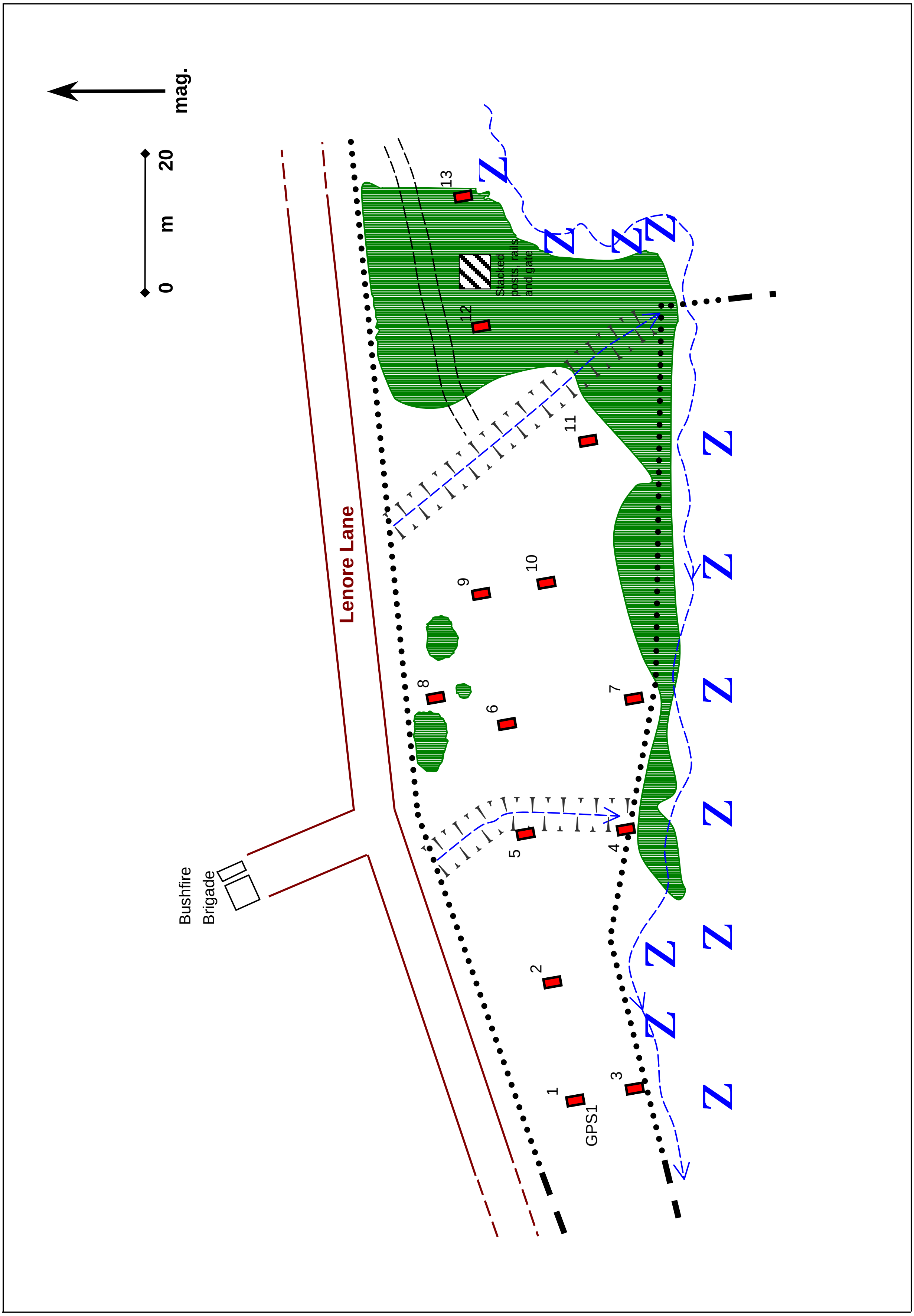


Figure 7.2 Map of Test Area 3 showing location of archaeological pits relative to topographic features

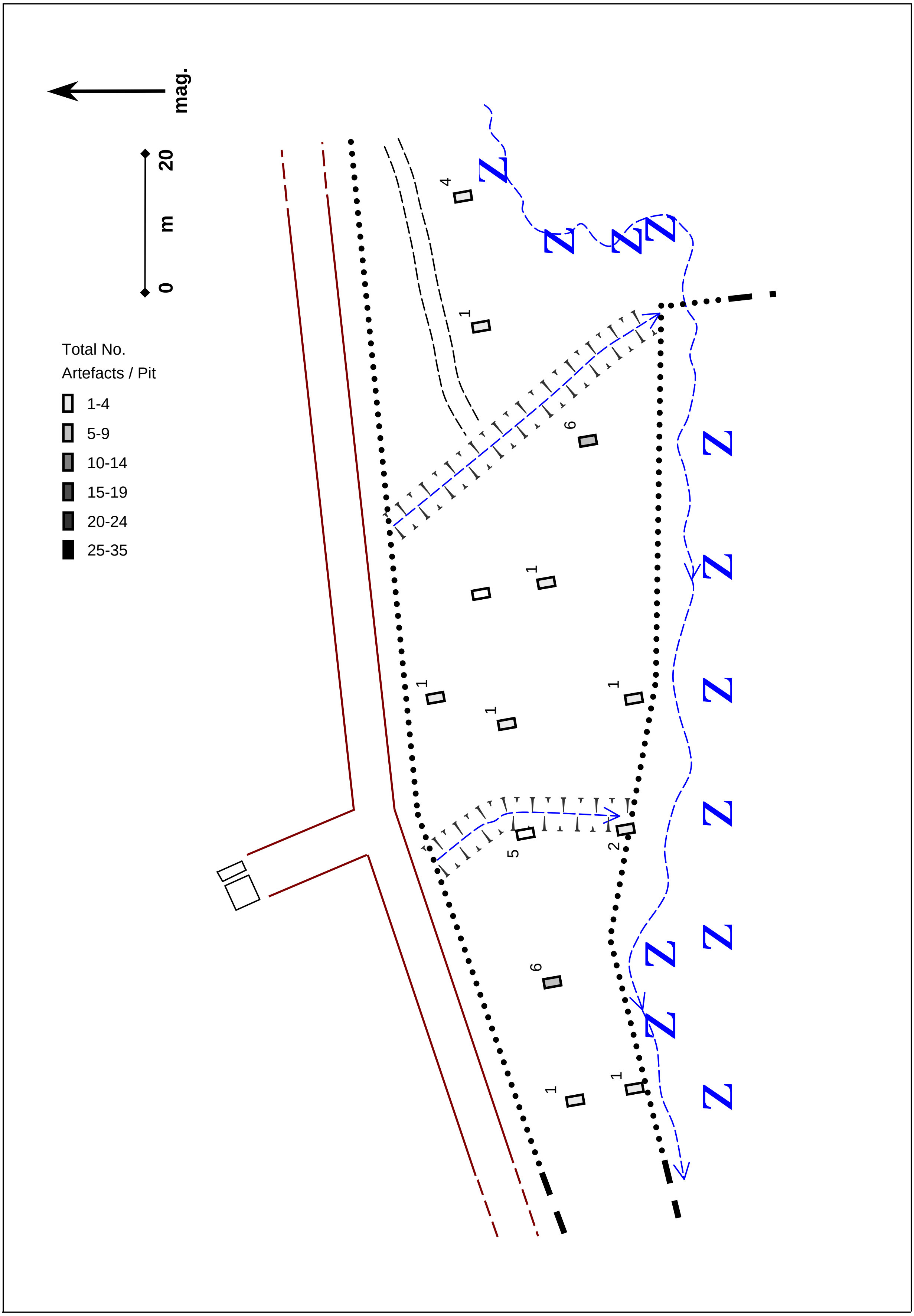


Figure 7.3 Map of Test Area 3 showing distribution of artefacts (number of artefacts per pit) across Test Area 3

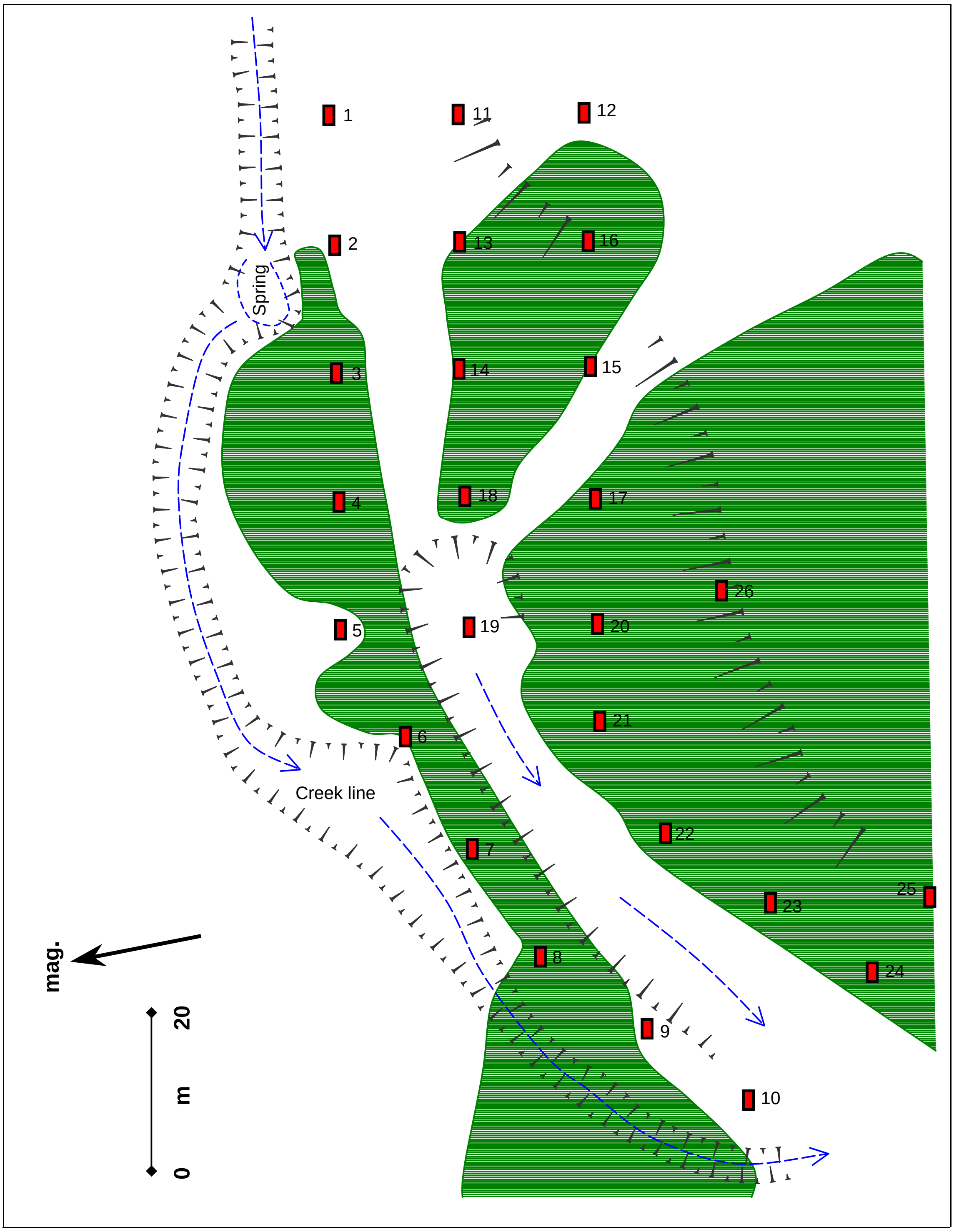


Figure 7.4 Map of Test Area 4 showing location of archaeological pits relative to topographic features

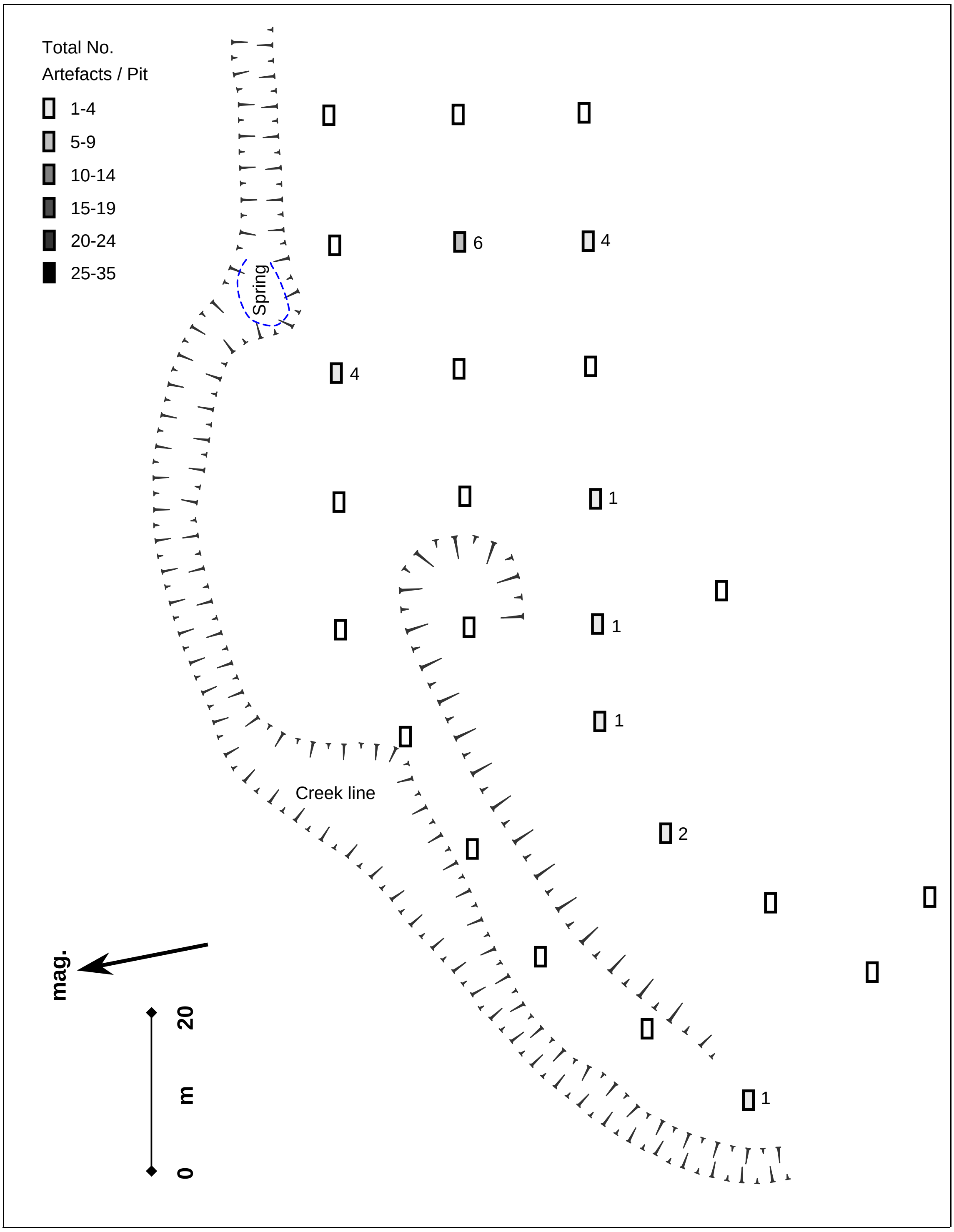


Figure 7.5 Map of Test Area 4 showing distribution of artefacts (number of artefacts per pit) across Test Area 4

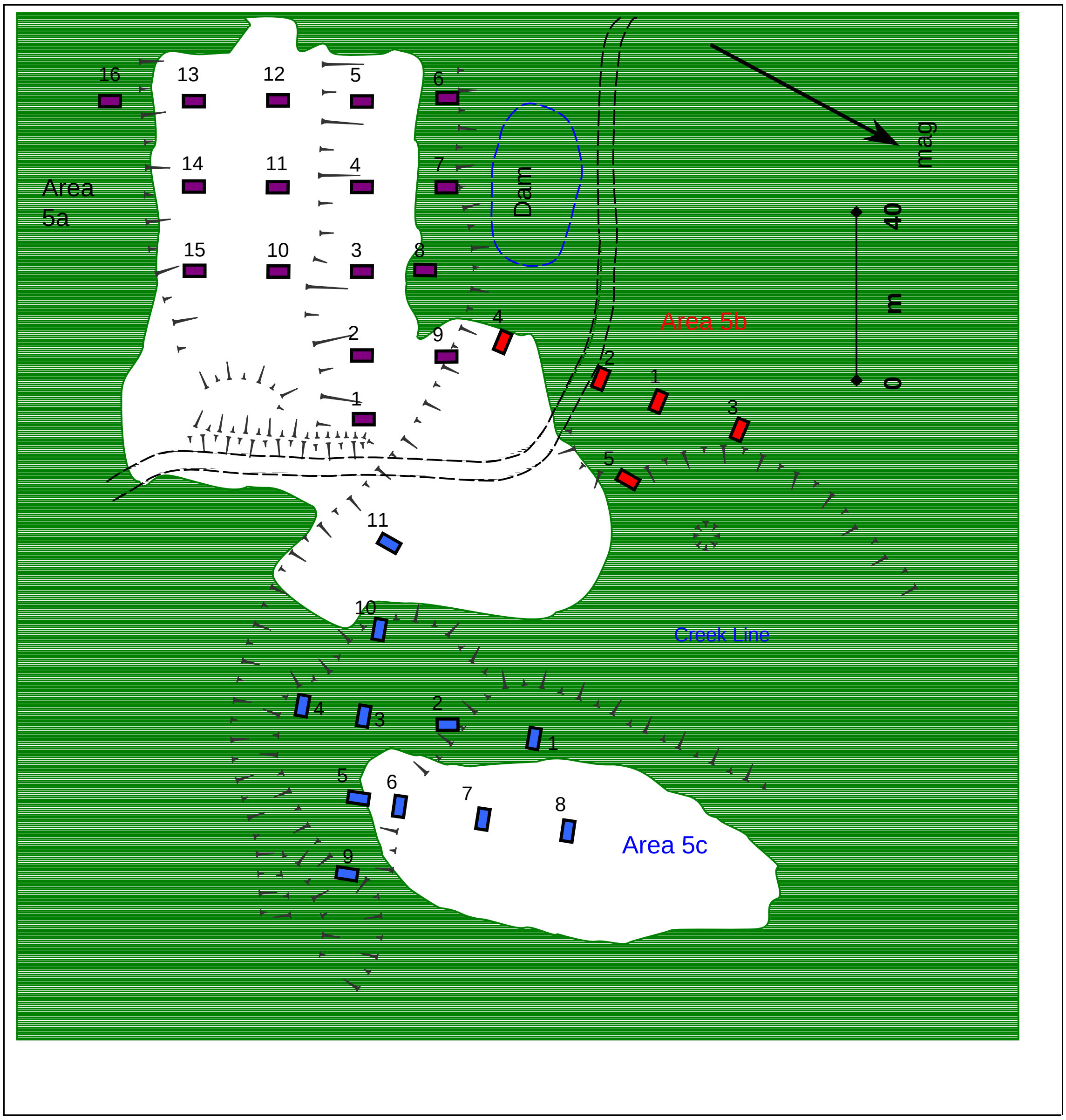


Figure 7.6 Map of Test Area 5 showing location of archaeological pits relative to topographic features

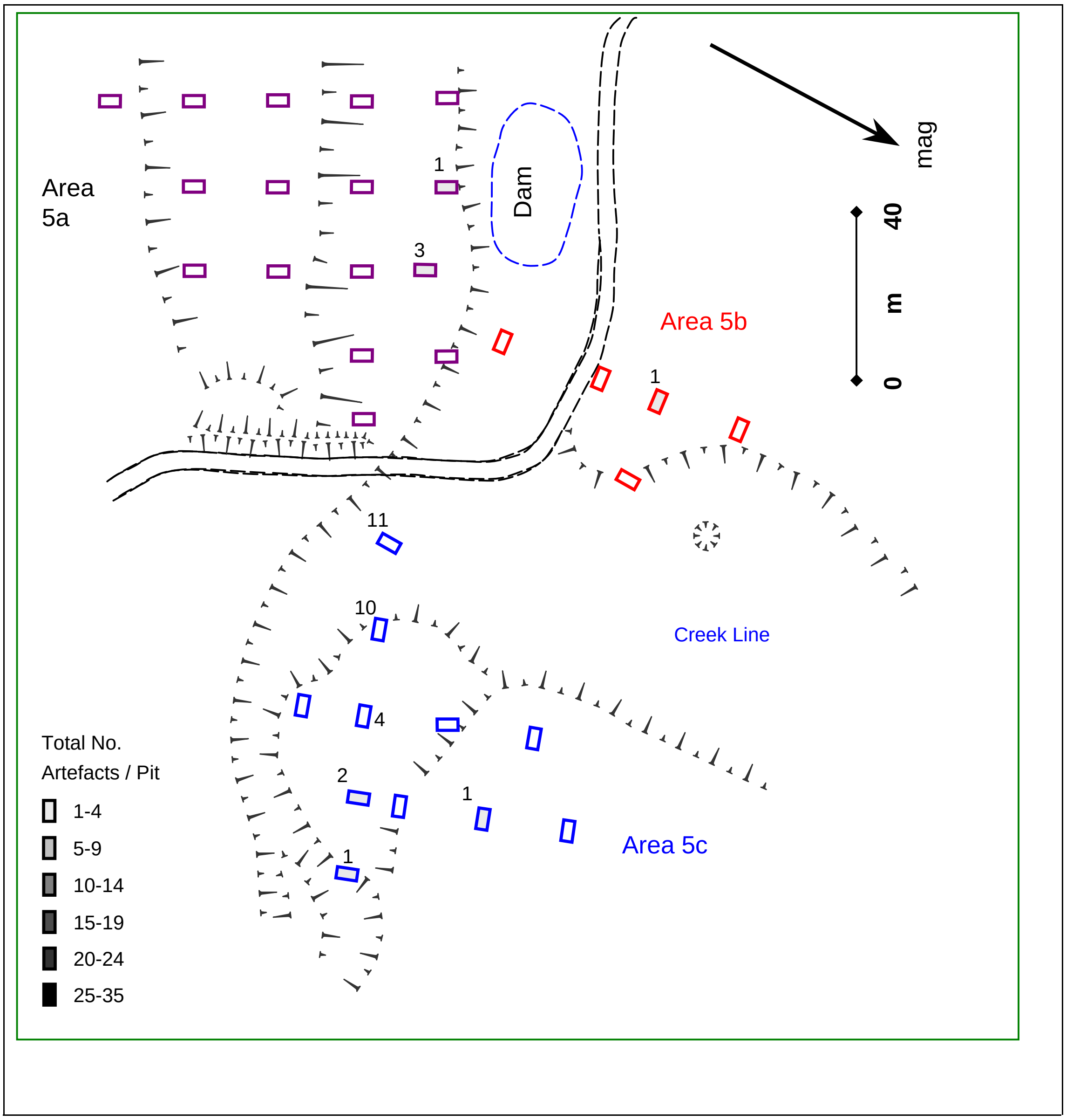


Figure 7.7 Map of Test Area 5 showing distribution of artefacts (number of artefacts per pit) across Test Area 5

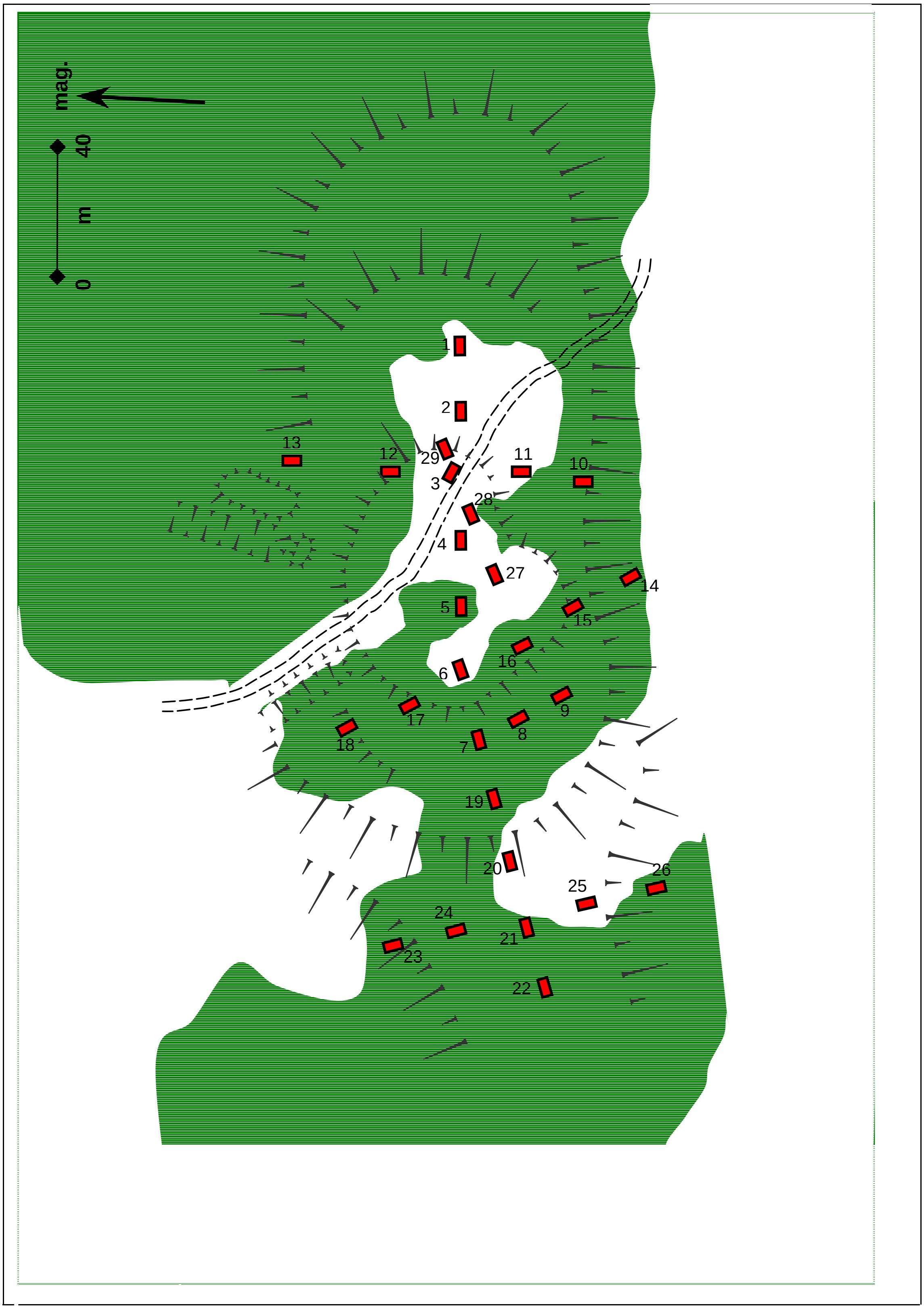


Figure 7.8 Map of Test Area 6 showing location of archaeological pits relative to topographic features

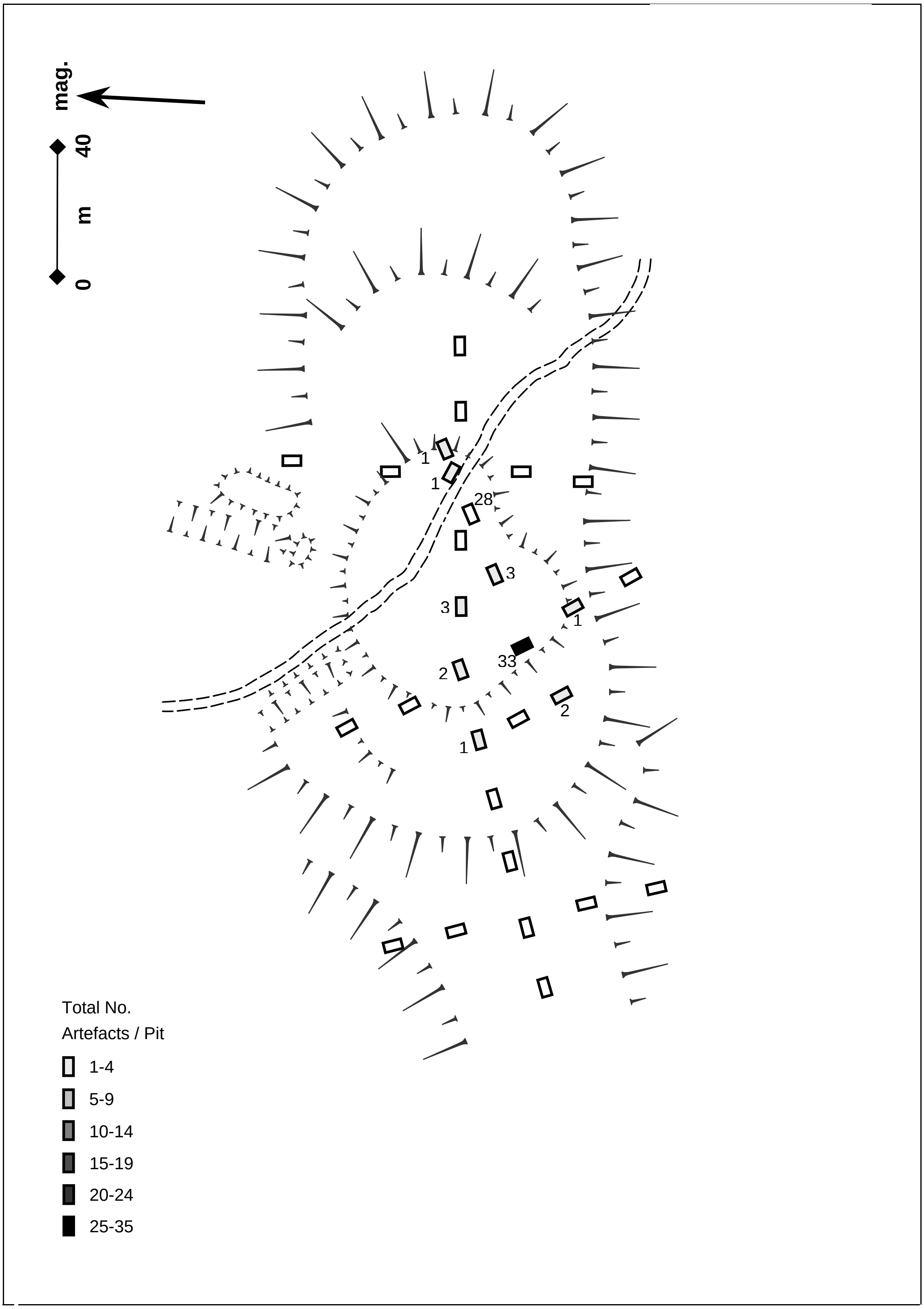


Figure 7.9 Map of Test Area 6 showing distribution of artefacts (number of artefacts per pit) across Test Area 6

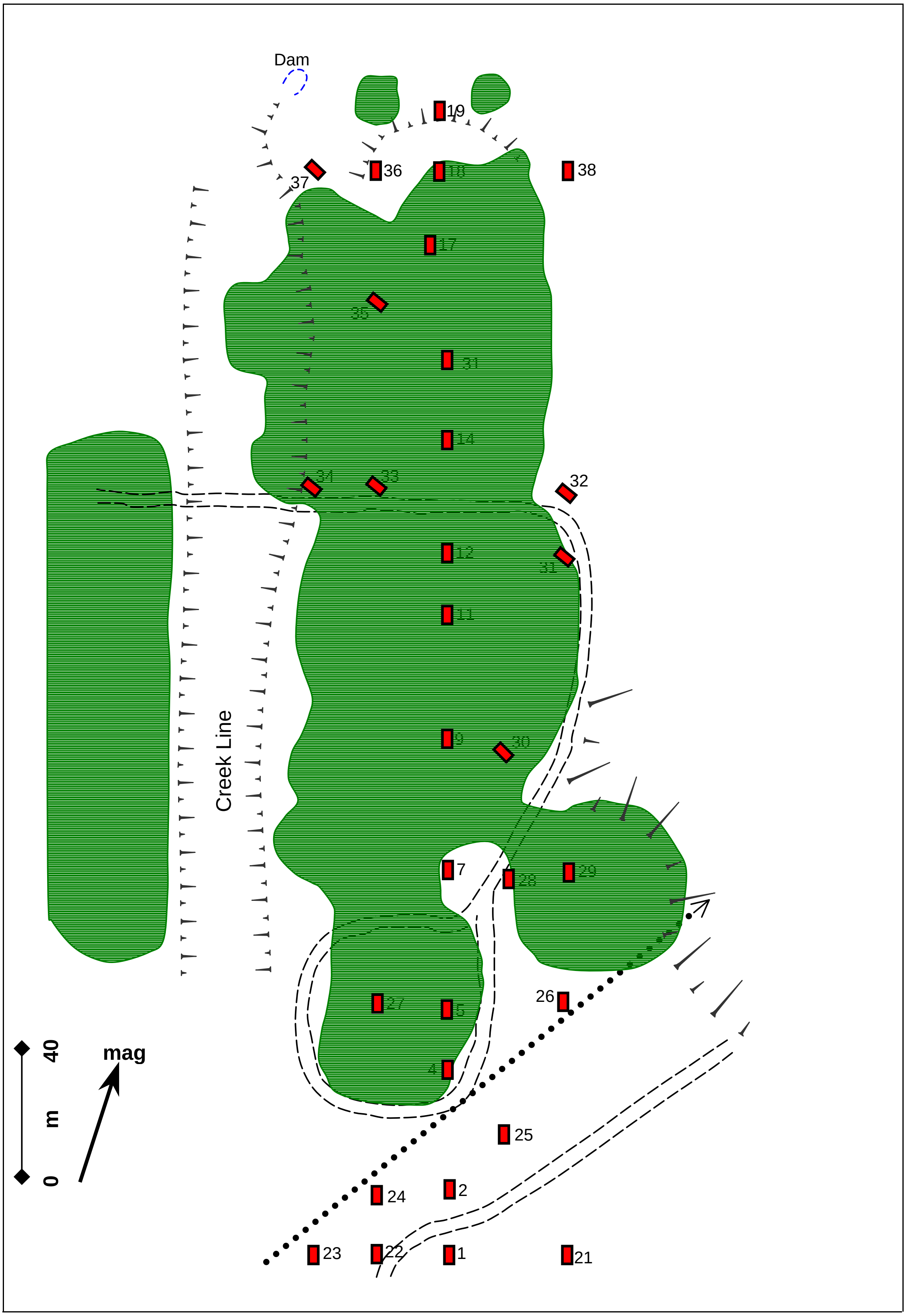


Figure 7.10 Map of Test Area 7 showing location of archaeological pits relative to topographic features

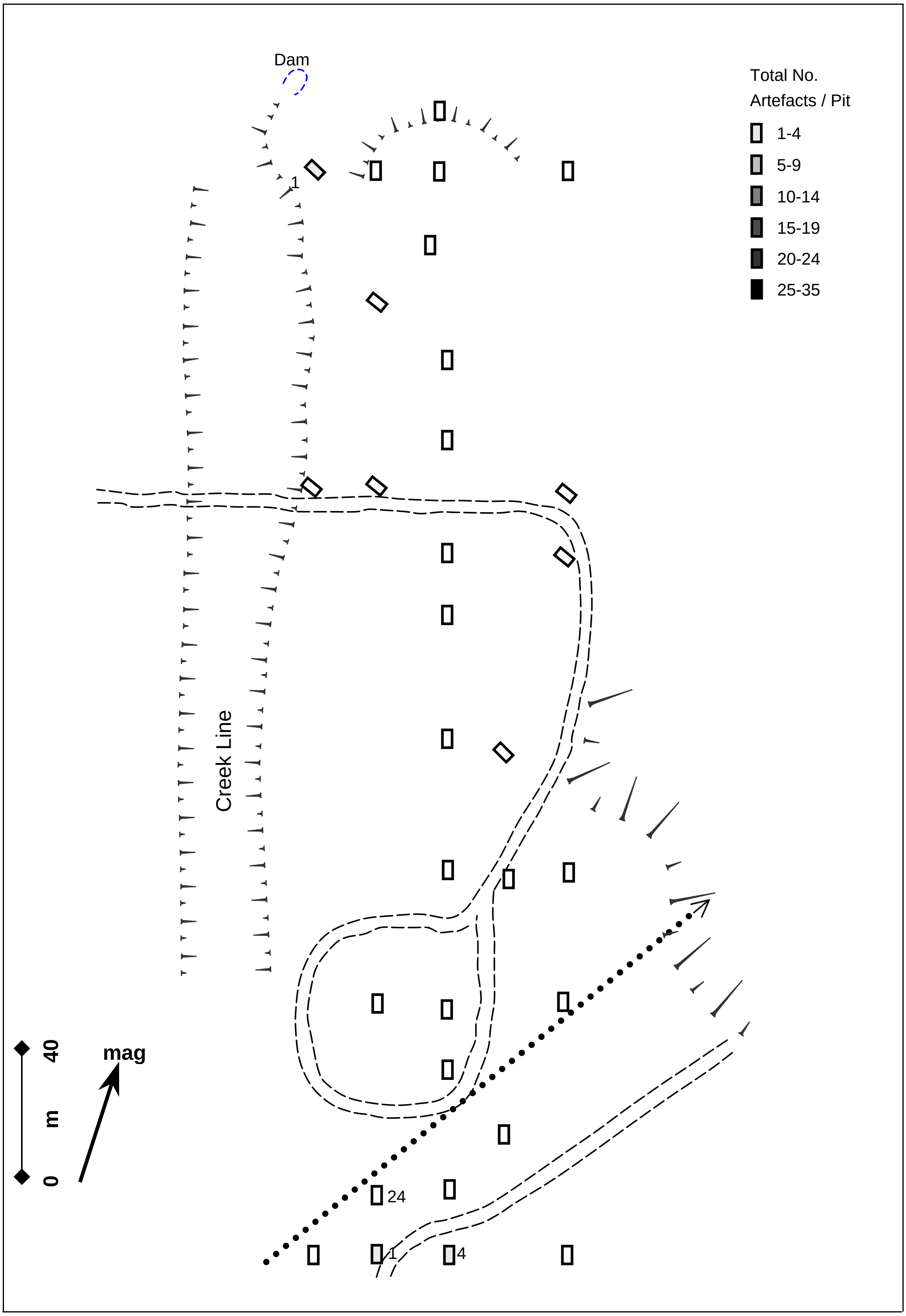


Figure 7.11 Map of Test Area 7 showing distribution of artefacts (number of artefacts per pit) across Test Area 7

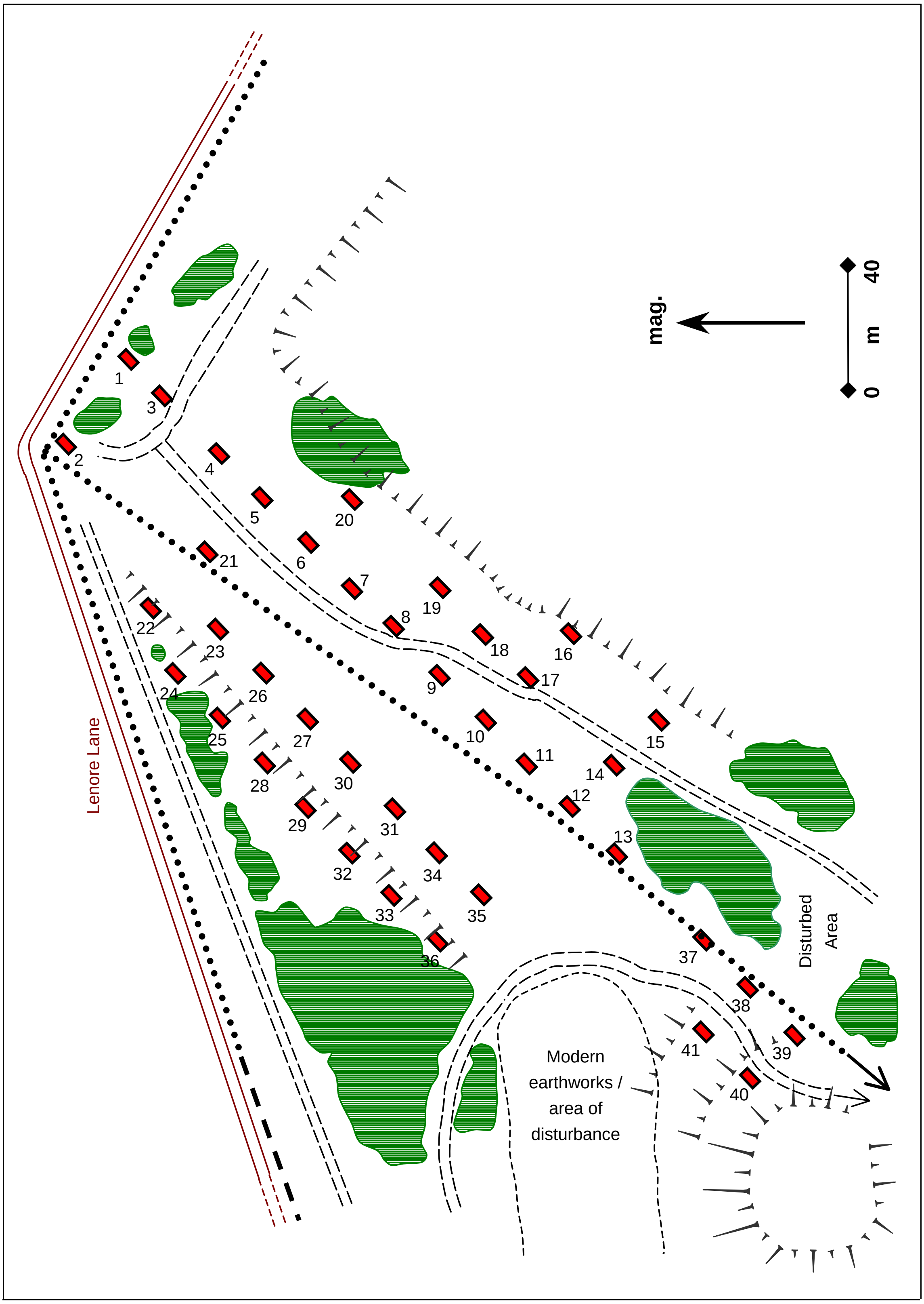


Figure 7.12 Map of Test Area 8 showing location of archaeological pits relative to topographic features

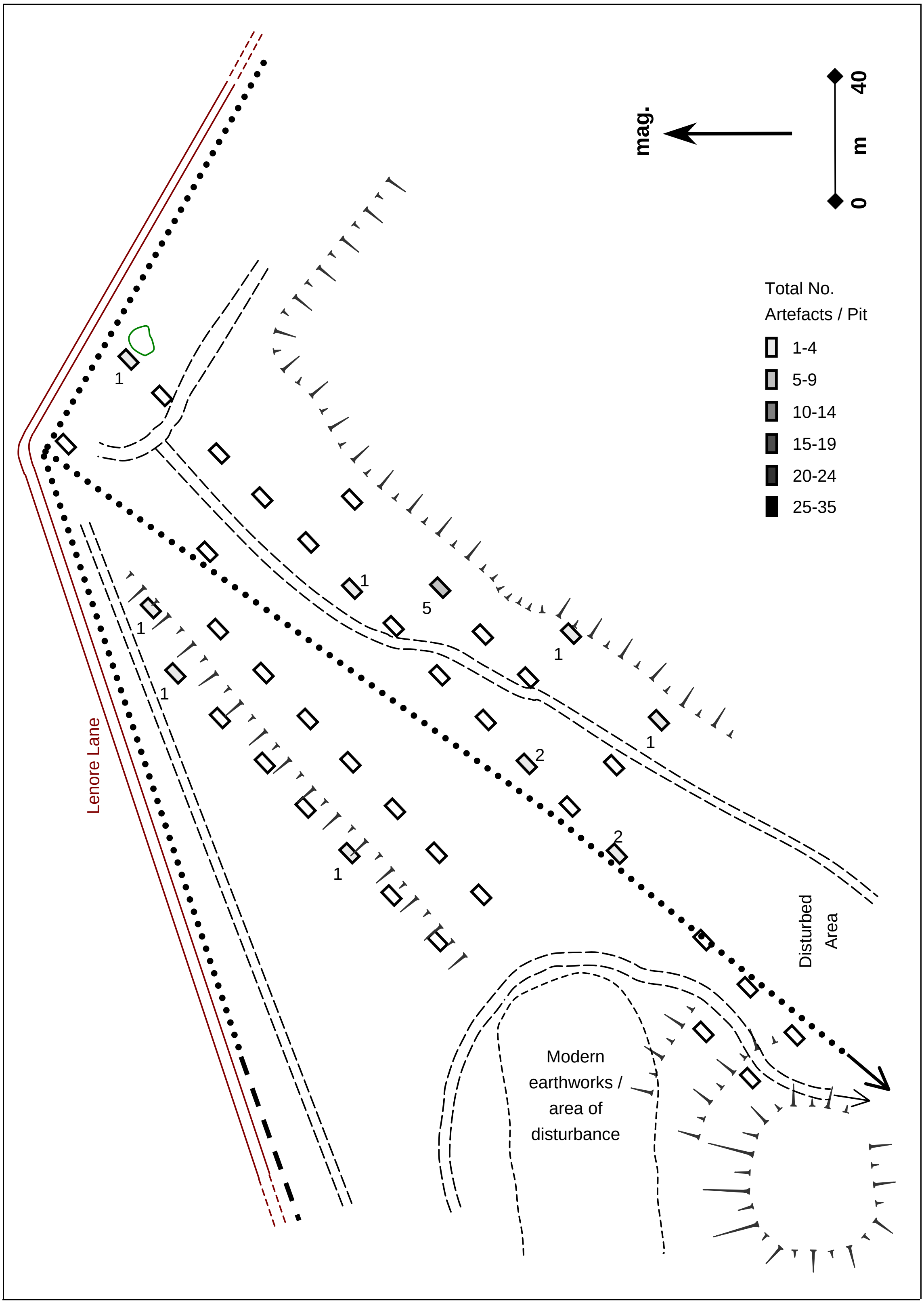


Figure 7.13 Map of Test Area 8 showing distribution of artefacts (number of artefacts per pit) across Test Area 8

Figure 7.14 Map of Test Area 9 showing location of archaeological pits relative to topographic features

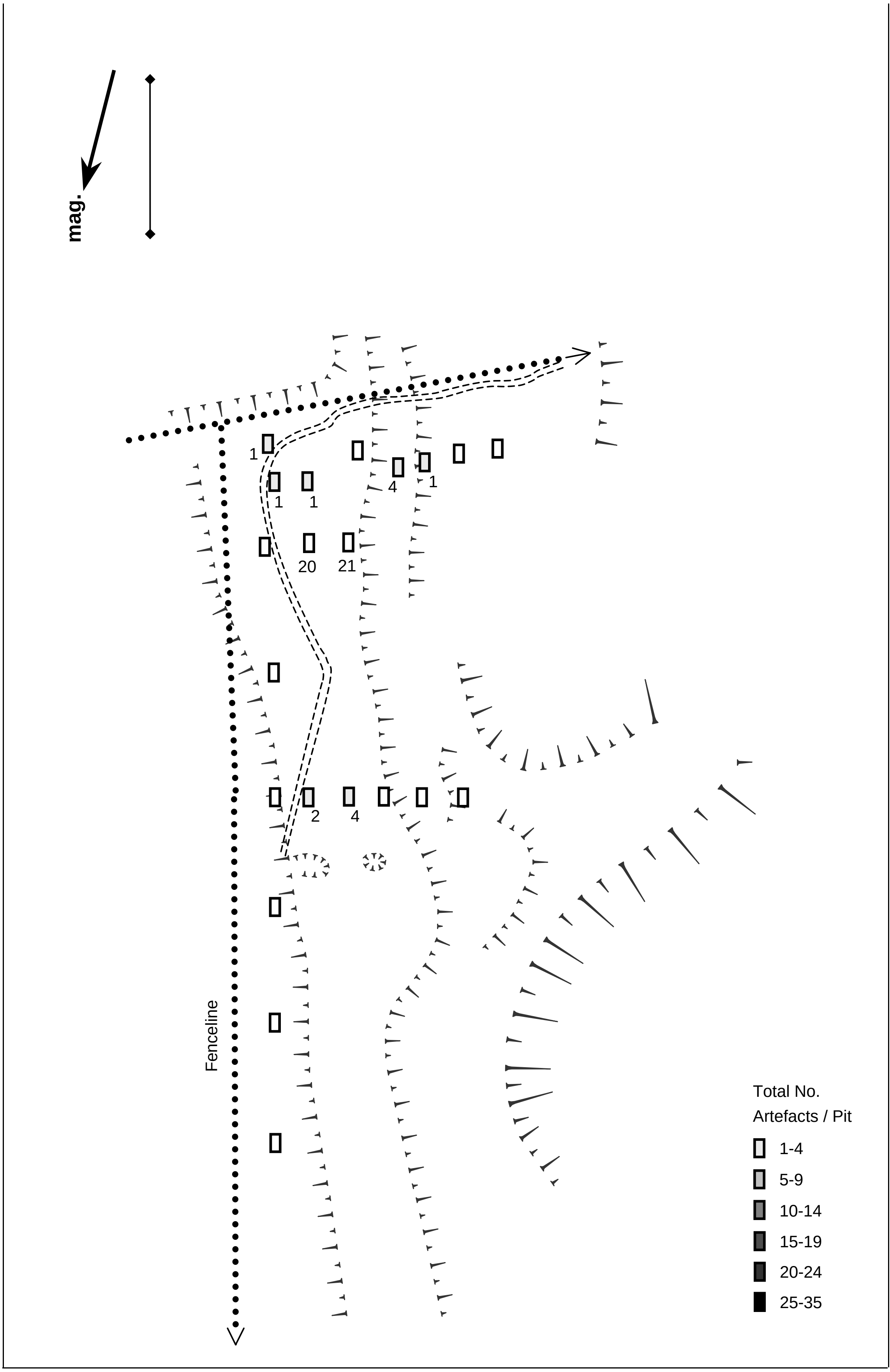


Figure 7.15 Map of Test Area 9 showing distribution of artefacts (number of artefacts per pit) across Test Area 9

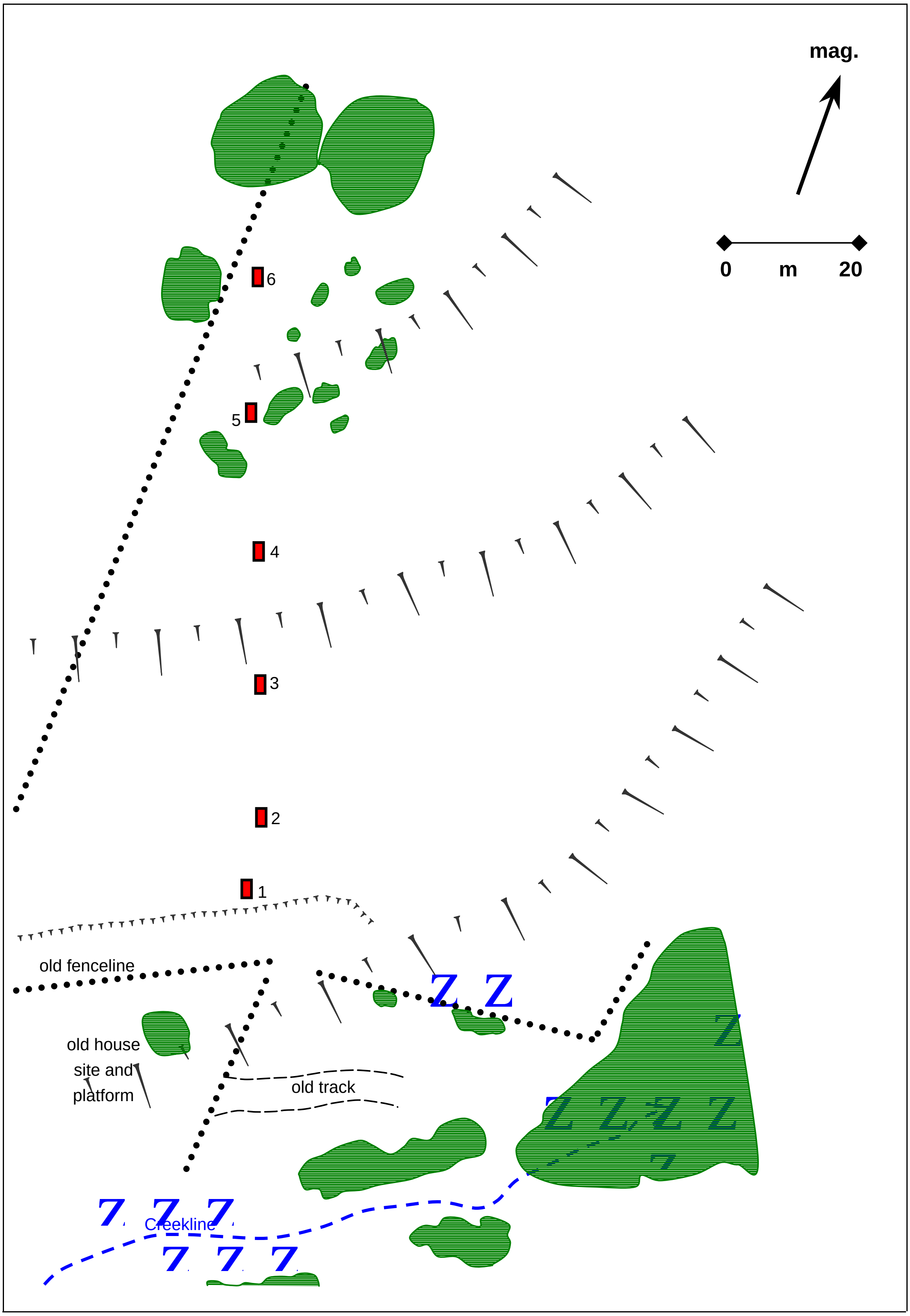


Figure 7.16 Map of Test Area 10 showing location of archaeological pits relative to topographic features

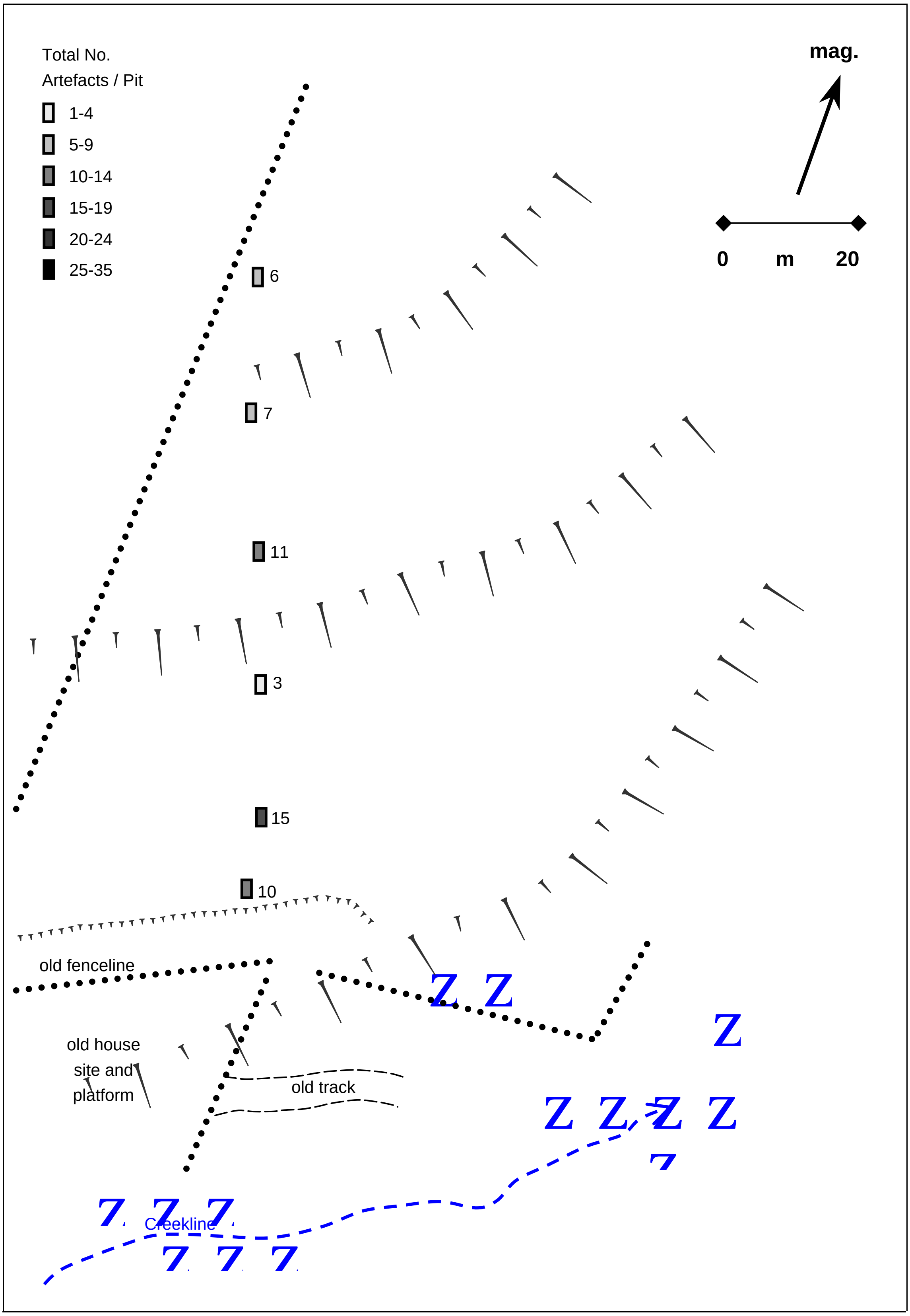


Figure 7.17 Map of Test Area 10 showing distribution of artefacts (number of artefacts per pit) across Test Area 10

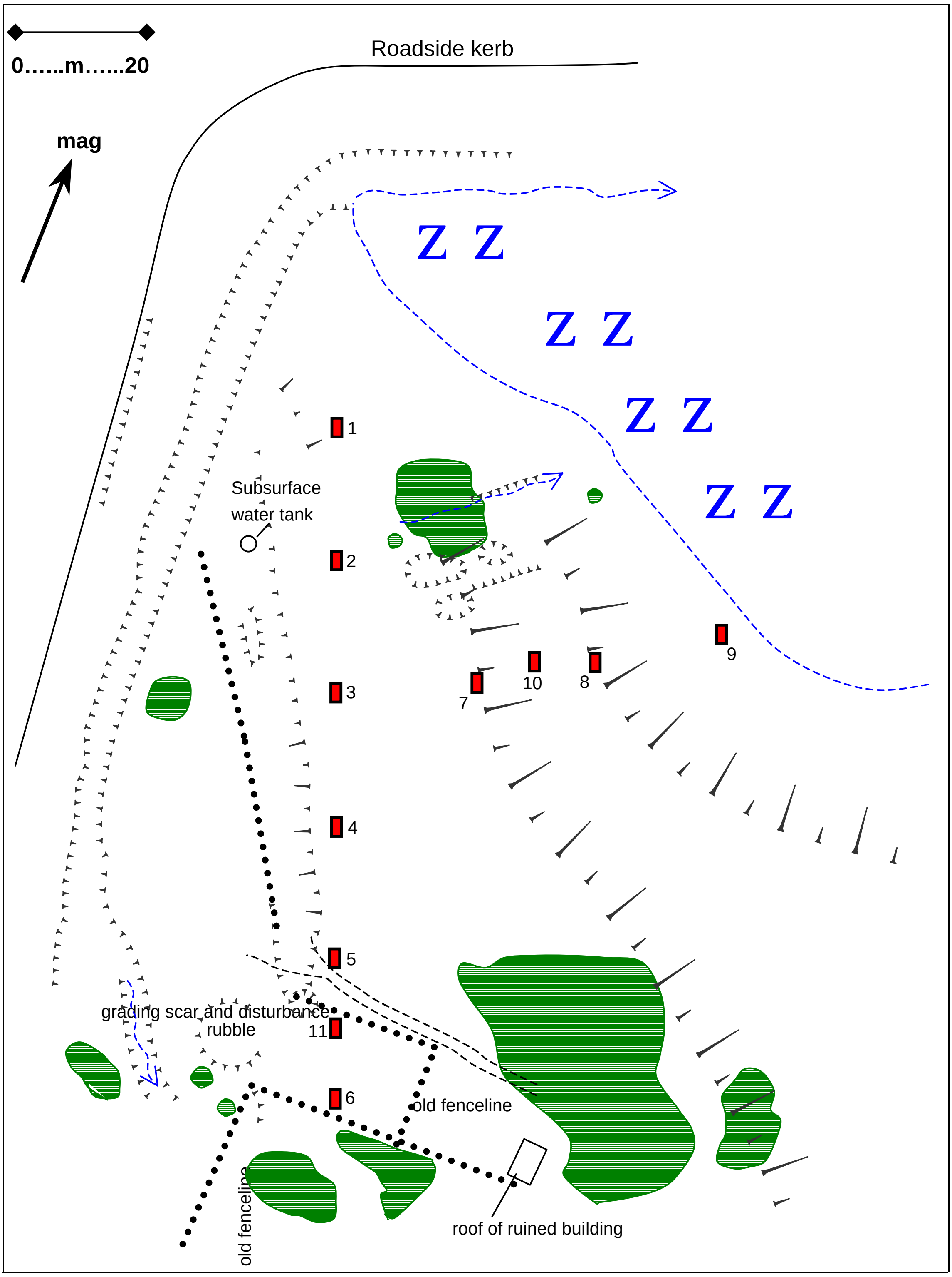


Figure 7.18 Map of Test Area 11 showing location of archaeological pits relative to topographic features

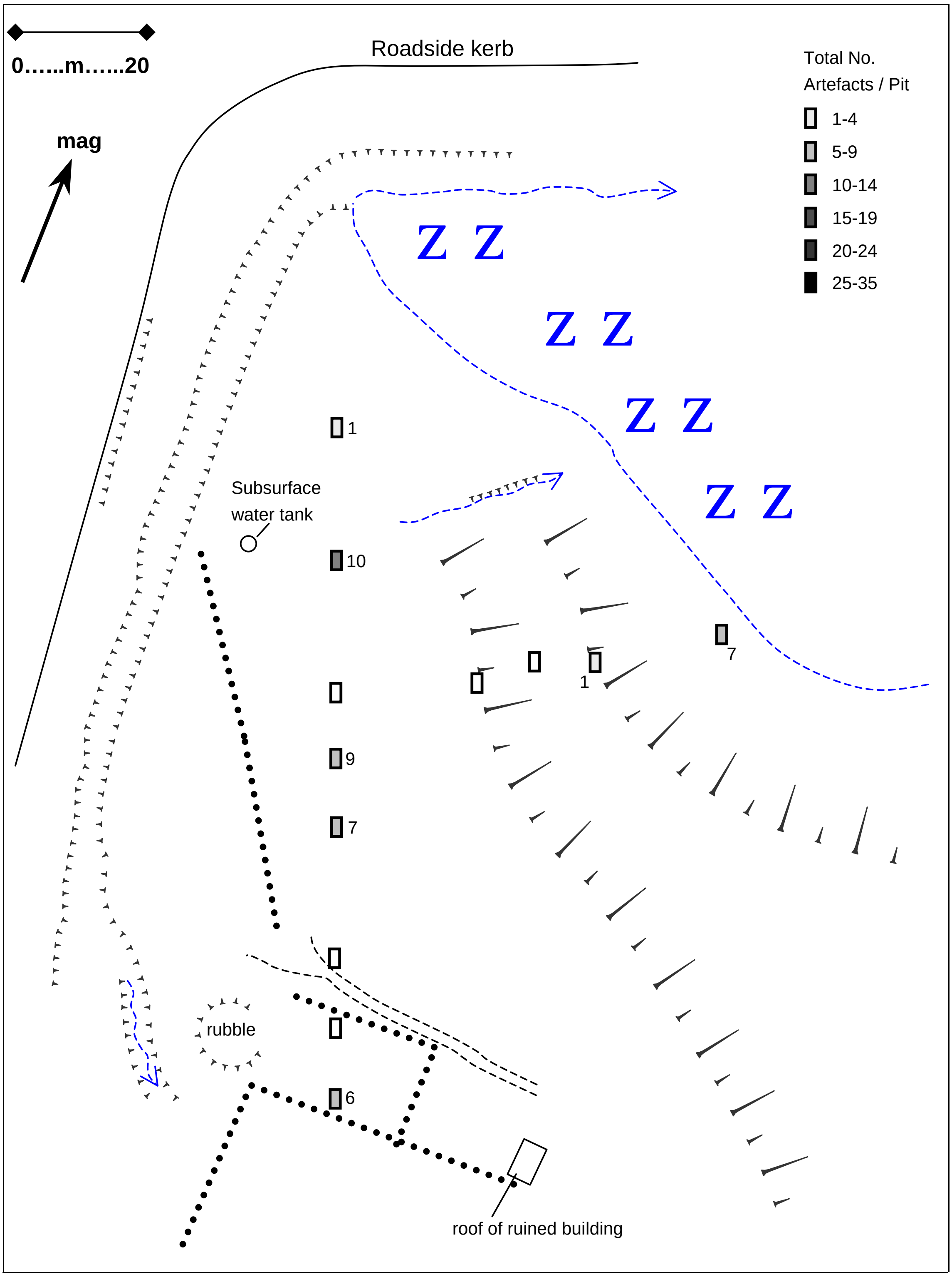


Figure 7.19 Map of Test Area 11 showing distribution of artefacts (number of artefacts per pit) across Test Area 11

8. SIGNIFICANCE ASSESSMENT

8.1 Significance Criteria

The Burra Charter of Australia defines cultural significance as 'aesthetic, historic, scientific or social value for past, present and future generations' (Aust. ICOMOS 1987). The assessment of the cultural significance of a place is based on this definition but often varies in the precise criteria used according to the analytical discipline and the nature of the site, object or place.

In general, Aboriginal archaeological sites are assessed using five potential categories of significance:

- significance to contemporary Aboriginal people,
- scientific or archaeological significance,
- aesthetic value,
- representativeness, and
- value as an educational and/or recreational resource.

Many sites will be significant according to several categories and the exact criteria used will vary according to the nature and purpose of the evaluation. Cultural significance is a relative value based on variable references within social and scientific practice. The cultural significance of a place is therefore not a fixed assessment and may vary with changes in knowledge and social perceptions.

Aboriginal significance can be defined as the cultural values of a place held by and manifest within the local and wider contemporary Aboriginal community. Places of significance may be landscape features as well as archaeologically definable traces of past human activity.

Scientific significance can be defined as the present and future research potential of the artefactual material occurring within a place or site. This is also known as archaeological significance.

There are two major criteria used in assessing scientific significance:

1. The potential of a place to provide information that is of value in scientific analysis and the resolution of potential research questions. Sites may fall into this category because they:

contain undisturbed artefactual material,
occur within a context which enables the testing of certain propositions,
are very old or contain significant time depth,
contain large artefactual assemblages or material diversity,
have unusual characteristics, are of good preservation, or
are a constituent of a larger significant structure such as a site complex.

2. The representativeness of a place. Representativeness is a measure of the degree to which a place is characteristic of other places of its type, content, context or location. Under this criteria a place may be significant because it is very rare or because it provides a characteristic example or reference.

The value of an Aboriginal place as an educational resource is dependent on: the potential for interpretation to a general visitor audience, compatible Aboriginal values, a resistant site fabric, and feasible site access and management resources.

The principal aim of cultural resource management is the conservation of a representative sample of site types and variation from differing social and environmental contexts. Sites with inherently unique features, or which are poorly represented elsewhere in similar environment types, are considered to have relatively high cultural significance.

The cultural significance of a place can be usefully classified according to a comparative scale that combines a relative value with a geographic context. In this way a site can be of low, moderate or high significance within a local, regional or national context. This system provides a means of comparison, between and across places. However it does not necessarily imply that a place with a limited sphere of significance is of lesser value than one of greater reference.

8.2 Erskine Park CSR Lands Test Areas

8.2.1 Scientific Values

The scientific or archaeological significance of the archaeological deposits within the Erskine Park CSR Lands subsurface Test Areas 3-11 (incorporating previously recorded sites EPQ1, EPQ2, EPQ3, EPQ 4, EPQ 5, EPQ6 and 'Isolated find') can be assessed according to the following criteria:

Extent of deposit disturbance

All of the soil profiles subject to testing were subject to constant mixing through bioturbation. The more elevated slopes typically displayed varying degrees of truncation and erosion.

Stratigraphic integrity

There appears to be no temporal differentiation within the deposit. Most if not all of the observed vertical distribution of lithic items is likely to be the result of bioturbation factors.

Presence of cultural features

No evidence of cultural features, such as hearths, pits, lenses of shell or other cultural organic material, or micro-stratigraphy was detected.

Potential for dating

No potentially datable material, relative to the cultural occupation of the area, was encountered in the excavations.

Density of artefacts

The overall density of lithic items is low, ranging from 0 to 10.5 artefacts per square metre. The potential for recovering a statistically viable sample of artefacts from the deposits subject to development impact is considered to be highly limited.

Rarity of site type (representativeness)

The site types revealed by test excavation at Erskine Park are open-air, low-density subsurface cultural deposits of lithic artefacts. The human activities carried out at these sites, identifiable by direct evidence, are generalised stone knapping, microblade production and discard and probable on-site use of stone implements.

Open sites of this type, and displaying evidence of microlith manufacturing, are the most common site type present within southeastern Australia.

Conclusion

Based on the above outline, the subsurface archaeological deposits investigated within the study area are assessed as having low archaeological significance within a local context only.

8.2.2 Aboriginal Cultural Values

Aboriginal cultural values can only be defined by Aboriginal people.

A written statement regarding the potential Aboriginal cultural values of the archaeological deposits detected in the current testing program has been requested from the three participating Aboriginal groups.

9. STATUTORY OBLIGATIONS[1]

9.1 The National Parks and Wildlife Act 1974

The following summary is based on:

- the provisions of the current National Parks and Wildlife Act 1974 (as amended). It should be noted that amendments to this Act were passed by both houses of the NSW State Government in 2001 (no.130, assented 19/12/2001). Some of these amendments are yet to be proclaimed.

- Department of Environment and Conservation policy as presented in the 1997 Standards and Guidelines Kit for Aboriginal Cultural Heritage provided by the NSW NPWS, and as communicated orally to the consultants on a periodic basis. The 1997 Standards and Guidelines Kit is currently under review and subject to change in the near future.

The guideline documents presented in the 1997 Standards and Guidelines Kit were stated to be working drafts and subject to an 18 months performance review. The Standards Manual was defined not to be a draft and subject to periodic supplements.

The National Parks and Wildlife Act 1974 (as amended) provides the primary basis for the legal protection and management of Aboriginal sites within NSW. The implementation of the Aboriginal heritage provisions of the Act is the responsibility of the Department of Environment and Conservation (DEC).

The rationale behind the Act is the prevention of unnecessary or unwarranted destruction of relics, and the active protection and conservation of relics that are of high cultural significance.

With the exception of some artefacts in collections, or those specifically made for sale, the Act generally defines all Aboriginal artefacts to be 'Aboriginal Objects' and to be the property of the Crown. An Aboriginal object has a broad definition and is inclusive of most archaeological evidence The Act then provides various controls for the protection, management and disturbance of Aboriginal Objects.

An Aboriginal object is defined as:

> 'any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.' [Section 5(1)].

In practice, archaeologists use a methodology that groups 'Aboriginal Objects' into various site classifications according to the nature, occurrence and exposure of archaeological material evidence. The archaeological definition of a site may vary according to survey objectives, however a site is not recognised or defined as a legal entity in the Act. It should be noted that even single and isolated artefacts are protected as Aboriginal Objects under the Act.

Generally it is an offence to do any of the following without a Permit from the Director-General of the Department of Environment and Conservation under Section 87: disturb or excavate any land for the purpose of discovering an Aboriginal Object; disturbing or moving an Aboriginal Object; take possession of or removing an Aboriginal Object from certain lands; and erecting a building or structure to store Aboriginal Objects on certain land (Section 86). The maximum penalty is $11,000 for individuals and $22,000 for corporations. Section 175B outlines circumstances where corporation

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[1] The following information is provided as a guide only and is accurate to the best knowledge of Navin Officer Heritage Consultants. Readers are advised that this information is subject to confirmation from qualified legal opinion.

directors may be taken to have contravened these provisions, based on the acts or omissions of that Corporation.

Consents regarding the use or destruction of Aboriginal Objects are managed through a system of Permits and Consents under the provisions of Sections 87 and 90 of the Act. The processing and assessment of Permit and Consent applications is dependent upon adequate archaeological review and assessment, together with an appropriate level of Aboriginal community liaison and involvement.

The Minister may declare any place which, in his or her opinion, is or was of special Aboriginal significance with respect to Aboriginal culture, to be an Aboriginal place (Section 84). The Director-General has responsibility for the preservation and protection of the Aboriginal place (Section 85). An area declared to be an Aboriginal place may remain in private ownership, or be acquired by the Crown by agreement or by a compulsory process (Section 145).

The Director General may make an interim protection order and order that an action cease where that action is, or is likely to, significantly affect an Aboriginal object of Aboriginal place. Such an order is current for 40 days (Section 91AA, Schedule 3[10]). Such an order does not apply to certain actions, such as where they are in accordance with development consents or emergency procedures.

9.1.1 General Management Constraints and Requirements

The Act, together with the policies of the Department of Environment and Conservation provide the following constraints and requirements on land owners and managers:

- It is an offence to knowingly disturb an Aboriginal Object (or site) without an appropriate permit or consent (Sections 87 and 90);

- Prior to instigating any action which may conceivably disturb an Aboriginal Object (this generally means land surface disturbance or felling of mature trees), archaeological survey and assessment is required (refer Standards for Archaeological Practice in Aboriginal Heritage Management in 1997 NPWS Standards and Guidelines Kit).

- When the archaeological resource of an area is known or can be reliably predicted, appropriate landuse practices should be adopted which will minimise the necessity for the destruction of sites/Aboriginal Objects, and prevent destruction to sites/Aboriginal Objects which warrant conservation (refer Standards for Archaeological Practice in Aboriginal Heritage Management in 1997 NPWS Standards and Guidelines Kit).

- Documented and appropriate consultation with relevant Aboriginal Community representatives is required by the Department of Environment and Conservation as part of the prerequisite information necessary for endorsement of consultant recommendations or the provision of Consents and Permits by the NPWS (refer Standards for Archaeological Practice in Aboriginal Heritage Management in 1997 NPWS Standards and Guidelines Kit).

9.2 The National Parks and Wildlife Amendment Bill 2001

Although this Act was passed by both houses of the NSW parliament in 2001, a number of its provisions with regard to Aboriginal cultural heritage have yet to be gazetted and are not yet law. These include the following provisions:

- The requirement for a section 90 ‘Consent to Destroy’ from the Director General will be replaced by a ‘heritage impact permit’ (Schedule 3[1], 3[3-8]).

- The offence under section 90 of the Principal Act of 'knowingly' destroying, defacing or damaging Aboriginal objects and Aboriginal Places without Consent will be changed so that the element of knowledge will be removed (Schedule 3 [2]). The amended section 90, subsection 1 will read:

  > 'A person must not destroy, deface, damage or desecrate, or cause or permit the destruction, defacement, damage or desecration of, an Aboriginal object or Aboriginal place.'

- Section 90 subsection 1 will not apply when an Aboriginal object or Aboriginal place is dealt with in accordance with a heritage impact permit issued by the Director-General (Schedule 3[3], Section 90(1B) in amended Act).

- It will be a defence to a prosecution for an offence against subsection 1 if the defendant shows that:

  (a) 'he or she took reasonable precautions and exercised due diligence to determine whether the action constituting the alleged offence would, or would be likely to, impact on the Aboriginal object of Aboriginal place concerned, and

  (b) the person reasonably believed that the action would not destroy, deface, damage or desecrate the Aboriginal object or Aboriginal place.' (Schedule 3[3], Section 90(1C) in amended Act)

- A court will be able to direct a person to mitigate damage to or restore an Aboriginal object or an Aboriginal place in appropriate circumstances when finding the person guilty of an offence referred to in section 90 of the Principal Act (Schedule 3[9]).

- Schedule 4[8] of the Bill provides for the Director-General to withhold in the public interest specified documents in the possession of the NPWS which relate to the location of Aboriginal objects, or the cultural values of an Aboriginal place or Aboriginal object.

9.3 Statutory constraints arising from artefacts which constitute background scatter

Background scatter is a term used generally by archaeologists to refer to artefacts that cannot be usefully related to a place or focus of past activity. There is no single concept for background 'scatter' or discard, and therefore no agreed definition. The recognition of background material within a particular study area is dependent on an appreciation of local contextual and taphonomic factors. Artefacts within a 'background' scatter can be found in most landscape types and may vary considerably in density.

Standard archaeological methodologies cannot effectively predict the location of individual background scatter artefacts. Surface survey may detect background material either as individual artefacts ('isolated finds'), or even as small, low-density 'sites'. Subsurface testing may sample, and through analysis, characterise background material. However, beyond the scope of archaeological sampling, the potential to encounter background artefacts within the context of development related ground disturbance will always remain.

Most previous cultural resource management archaeological methodologies have acknowledged that there is little scientific justification for the conduct of archaeological salvage or ground disturbance monitoring to effect the recovery of background artefacts. The intrinsic scientific value of any recovered artefacts does not, in general, outweigh the expense of conducting the monitoring. However, low-density distributions of artefacts are a current subject of interest by some heritage practitioners and DEC policy regarding this issue may change in the future. The monitoring of construction related ground works by Aboriginal groups is now increasingly practiced. The recovery of background scatter artefacts is often a probable outcome of such monitoring exercises.

Given the nature of statutory and DEC policy requirements in NSW the detection of background artefacts during monitoring can be problematic. Unless the Aboriginal object is covered by a current

Consent or Permit (or Heritage Impact Permit (HIP)), from DEC, all further impact to the find, and the ground in its immediate vicinity, must cease until one is gained. It may take up to eight weeks for this to occur. In the past, however, DEC has not as a general rule granted Consents to cover artefacts within background scatters. This is because DEC only provide Consents where the significance and location of the Aboriginal Objects to be impacted can be reliably defined. By their very nature, this cannot be done for artefacts that constitute a background scatter.

The present policies of DEC do not provide an effective or proactive means of dealing with the statutory constraints posed by the detection of background scatter artefacts during development works. It should therefore be noted, that in the event that an Aboriginal artefact ('Aboriginal object') is detected during ground disturbance within a development study area, and that area is not covered by a Consent to Destroy (or Heritage Impact Permit), there may be considerable delays to development works while an application for a Consent to Destroy is processed.

9.4. Implications for Developments on the CSR Land at Erskine Park

The presence of *Aboriginal Objects* (as defined under the NPW Act) within the CSR Lands at Erskine Park has the following implications:

- No activities can occur in the proposed development areas that may disturb either known surface artefacts or known subsurface archaeological deposits, without the receipt of an appropriate permit (a *Section 90 Consent to Destroy*) from the DEC.

10. RECOMMENDATIONS

1. No further archaeological assessment is required for the CSR lands at Erskine Park.

2. An application should be made to the Director General of the NSW DEC for a Section 90 Consent to Destroy (or Heritage Impact Permit) for the identified Aboriginal sites and associated archaeological deposits within the CSR industrial subdivision lands at Erskine Park.

3. It is possible that relics remain undetected within the 'untested' areas of the CSR lands at Erskine Park. As a precautionary measure the Section 90 application should include the entire development area (not just the identified Aboriginal sites and relics within the area).

4. Application should be made well before ground disturbance is anticipated in the areas where relics are known to occur. Disturbance to the known relics and deposits cannot occur until the Section 90 Consent has been issued by the DEC.

5. Three copies of this report should be forwarded to the NSW DEC for review.

6. Reports and the Section 90 application should be forwarded to

    Ms Kathryn Przywolnik
    Cultural Heritage Officer
    Conservation Planning Unit
    Metro EPRD
    NSW Department of Environment and Conservation
    PO Box 1967
    HURSTVILLE NSW 2220

7. Written statements should be requested from the Deerubin Local Aboriginal Land Council (DLALC), the Darug Tribal Aboriginal Corporation (DTAC) and the Darug Custodians Aboriginal Corporation (DCAC) which identifies their views regarding any Aboriginal cultural values of the archaeological deposits documented in this report.

8. Written statements should be requested from the DLALC, the DTAC and the DCAC regarding the Section 90 application for the industrial subdivision on CSR lands at Erskine Park. These statements are a requirement for any Section 90 application.

9. A copy of this report should be forwarded to each of the participating Aboriginal groups.

    Mr Phil Khan
    Sites Officer
    Deerubin Local Aboriginal Land Council
    PO Box V 3184
    MOUNT DRUITT VILLAGE NSW 2770

    Ms Celestine Everingham
    Darug Tribal Aboriginal Corporation
    PO Box 441
    BLACKTOWN NSW 2148

    Ms Leanne Wright
    Darug Custodians Aboriginal Corporation
    PO Box 36
    KELLYVILLE NSW 2153

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APPENDIX 1

RECORD OF ABORIGINAL PARTICATION

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park

Aboriginal Organisation: Deerubin Local Aboriginal Land Council

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
Kane Morton, Peter Knight, Daniel Hunter	7 Feb 05	Field Excavation	8am	5pm
Kane Morton, Peter Knight, Daniel Hunter	8 Feb 05	"	8 am	5 pm
Kane Morton, Peter Knight, Daniel Hunter	9 Feb 05	"	8 am	5 pm
Kane Morton, Peter Knight, Daniel Hunter	10 Feb 05	"	8 am	5 pm
Kane Morton, Peter Knight, Jason Bonham	11 Feb 05	"	8 am	3pm

Issues raised: ....

....

Signed *(archaeologist)*: .... *(Aboriginal representative)*: S Randall **Date** 11.2.05

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park.

Aboriginal Organisation: Darug Tribal Aboriginal Elders Corporation

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
Alan Watson	31 Jan 05	Excavation	10 am	5 pm
Alan Watson	1 Feb 05	Excavation	8 am	5 pm
Alan Watson	3 Feb 05	Excavation	8 am	5 pm
Alan Watson	4 Feb 05	Excavation	8 am	5 pm

Issues raised: ....

....

Signed *(archaeologist)*: [signature] ...... ***(Aboriginal representative):*** ...... **Date** ......

...... ***(Aboriginal representative):*** ...... **Date** ......

...... ***(Aboriginal representative):*** ...... **Date** ......

...... ***(Aboriginal representative):*** ...... **Date** ......

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park

Aboriginal Organisation: Darug Custodians Aboriginal Corporation

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
Wayne Boney	31/1/05	Archaeological	10:00	17:00
Wayne Boney	1/2/05	Excavation	8:00	17:00
"	3/2/05	"	8:00	17:00
"	4/2/05	"	8:00	15:00

Issues raised: ....

....

Signed ***(archaeologist)***: V.J. Myles .... ***(Aboriginal representative):*** Wayne Boney .... **Date** 4/2/05

.... ***(Aboriginal representative):*** .... **Date** ....

.... ***(Aboriginal representative):*** .... **Date** ....

.... ***(Aboriginal representative):*** .... **Date** ....

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park

Aboriginal Organisation: Deerubin Local Aboriginal Land Council

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
LESTER ROBERTS	24/01/05	Archaeological	10.30a	5.00pm
ANTHONY HUNTER	24/01/05	Excavation	10.30a	5.00pm
HENRY KHAN	24/01/05	" "	10.30a	5.00pm
LESTER ROBERTS	25/01/05	" "	8.00a	4.30pm
ANTHONY HUNTER	25/01/05	" "	8.00a	4.30pm
HENRY KHAN	25/01/05	" "	8.00a	4.30pm
SEAN ~~[illegible]~~ BARKER	26/01/05	" "	8.00a	5.00p
PHIL KHAN	26/01/05	" "	8.00a	5.00p
ANTHONY HUNTER	26/01/05	" "	8.00a	5.00p

Issues raised: ....

Signed *(archaeologist)*: .... *(Aboriginal representative)*: .... **Date** 26.01.05

.... *(Aboriginal representative)*: .... **Date** 26.01.05

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park.

Aboriginal Organisation: Deerubin Local Aboriginal Land Council

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
JASON BONEHAM	27/1/05	Archaeological	8.00a	5.00p
JEFF HICKEY	27/1/05	Excavation	8.00a	5.00p
DANIEL HUNTER	27/1/05		8.00a	5.00p
JASON BONEHAM	28/1/05	Archaeological	8.00a	3.00p
JEFF HICKEY	28/1/05	Excavation	8.00a	3.00p
DANIEL HUNTER	28/1/05		8.00a	NOON.

Issues raised: ....

Signed *(archaeologist)*: [signature] ***(Aboriginal representative):*** [signature] **Date** 28/01/05

.... ***(Aboriginal representative):*** .... **Date** ....

.... ***(Aboriginal representative):*** .... **Date** ....

.... ***(Aboriginal representative):*** .... **Date** ....

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park

Aboriginal Organisation: Darug Tribal Aboriginal Elders Corporation

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
MATTHEW MORTON	17-1-05	Subsurface Testing	10.00	5.00
" "	18-1-05	" "	8.00	3.30
" "	19-1-05	" "	8.00	5.00
ALLAN EVANS	20-1-05	" "	8.00	5.00
" "	21-1-05	" "	8.00	2.30

Issues raised: ....

....

Signed *(archaeologist)*: [signature] *(Aboriginal representative)*: [signature] **Date** 21-1-05

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

Record of Aboriginal Representative Participation*

Project Name: CSR Lands at Erskine Park

Aboriginal Organisation: Darug Custodians Aboriginal Corporation

Client Name & Address: Mr David Chan, CGP Management Pty Ltd, Level 5, 97 Pacific Highway, NORTH SYDNEY NSW 2060
(Please send invoice to this address)

Archaeologist(s): name & address: Navin Officer Heritage Consultants Pty Ltd, 4/71 Leichhardt Street, KINGSTON, ACT 2604 (Tel: 02 6282 9415, Fax: 6282 9416)

Name of Representative	Date	Type of Participation	Start time	Finish time
BRAD PITTMAN	17-1-05	Subsurface Testing.	10.00	5.00
" "	18-1-05	" "	8.00	4.30
" "	19-1-05	" "	8.00	5.00
" "	20-1-05	" "	8.00	5.00
" "	21-1-05	" "	8.00	2.30

Issues raised: ....

....

Signed *(archaeologist)*: M. Baker [signature] .... *(Aboriginal representative)*: B. Pittman [signature] .... **Date** 21-1-05

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

.... *(Aboriginal representative)*: .... **Date** ....

APPENDIX 2

LITHIC DATABASE

TEST AREA 3

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	1	1	pink	silcrete	flake fragment	1	0.40	
2	2	1	orange	quartzite	lithic fragment	2	0.95	metal residue from pressing artefact on sieve
3	2	1		milky quartz	flake fragment	1	0.20	
4	2	1		milky quartz	lithic fragment	1	0.28	fragment from quartz pebble
5	2	1		milky quartz	flake fragment	1	0.15	
6	2	1		milky quartz	flake	1	0.10	
7	2	1	red	silcrete	microlith backing flake	1	0.11	
8	3	1	grey	chert	lithic fragment	1	0.17	
9	4	1	grey	quartzite	lithic fragment	1	0.13	
10	4	1		milky quartz	lithic fragment	1	0.13	
11	4	2		milky quartz	lithic fragment	1	0.18	fragment from a quartz pebble
12	6	2	red	silcrete	flake portion	2	0.28	proximal portion; possibly thermal shatter
13	7	1		chalcedony	lithic fragment	2	0.99	fragment of a chalcedony clast or pebble possibly of natural origin
14	8	1	red	silcrete	lithic fragment	1	0.11	thermal shatter
15	10	2	red	silcrete	flake	1	0.12	
16	11	1		milky quartz	flake fragment	1	0.09	
17	11	1		quartzite	lithic fragment	1	0.14	
18	11	1	grey	chert	flake	2	0.30	
19	11	1	grey	silcrete	lithic fragment	1	0.05	
20	11	2	grey	quartzite	lithic fragment	1	0.28	from pebble
21	11	2	orange	silcrete	lithic fragment	1	0.23	
22	12	2	grey	silcrete	lithic fragment	1	0.08	probable thermal shatter

23	13	1	orange	silcrete	lithic fragment	2	0.81	thermal shatter
24	13	1	orange	silcrete	flake	1	0.23	
25	13	1	grey	silcrete	flake fragment	2	0.35	
26	13	1	red	silcrete	microblade portion	1	0.09	proximal part

TEST AREA 4

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	3	2	red	silcrete	lithic fragment	3	1.72	thermal shatter fragment; potlid fractures
2	3	2	red	silcrete	lithic fragment	3	1.56	thermal shatter fragment
3	3	2	red	silcrete	lithic fragment	1	0.29	thermal shatter
4	3	2	red	silcrete	lithic fragment	2	0.52	
5	10	1	white	milky quartz	flake	2	1.27	pebble cortex on initiation surface
6	13	1	red	silcrete	lithic fragment	2	1.21	potlid flake
7	13	1	red	silcrete	lithic fragment	2	0.66	thermal fracture
8	13	2	yellow	silcrete	microblade	2	1.00	
9	13	2	red	silcrete	lithic fragment	2	0.12	thermal fracture
10	13	2	red	silcrete	lithic fragment	1	0.21	thermal fracture
11	13	2	red	silcrete	lithic fragment	1	0.17	probable thermal fracture
12	16	2	grey	silcrete	lithic fragment	1	0.20	possible thermal fracture
13	16	2	grey	silcrete	lithic fragment	4	8.69	thermal fracture
14	16	2	pink	silcrete	lithic fragment	2	0.55	thermal fracture
15	16	2	red	silcrete	lithic fragment	1	0.01	
16	17	2	yellow	silcrete	microblade portion	3	2.56	proximal portion
17	20	2	red	silcrete	lithic fragment	1	0.10	
18	21	1	grey	quartzite	lithic fragment	5	16.27	cortical fragment from a pebble
19	22	2		milky quartz	flake portion	2	0.77	proximal portion; tabular cortex appears to be from a very flattish pebble
20	22	2	grey	rhyolitic tuff	flake portion	1	0.06	longitudinal portion; small area of red coloured cortex with flat surface; groundmass is very slightly leached and still has relatively fresh appearance

TEST AREA 5B

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	1	1	pink	silcrete	flake portion	2	0.53	proximal portion

TEST AREA 5C

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	3	1	pink	silcrete	microlith backing flake	2	0.41	
2	3	1	pink	silcrete	flake fragment	2	0.23	
3	3	1	pink	silcrete	microblade portion	1	0.22	proximal portion
4	3	1	red	silcrete	microblade	2	0.26	
5	5	1	pink	silcrete	lithic fragment	1	0.10	
6	5	1	pink	silcrete	lithic fragment	1	0.09	potlid flake
7	7	1	grey	silcrete	lithic fragment	2	1.81	typical thermal shatter; typical pyramid
8	9	1	pink	silcrete	microblade portion	2	0.20	proximal portion

TEST AREA 5A

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	7	2	pink	silcrete	flake portion	3	5.85	step terminated portion; groundmass grades are red flake - step terminated
2	8	1		silcrete	lithic fragment	2	3.68	thermal shatter
3	8	1		silcrete	flake portion	2	0.39	distal portion; varicoloured groundmass - white, red, pink
4	8	1	red	silcrete	flake fragment	2	0.27	

TEST AREA 6

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	3	1	red	silcrete	microblade	3	1.29	
2	5	1	red	silcrete	microblade portion	2	0.40	proximal portion; groundmass grades to grey; associated with #1 - they come from the same nucleus
3	5	1	grey	silcrete	microblade portion	2	0.25	distal part
4	5	1	grey	silcrete	flake	1	0.30	
5	6	1	red	silcrete	flake portion	2	0.18	proximal part
6	6	1	red	silcrete	microblade portion	2	0.25	groundmass grades to grey; proximal part associated with #1, #2
7	7	1	red	silcrete	lithic fragment	4	6.59	thermal fracture; extensively potlid fractured
8	9	1	red	silcrete	microblade portion	2	0.30	mid portion
9	9	1	red	silcrete	flake	2	0.21	
10	15	1	grey	silcrete	lithic fragment	3	1.76	thermal fracture; extensively potlid fractured
11	16	1	red	silcrete	lithic fragment	1	0.21	thermal fracture; groundmass within this series is invariably red to dull purple and natural grey
12	16	1	red	silcrete	lithic fragment	3	3.66	thermal fracture
13	16	1	red	silcrete	lithic fragment	3	7.99	thermal fracture
14	16	1	red	silcrete	lithic fragment	3	2.10	thermal fracture
15	16	1	red	silcrete	lithic fragment	2	1.00	thermal fracture
16	16	1	red	silcrete	lithic fragment	3	1.89	thermal fracture
17	16	1	red	silcrete	lithic fragment	2	0.68	thermal fracture
18	16	1	red	silcrete	flake	2	0.37	thermal fracture
19	16	1	red	silcrete	flake	2	1.03	thermal fracture
20	16	1	red	silcrete	flake	3	1.68	thermal fracture
21	16	1	red	silcrete	flake fragment	2	0.25	thermal fracture

22	16	1	red	silcrete	flake	2	0.25	thermal fracture
23	16	1	yellow	silcrete	flake fragment	1	0.16	thermal fracture
24	16	1	red	silcrete	flake fragment	2	0.15	thermal fracture
25	16	1	red	silcrete	lithic fragment	1	0.11	thermal fracture
26	16	1	red	silcrete	flake portion	1	0.11	proximal
27	16	1	red	silcrete	microblade portion	1	0.11	mid-section
28	16	1	red	silcrete	flake portion	1	0.07	distal portion
29	16	1	red	silcrete	flake portion	1	0.11	proximal portion
30	16	1	red	silcrete	bondi point preform	1	0.15	fragment of a preform
31	16	1	red	silcrete	bondi point preform	1	0.19	proximal half of a bondi point almost certainly broken during backing process
32	16	1	red	silcrete	flake	1	0.14	
33	16	1	red	silcrete	lithic fragment	1	0.13	
34	16	1	red	silcrete	lithic fragment	1	0.14	
35	16	1	red	silcrete	lithic fragment	1	0.10	
36	16	1	red	silcrete	lithic fragment	1	0.06	
37	16	1	red	silcrete	flake portion	1	0.16	longitudinal portion
38	16	1	red	silcrete	microblade	1	0.06	
39	16	2	red	silcrete	microblade	3	2.06	bondi point preform with some minimal retouch at one end, indicating that it was abandoned at an early stage
40	16	2	red	silcrete	lithic fragment	2	1.72	thermal fracture
41	16	2	red	silcrete	lithic fragment	2	0.31	
42	16	2	red	silcrete	lithic fragment	1	0.09	
43	16	3	red	silcrete	lithic fragment	1	0.23	thermal fracture
44	27	1	red	silcrete	microblade portion	1	0.18	proximal
45	27	1	red	silcrete	microblade	2	0.56	

46	27	1	grey	chert	scraper	3	5.22	use-wear along 2 margins; use-wear comprises moderately developed use-polish bilateral, within 1 mm both sides on each edge, with use-fracture mostly on the dorsal faces of flake, with occasional use-fracture along ventral surface of the flake; 25 x 22 x 8 mm
47	29	1	red	silcrete	microblade core	4	17.72	shows 3 rotations and shows evidence of potlid scarring

TEST AREA 7

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	1	1		silcrete	flake	1	0.10	probably from microblade core
2	1	2		silcrete	microblade core fragment	2	1.47	
3	1	2	red	silcrete	microblade	2	0.43	
4	1	2	grey	rhyolitic tuff	flake portion	1	0.12	distal portion; grey coloured groundmass with very fresh appearance indicating that there has been no patination of the surface; condition of this susceptible stone type suggests that the site is very recent occupation such as terminal prehistory
5	22	1		milky quartz	bipolar flake	2	0.94	small area of apparently tabular cortex; flattish pebble
6	37	1	red	silcrete	lithic fragment	4	12.07	probable thermal shatter

TEST AREA 8

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	11	1	red	silcrete	lithic fragment	2	2.08	thermal fracture; typical geometric shape
2	11	1	red	silcrete	lithic fragment	2	0.49	thermal fracture; typical geometric shape
3	13	1	red	silcrete	lithic fragment	2	1.73	thermal fracture; typical geometric shape
4	13	1	red	silcrete	lithic fragment	1	0.13	possible thermal shatter
5	15	1		unidentified	lithic fragment	3	4.28	unidentified metamorphic stone type
6	16	1	red	rhyolitic tuff	flake fragment	2	0.29	whitish surface patination
7	19	1	grey	unidentified	lithic fragment	3	5.62	#7 I33- #12 are associated; unidentified metamorphic stone
8	19	1	grey	unidentified	lithic fragment	2	1.62	
9	19	1	grey	unidentified	lithic fragment	2	0.82	
10	19	1	grey	unidentified	lithic fragment	2	0.72	
11	19	1	grey	unidentified	lithic fragment	2	0.99	
12	22	1	grey	unidentified		2	2.10	uncertain identification of stone type; apparently patinated possibly wind-blasted rhyolitic tuff; some anomalous edge-rounding along one margin
13	24	1	red	silcrete	lithic fragment	3	6.82	thermal fracture; typical geometric shape
14	32	1		quartz	bipolar core	4	30.82	quartz pebble with very early stage of bipolar flaking; two flake removals off the top end and cone crack on the opposite cortex end of the pebble
15	1	1	white	rhyolitic tuff	flake fragment	2	1.22	possibly a fragment of a preform or an implement with abrupt flaking along one margin
16	7	1	grey	silcrete	lithic fragment	3	4.08	thermal fracture

TEST AREA 9

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	8	1		milky quartz	lithic fragment	2	1.71	pebble cortex on initiation surface
2	8	2	red	silcrete	lithic fragment	1	0.32	possible thermal shatter
3	7	2	pink	silcrete	lithic fragment	1	0.07	potlid flake
4	9	1	red	silcrete	flake portion	1	0.06	proximal step-terminated portion; probably a flake from a microblade core
5	9	1	orange	rhyolitic tuff	flaked piece	3	3.11	distal fragment of a flake with bifacial flaking or more specifically retouch along two margins; an indeterminate item, possibly a piece of a stone implement
6	9	2	pink	silcrete	flake	2	0.33	
7	9	3	yellow	rhyolitic tuff	flake	2	0.72	possibly a flake from a microblade core; has post-depositional fracture damage along lateral margins
8	13	1	red	silcrete	bondi point portion	2	0.51	proximal portion of a bondi point carefully backed along one margin; the material has a glossy sheen suggestive of heat treatment
9	14	1	red	silcrete	flake	2	0.31	possibly a microlith backing flake
10	16	2	yellow	silcrete	flake	1	0.11	
11	16	2	pink	silcrete	flake fragment	1	0.12	
12	16	2	purple	silcrete	indeterminate	2	1.27	abruptly angled retouch along one margin; large potlid fracture on two surfaces; heat fracture possibly from an implement or a core
13	16	3	purple	silcrete	flake	2	1.71	flake from microblade core; rough granular surface on one of dorsal surfaces, 2 potlid flake scars on ventral surface
14	17	3	white	rhyolitic tuff	flake	2	0.20	potlid heat fractured; classic example of a potlid flake, with a negative potlid scar on the dorsal surface

TEST AREA 10

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	1	1	red	silcrete	lithic fragment	1	0.18	possible thermal fracture
2	1	1	red	silcrete	flake	1	0.06	
3	1	2	red	silcrete	lithic fragment	1	0.09	
4	1	2	red	silcrete	flake	2	0.40	
5	1	2	red	silcrete	lithic fragment	1	0.03	probably a potlid flake; thermal fracture
6	1	2	red	silcrete	lithic fragment	1	0.04	probable thermal fracture
7	1	2	yellow	silcrete	microblade portion	2	0.66	distal portion
8	1	2	yellow	silcrete	flake	2	0.91	
9	1	2	yellow	silcrete	flake	1	0.08	
10	1	2	yellow	silcrete	flake	1	0.03	probably a microlith backing flake
11	1	2	yellow	silcrete	flake portion	1	0.06	step terminated flake
12	2	1	red	silcrete	flake	2	0.72	from a microblade core; #12-#17 are associated
13	2	1	red	silcrete	lithic fragment	1	0.31	possibly flake or flake fragment; #12-17 are associated
14	2	1	red	silcrete	flake	2	0.11	#12-17 are associated
15	2	1	red	silcrete	microblade	2	0.11	very rough specimen; #12-17 are associated
16	2	1	red	silcrete	flake	1	0.06	flake from microblade core; #12-17 are associated
17	2	1	red	silcrete	flake	1	0.16	#12-17 are associated
18	2	1	red	rhyolitic tuff	lithic fragment	1	0.14	item is thermal fractured; clearly this item has been subjected to heat that has changed its colour to red and cause potlid fracturing on at least two of its surfaces
19	2	3	purple	silcrete	lithic fragment	4	6.94	thermal fracture
20	2	3	red	quartzite	flake	3	5.51	
21	2	3	red	silcrete	lithic fragment	1	0.41	probably thermal fracture

22	2	3	red	silcrete	lithic fragment	1	0.05	
23	2	3	red	silcrete	lithic fragment	1	0.03	
24	2	3	red	silcrete	lithic fragment	1	0.03	
25	2	3	red	tuff	flake portion	3	1.09	longitudinal portion
26	2	3	red	tuff	flake fragment	2	0.62	
27	3	1	pink	silcrete	flake	1	0.03	
28	3	2	red	tuff	lithic fragment	1	0.05	potlid flake
29	3	3	red	silcrete	lithic fragment	2	0.29	
30	4	1	pink	silcrete	lithic fragment	1	0.23	thermal fracture; potlid flake
31	4	1	pink	silcrete	lithic fragment	1	0.39	thermal fracture; typical geometric shape
32	4	3	orange	tuff	microblade	2	0.25	
33	4	3	orange	tuff	flake	2	0.14	
34	4	3	orange	tuff	flake	1	0.01	
35	4	3	orange	tuff	flake	2	0.21	
36	4	3	red	silcrete	lithic fragment	1	0.68	thermal fracture
37	4	3	red	silcrete	lithic fragment	2	0.40	classic example of a potlid flake
38	4	2	orange	tuff	flake	2	0.25	
39	4	2	red	silcrete	microblade core	4	18.45	single initiation platform
40	4	4	red	chalcedony	flake	2	1.18	
41	5	2	red	silcrete	flake	1	0.12	
42	5	3	pink	silcrete	microblade	4	6.04	
43	5	3	red	silcrete	lithic fragment	3	2.88	
44	5	3	red	silcrete	lithic fragment	2	0.44	potlid flake
45	5	3	red	silcrete	lithic fragment	2	0.74	
46	5	3	yellow	silcrete	flake	2	0.71	

47	5	5	yellow	unidentified	utilised flake	5	28.94	proximal part of chunky flake with short length of lateral margin truncated by break, exhibiting denticulate retouch; probable use fracturing & edge-rounding of prominences; probably metamorphic rock, possibly spotted hornfels, remnant area pebble cortex
48	6	2	red	tuff	flake fragment	1	0.06	pebble cortex
49	6	2	red	tuff	lithic fragment	2	0.72	pebble cortex; probable thermal fracture
50	6	3	red	silcrete	lithic fragment	3	9.16	thermal fracture; typical geometric shape
51	6	3	red	tuff	flake	2	0.34	
52	6	3	yellow	silcrete	utilised flake	4	3.92	27x 8 x 6 mm; fine use-fracturing along 20 mm length of one lateral margin; very likely to have been a hand-held flake tool used for a light duty activity
53	6	3	orange	tuff	flake	2	0.22	

TEST AREA 11

Ref #	Pit	Spit	Colour	Stone	Type	Size	Weight (g)	Comments
1	1	3	red	tuff	flake	1	0.29	
2	2	1	red	silcrete	lithic fragment	3	13.71	thermal fracture; typical geometric shape
3	2	1	red	silcrete	lithic fragment	3	2.44	thermal fracture; negative potlid scar on one surface
4	2	1	red	silcrete	flake portion	2	0.29	longitudinal portion
5	2	1	grey	chert	flake	2	1.62	cortical flake; pebble cortex
6	2	1	grey	silcrete	flake	2	0.27	
7	2	1	red	tuff	flake fragment	2	0.37	
8	2	1	red	silcrete	flake portion	1	0.22	proximal portion
9	2	1	red	silcrete	lithic fragment	1	0.19	thermal fracture; potlid flake; typical geometric shape
10	2	1	yellow	silcrete	lithic fragment	2	0.40	probable thermal fracture
11	2	1	red	silcrete	flake fragment	1	0.10	
12	4	2	red	silcrete	lithic fragment	3	4.32	thermal fracture
13	4	2	red	silcrete	lithic fragment	3	2.63	
14	4	2	red	tuff	flake	3	3.88	
15	4	2	yellow	tuff	lithic fragment	3	3.71	pebble cortex
16	4	2	red	silcrete	lithic fragment	3	3.61	
17	4	2	red	silcrete	flake	2	0.19	
18	4	2	orange	tuff	lithic fragment	1	0.16	potlid flake
19	6	1	white	tuff	lithic fragment	2	1.02	pebble cortex
20	6	1	white	quartzite	flake fragment	2	0.78	
21	6	1	red	chalcedony	flake fragment	2	0.21	
22	6	2	red	silcrete	lithic fragment	2	0.59	
23	6	2	red	silcrete	lithic fragment	2	0.36	potlid flake

24	6	2	red	silcrete	flake portion	2	0.39	proximal portion; possibly bipolar flake
25	8	1	grey	silcrete	flake	2	0.62	glossy, waxy sheen suggestive of heat treatment; groundmass grades from grey to red
26	9	1	red	silcrete	lithic fragment	3	6.77	thermal fracture
27	9	1	red	silcrete	lithic fragment	2	1.51	thermal fracture
28	9	1		quartz	compression flake	2	0.84	
29	9	1	orange	tuff	flake	1	0.16	
30	9	1	red	tuff	lithic fragment	1	0.11	thermal fracture
31	9	2	red	silcrete	lithic fragment	2	0.31	thermal fracture; typical geometric shape, glossy, waxy lustre
32	9	2	red	tuff	lithic fragment	2	0.25	pebble cortex
33	12	1	orange	tuff	microblade core	3	9.77	
34	12	1	white	quartzite	flake	2	2.85	
35	12	1	white	quartzite	flake portion	2	0.55	proximal portion
36	12	1	white	quartzite	flake fragment	2	0.74	
37	12	1	white	quartzite	lithic fragment	2	0.44	
38	12	1	black	quartzite	utilised flake	2	2.18	20 x 16 x 6 mm; use-fracturing along one lateral margin; moderate edge-rounding along opposite margin
39	12	1		milky quartz	flake fragment	2	1.33	probably bipolar
40	12	1		milky quartz	bipolar flake	3	2.05	bipolar
41	12	1	grey	quartzite	flake portion	2	0.40	proximal portion; possibly a microblade portion

APPENDIX 3

CHARACTERISTICS & DISTRIBUTIONS OF

STONE TYPES AT ERSKINE PARK

Silcrete

Silcrete was one of the most important stone materials for making flaked stone tools throughout most of Australia, including the Cumberland Plain, and was used for a variety of tasks, including heavy-duty woodworking and as spear armatures. The edges of silcrete flakes are relatively durable and sharp and resistant to wear. The occurrence of the stone in primary geological context and as waterworn stones in watercourses is widespread in the continent.

When the silcrete is fine-grained it may be similar in mechanical properties and surface texture to chert, and when relatively coarse-grained it may be similar to quartzite. The rock is composed mainly of cryptocrystalline or microcrystalline quartz, and/or chalcedony and amorphous (opaline) silica. Crystals within the matrix range in size up to about 0.5 mm. The matrix is usually seeded with larger detrital grains or crystals, most often quartz but also chert and chalcedony, or heavy mineral particle such as tourmaline or felspar. A small proportion of silcretes has opal-CT, which may occur as both a general matrix component and as a late-stage void-fill. Under low magnification silcrete is often easily identifiable by the sheared quartz grains reflecting brightly in a groundmass of finely textured coloured matter (Langford-Smith 1978:3; Summerfield 1983:59).

Mineral composition is highly variable, and silcrete cannot be precisely characterised by its bulk chemical composition, other than that its minimum silica content of 85% weight, which provides an arbitrary lower limit. In addition to silicon only aluminium, iron, and titanium are generally present in significant amounts. Titanium is mostly present as anatase, much of it probably authigenic (Summerfield 1983:64, 66-67). Iron may occur in microscopic voids and both within the matrix and as a late-stage precipitate within weathering surfaces. While a process of titanium concentration is closely associate with silcrete formation, not all silcrete is titanium-rich. Trace element abundance tends to be related to the composition of the host material. Silcrete is often grey or yellow in natural colour, but other colours include white, red and brown. Heating, either by natural or cultural agency, may cause colour change, most notably to red, purple or pink (see discussion below).

Silcrete forms as a sedimentary layer from the massive accumulation of silica precipitated from aqueous solution under low temperature. This silica is derived from chemical weathering of a near-surface sedimentary bedrock layer, weathering deposits, unconsolidated sediments, soil or other material. The formation of silcrete requires the removal of most elements other than silicon in the host material.

Silcrete formed as sedimentary layers over vast, poorly drained regions of Australia more than twenty million years ago. The process is massive accumulation of silica precipitated from aqueous solution under low temperature. The silica atoms in solution are derived from chemical weathering of a near-surface sedimentary bedrock layer, weathering deposits, unconsolidated sediments, soil or other material. The formation of silcrete requires the removal of most elements other than silicon in the host material.

Exposures of silcrete bedrock are commonly layers between one and three metres thick. Erosion products occur as waterworn boulders, cobbles and pebbles in ancient and modern watercourses. Bedrock outcrops occur along the eastern and southeastern coasts (Summerfield 1983:60). In the past, geologists have referred to silcrete along the New South Wales coast as 'grey billy', a term still used occasionally in the geological literature. The formation process of east coast silcrete, especially silcretes underlying basalt, is a current issue of debate amongst geologists. The most popular hypothesis is that weathering of basalt has released silica which has precipitated downwards. However, Young and McDougall (1982) argue that silcretes formed in the Ulladulla region of the South Coast pre-date local basalt flows and therefore are not a consequence of it. They further argue that silcretes in eastern Australia are minimally of Tertiary age.

The silcrete component of artefact assemblages from the south coast is as high as 45% and higher percentages have been reported for sites further north in the Hunter Valley. This is also case for the Cumberland Plain, where silcrete may comprise over half of the assemblage (for instance, in Erskine Park Test Areas 1 & 2 it is a total of 55%). Both on the Cumberland Plain and the Hunter Valley, the alluvial gravels in riverbeds, ancient and modern are the major sources of the silcrete in archaeological assemblages. Ongoing changes in sediment erosion and deposition have occurred since oceanic 'stillstand' of the ocean at bout 6450 years ago, and also during the historic period of European settlement. In particular, lateral migrations in the river channels has buried or exposed silcrete gravel deposits (cf., Roy *et al.* 1995:80).

Rhyolitic tuff

Stone previously identified as 'indurated mudstone' in assemblages from the Hunter Valley and Sydney region, and also sometimes as 'chert', is now known to be indurated rhyolitic tuff. This new identification has been determined through microscopic examination under reflected light, thin-section analysis and XRD analysis (Kamminga 1978). Kuskie and Kamminga (2000) discuss the characteristics and distribution of this tuff in detail, and therefore only a summary is presented here.

While the tuff is in some respects similar to chert and indurated mudstone there are important differences in mechanical properties and mineral composition. Thin section analysis has shown that artefactual rhyolitic tuff is 87-95% microcrystalline silica (0.005 mm sized particles are common) and up to 13% feldspar and other minerals. The tuff has been the subject of a large series of replicative tool-use experiments for the purpose of determining use-wear and tool-use residue characteristics (Kamminga 1978, 1982). Commonly, the particles within a tuff layer are graded according to size because of sorting during slow descent of the original ash fall through air and water. Ripples indicating an aqueous depositional environment are often evident in the laminations or layers (Kamminga 1982; Fahey 1994).

Over at last two decades, variation in colour has been noted by archaeologists describing Hunter Valley lithic assemblages. In its pristine, unweathered form rhyolitic tuff is grey to green in colour; at surface exposure it may be grey, as river gravel grey, yellow or orange, with orange to brown cortex, and as artefacts in cultural sediments black, purple, orange, yellow, white and grey, though the interior matrix may be of a different colour, though often grey. Tuff artefacts recovered from a sandy sediment, such as a coastal dune, tend to be white because of bleaching action. Tuff that has been subject to intense heat (such as from a campfire) may be grey, orange, red, powdery white or metallic white. Much of the colour variation exhibited by rhyolitic tuff artefacts in archaeological assemblages is attributable to post-depositional leaching or staining. Yellow, orange and brown colouration is attributable to groundwater charged with iron compounds (in particular goethite and haematite) diffusing through the porous tuff and precipitating out in micropores; purple colour may be caused by the trace element cobalt; black may be from manganese oxide which is often associated with iron in groundwater. Heating from bushfire, or dehydration due to weathering, may transform yellow goethite transforms to red haematite [$2FeO(OH) \rightarrow Fe_2O_3 + H_2O$]. Colour banding on tuff artefacts, such as black and white, red and brown or red and yellow, is often only a surface feature and attributable to different degrees of porosity of the laminations within the tuff groundmass. Whether a tuff artefact is leached, or variously coloured by mineral infusion, to a large extent probably depend on the composition and porosity of the sediment immediately surrounding the artefact. For this reason, the potential for association of tuff artefacts on the criterion of colouration is limited.

While the texture of rhyolitic tuff ranges from granular to very fine grained and even glossy, in general the stone represented in artefactual assemblages tends to be uniform. Thus current methods of petrological analysis normally do not provide a basis for attributing individual artefacts or assemblages to a particular source.

Permian Era rhyolitic tuffs occur in widespread seams throughout the Hunter Valley and are occasionally exposed in drainage lines, in cliff faces (eg. Nobbys Head), or in terrace gravel beds. Numerous volcanic tuff members occur within the Newcastle Coal Measures (Diessel 1980:103). Some, such as the well-known Nobbys Tuff Member, are over ten metres thick. The Nobbys Tuff occurs as a continuous layer 70 m long from north to south, and ranges up to 25 m thick. At Nobby's Head it is at its maximum thickness (Ives 1995:233).

Rhyolitic tuff is an important component of lithic assemblages in western Sydney and on the western side of the Blue Mountains. It occurs as waterworn pebbles and cobbles in the Hawkesbury and Nepean River gravel beds and in relict river terraces on the Cumberland Plain. Tuff is also found around Wollongong and further south along the Illawarra coast.

Quartz

One of the two most common types of stone used for flake tools in Australia is quartz, which is readily available throughout most of the continent. In some regions it is almost the only suitable stone type that occurs. Quartz is composed of extremely small hexagonal crystals of silicon oxide, which give it a glossy texture. It is translucent when composed purely of silicon oxide, but with the addition of minute traces of other elements it exhibits colour. Most quartz has microscopic gas or liquid filled vacuoles which makes it milky in appearance. While trace elements or vacuoles do not affect the rock's strength, clay minerals (particularly iron compounds) in groundwater that seeps into flaws in the stone may weaken it, or even cause it to break into pieces.

There are three major forms of massive (as opposed to microscopic) quartz: veins, geodes and macro crystals. These varieties are essentially the same in terms of knapping properties. Because it exhibits a small degree of cleavage and tends to have internal flaws, quartz ranges in knapping quality from very poor to acceptable. Vein or reef quartz is more likely to contain major pre-existing flaws. Internal cracking of quartz often occurs during flaking and its fracture path is usually much less predictable than with stone that breaks with a strong conchoidal fracture. For these reasons, quartz tends to be a poor-quality knapping material compared with chert and silcrete. However, it was often used because it was readily available, and in some areas was the predominant knapping material. The other advantage offered by quartz is that it provides small flakes with sharp edges suitable for light-duty work such as skinning, light-duty butchering and cutting plant matter.

Because of its hardness, quartz tends to survive geological recycling and is therefore commonly occurs as waterworn pebbles. The beds of watercourses probably were the primary source of artefactual quartz in Australia. In general, quartz is a minor component in Cumberland Plain lithic assemblages and, consistent with this general trend, in the Erskine Park assemblage it was represented by only a single artefact (2%). It seems likely that good quality flaking quartz pebbles were collected from watercourses in the general or immediate region around the sites currently being investigated.

Quartzite

Quartzite occurs in many Australian stone industries, at times constituting up to 95% or more of the excavated stone artefacts. This stone type is a close relative geologically to sandstone, the essential difference being that fracture in quartzite passes through constituent grains, whereas in sandstone it passes through the cement material and predominantly around the grains. Basically, there are two major types of quartzite: sandstone recrystallised by volcanic activity, in which the original quartz constituents are transformed to interlocking crystals; and sandstone that has been completely indurated by silica solution percolating into intergranular pore space. In the latter form, the cementing material may be quartz, opaline or chalcedonic silica, or any combination of these. The critical factor for overall strength and resistance to abrasive wear is the bond strength between the crystals or grains constituting the stone matrix. While mechanical variation of quartzite is considerable in general, there is much less variation in quartzite selected for knapping stone artefacts.

Quartzite pebbles and cobbles are known to occur in the present day and relict gravels of the Nepean River (such as at the Cranebrook quarry). Other sources of this stone type in the Sydney region have not been specifically identified during archaeological surveys.

Chert (including flint)

Chert is consistently one of the finest material used in knapping stone implements in Australia. Randomly orientated interlocking grains of microcrystalline quartz forms the bulk of most types of chert. Often, the groundmass comprises various proportions of quartz, chalcedony and amorphous silica arranged in a very finely granular mosaic. Impurities such as dolomite, calcite, pyrite and glaucanite can occur.

Exposures of bedrock chert and chert pebbles in gravel beds are found in many areas of Australia, including the south and southeast coasts and the Sydney Basin including the Cumberland Plain. Flint is a type of chert that occurs in Australia but is better known in Europe where it is the predominant stone type in Stone Age assemblages. Other types such as rhyolitic tuff, chalcedony, indurated siltstone and metamorphosed sediments have been sometimes been misidentified as chert even though their microscopic characteristics and mechanical properties are different (Kamminga 1978).

Occasional chert pebbles occur in the ancient and modern river gravels in the Cumberland Plain. These pebbles are small, ranging up to about 3 cm in size, and are the source of the artefacts found in archaeological assemblages in the Erskine Park test pits and the area generally.

Chalcedony

Chalcedony, like fine quality chert, is a hard siliceous stone usually characterised by conchoidal fracture and amenable to controlled knapping. It was also exploited for stone tool making in the regions where it occurred. Semi-precious coloured varieties include carnelian (yellow brown), sard (brown), agate (varicoloured) and jasper (red).

The bulk of chalcedony consists of cryptocrystalline and microcrystalline quartz crystallites, which are often fibrous in form. Submicroscopic pores containing water are interspersed amongst these crystallites. As with chert, the crystalline structure of the stone can be seen only at very high magnification.

Chalcedony can occur in the veins, or as pseudomorphs resulting from solution infiltrating casts left in rock (usually volcanic) or gradually replacing decaying organic matter (such as wood, hence fossil wood). Over geological time the solution hardens into chalcedonic silica. While the mechanical properties and variability of chalcedony have not been studied in detail, its Mohs hardness always registers within half a point of 7 (Kamminga 1978).

Small numbers of chalcedony artefacts occur in archaeological sites on the Cumberland Plain and the stone type occurs naturally in the ancient and modern gravel beds of the Nepean River and its major tributaries. It is most probable that the chalcedony in the lithic assemblage at Erskine Park derives from these gravel beds.

Metamorphic stone types

This general group of rock types includes hornfels, and recrystallised basalt, which are common minor components in archaeological assemblages in southeastern Australia. These rock types display a wide range of mechanical properties relevant to tool making and tool use. Normally, fine grained, tough metamorphic stone was chosen for making ground stone hatchet heads and other edge ground artefacts.

APPENDIX 4

GLOSSARY

alluvial - pertaining to alluvium and fluvial processes.

alluvium - unconsolidated deposit of gravel, sand, mud etc., formed by water flowing in identifiable channels. Commonly well-sorted and stratified.

archaeological site - A site is defined as any material evidence of past Aboriginal activity which remains within a context or place which can be reliably related to that activity. Usually a site classification requires a minimum of two detected artefacts.

artefact - an object, normally portable, made or modified by human hand (see 'stone artefact').

assemblage - see lithic assemblage.

attribute - An observable and definable trait. Although used in a general sense it is also employed to depict qualities of a larger entity called a ‘variable’. For example, the variable *striking platform modification* can have attributes of *uniplanar, abraded, faceted*, and so forth.

background discard - There is no single concept for background discard or 'scatter', and therefore no agreed definition. The definitions in current use are based on the postulated nature of prehistoric activity, and often they are phrased in general terms and do not include quantitative criteria. Commonly agreed is that background discard occurs in the absence of 'focused' activity involving the production or discard of stone artefacts in a particular location. An example of unfocussed activity is occasional isolated discard of artefacts during travel along a route or pathway. Examples of 'focussed activity' are camping, knapping and heat-treating stone, cooking in a hearth, and processing food with stone tools.

In practical terms, over a period of thousands of years an accumulation of 'unfocussed' discard may result in an archaeological concentration that may be identified as a 'site'. Definitions of background discard comprising only qualitative criteria do not specify the numbers (numerical flux) or 'density' of artefacts required to discriminate site areas from background discard.

background lithic material - natural stone (in the form of pebbles and/or fragments) of types used by Aborigines to make artefacts (such as quartz, tuff, silcrete, chalcedony and quartzite) and occurring in or near a prehistoric archaeological site.

background scatter - can be generally defined as manuport and artefactual material which is *insufficient either in number or in association* with other material to suggest focused activity in a particular location. However, a specific definition of 'background scatter' is inappropriate because it may imply more than simply a pattern of dispersed isolated finds. A less ambiguous terminology is 'background discard' or 'background flux'. (see below).

backing (retouch) - abruptly angled flaking (retouch) which has shaped a thick back part to an implement such as an elouera or microlith. The process of flaking varies from bipolar impact (on some eloueras) to delicate application of pressure with a small stone ('chimbling') used to make microliths.

bending initiation - the commencement of a fracture by the application of a bending load or force, as in breaking a bar of chocolate, where the load is applied away from the point at which the object breaks. Bending initiation is common in the fracture of a tool's cutting edge during its use, and is commonly caused by human treadage at a site. It normally occurs on thin edges (see also 'snap fractures or flakes').

bioturbation - the process of mixing soil materials or sediments by living organisms.

bipolar core - A core (nucleus) that is supported on a stone anvil surface and struck repeatedly with a hammerstone from above. Diagnostic attributes of bipolar fracture damage are point or sinuous ridge type initiation platforms, crushing, cracks, and concentrated overlapping step fractures emanating from areas of hammer impact.

bipolar flake - (and broken bipolar flake) -a flake retaining evidence of bipolar fracture damage on at least one end. Some of these are 'compression flakes' formed by substantial compressive force. A broken bipolar flake has a transversely oriented breakage.

bipolar flaking - a method of making flakes or retouched flake tools by smashing a piece of stone, often a quartz pebble, rested on a stone surface and repeatedly striking the core from above with a stone hammer.

bondi point - A subtype of microlith with abruptly angled backing retouch along one lateral margin (and often the butt end) so that it has an asymmetrical plan shape similar to a pen knife blade but more triangular in cross-section because of a retouched back surface to oppose the cutting edge. This microlith type is commonly found east of the Great Dividing Range as far north as Great Keppel Island. Broken portions are described as proximal, mid-section, and tip sections. This implement is thought to have been a variety of spear barb. Often the tips are broken because they are so delicate (see also 'microlith').

bondi point preform - a microblade or flake that has been partially backed by abruptly angled retouch scars along one lateral margin for the purpose of making a bondi point.

broken flake - A flake with two or more breakages but retaining its area of flake initiation.

chalcedony - a compact variety of silica, formed of quartz crystallites, often fibrous in form and with sub-microscopic pores which contain water (about 1% of weight). Coloured varieties include carnelian (yellow brown), sard (brown), agate (varicoloured) and jasper (red). Chalcedony can form veins or can occur as pseudomorphs, resulting from silica-charged solution infiltrating voids or cavities in rock, sometimes by gradually replacing decaying organic matter. Chalcedony, like fine quality chert, was a valued stone tool material. Mohs hardness always registers within half a point of 7. Chalcedony appears very fine-grained to the naked eye and can be translucent, banded and include a wide variety of colours. This rock type breaks by the process of conchoidal (shell-like) fracture and provides flakes that have sharp durable edges.

chert - a highly siliceous rock type formed biogenically from the compaction and precipitation of the silica skeletons of diatoms. Normally there is a high percentage of cryptocrystalline quartz. This rock type breaks by the process of conchoidal (shell-like) fracture and provides flakes that have sharp durable edges.

classification - An ordering of objects, such as pieces of stone, into smaller groups with specific criteria for inclusion

clast - a grain or crystal with a finer grained matrix (usual in silcrete).

colluvium - an unconsolidated deposit of gravel, sand, mud etc., formed by water flowing across a hillslope surface (slopewash, sheetwash, rainwash) and/or by mass movement. Commonly poorly sorted and stratified.

cobble - waterworn stones of diameter greater than 64 mm (about the size of a tennis ball) and less than 256 mm (about the size of a basketball). Archaeologists often refer to cobbles as pebbles (see also 'pebble').

compression flake - occurs during bipolar flaking, when dynamic compressive force from the vertically orientated hammer blow dominates the fracture process and causes the bipolar core to break into two or three pieces of roughly equal size.

conchoidal flake - a flake created by Hertzian initiation (a cone crack). This is the most common type of flake produced by tool making, but occasionally also occurs in nature. It is distinguished by a partial or complete cone crack and a bulb of force; other fracture surface features are éraillure scar, lances and undulations (see these other glossary entries, and Cotterell and Kamminga 1987, 1992). The inside fracture surface of a well-formed conchoidal flake is similar to that of a bivalve shell, hence the term 'conchoidal'. 'Conchoidal fracture' refers to the process of this flake formation.

concretion and nodules - a mineral forming in isolated aggregates, sometimes as spherical or ellipsoidal forms. Concretions display a concentric zonation of matrix components, whereas nodules display an undifferentiated internal fabric.

cone crack initiation - a Hertzian cone initiation which leads to the formation of a conchoidal flake. A Hertzian cone is similar in shape to the neck of a milk bottle with the top of this cone being the initiation of the circular fracture. On a flake surface the cone is not fully formed and is represented by one side, because the fracture-initiating force was applied from above at an angle of about forty five degrees, not ninety degrees. Other terms in current usage are 'focussed initiation' and 'split cone'.

conjoin analysis - Piecing together or 'conjoining' artefacts helps in reconstructing prehistoric 'events' (such as tool manufacture, tool use activities and cutting-edge rejuvenation), determining chronology and assessing site integrity.

core
(synonymous with nucleus) - a piece of stone, often a pebble or cobble but also quarried stone, from which flakes have been struck for the purpose of making stone tools. (see also 'tabular nucleus'). The core (or core fragment) is generally amorphous in shape. Flakes removed from a core are called 'primary flakes' and may be further shaped by finer flaking, called 'retouch'. The term 'nucleus' refers to cores and flakes or cores that have been retouched.

core rotation - rotation of a core so that another surface is presented from which to initiate fractures that create flakes or blades. Usually this occurs when the previously flaked part of the core because unsuitable for further flake removals. Core rotation may be in any direction. The process may be opportunistic or planned, and is aimed at maximising the number of suitable flakes detached from the core.

cortex - cortex is the weathered exterior of rocks formed by long periods of exposure to chemical and physical weathering. The percentage of cortex remaining on either the dorsal (if limited to the dorsal), the platform (if limited to the platform) or both dorsal and platform (if occurring on both) is recorded in 10% increments. On flaked pieces, cortex is recorded as an estimation of the total surface area covered

cortex type - cortex type varies according to the environment in which it formed and the subsequent processes by which it came to be transported to its current position. Three types of cortex are recorded for all artefacts preserving a cortical remnant. These are angular, rounded and irregular.

cortex initiation face - an initiation surface on a pebble or cobble (see 'cortex' and 'initiation surface).

debitage - commonly used French word for the stone refuse from flaking activity. Usually there is a large quantity of flaking debitage for every finished stone implement.

dendrite - minerals (usually iron compounds, or manganese) deposited from solution in cracks in a stone material.

discard - when referring to lithic scatters the term discard means the incidental, intended and unintended scatter of artefacts on the ground surface or directly into a sediment.

distal portion or end - the end of a flake or microblade (the opposite end to the that of the point of fracture origin on the ventral (or inside) surface. Tabular cortex is the weathered surface of a tabular shaped nucleus (core).

dorsal face/facet - the outside surface(s) of a flake, the inside surface of the flake being one side of the fracture created during the formation of the flake. The speed at which these fracture formed ranges from about 200 metres to over one kilometres a second (see also 'ventral face').

end scraper - A flake with a flat ventral surface and steeply retouched distal end.

Éraillure flake - a secondary flake, always very thin in cross-section, that usually remains attached by a fine bridge of stone to the bulbar surface of a conchoidal negative flake scar. The fine attachment is easily removed by applying a very small force. A negative éraillure scar is left on one side of the bulb of force, which is in the upper part of the ventral surface of the primary flake from which it was detached, and is often referred to as 'bulbar scar'. This flake type has no initiation platform, are round or ovoid in plan view, and are always very thin. This flake type is not significant for the purposes of analysis other than to indicate conchoidal flaking.

flake - (General) a piece of stone detached from a nucleus such as a core. A complete or substantially complete flake of lithic material usually with evidence of hard indenter initiation, or occasionally bending initiation. A general category for substantially complete conchoidal flakes, and rarely bending-initiated flakes. The most common type of flake is called 'conchoidal flake'. In certain circumstances flakes (especially conchoidal flakes) may be the result of natural fracture of stone. The flake's primary fracture surface (the ventral or inside surface) exhibits features such as fracture initiation, bulb of force, and undulations and lances that indicate the direction of the fracture front. Very occasionally a conchoidal flake comprises only a bulb of force (see also 'core', 'fracture initiation', 'bulb or force', 'lances' and 'undulations', and specific flake types).

flake portion - multiple breaks/proximal, distal/longitudinal, indicting the portion of the original flake. Multiple breakages indicates a fragment of a flake exhibiting more than one breakage but still retaining at least some of its initiation area. Proximal portion of a flake is synonymous with 'step-terminated flake'. This variety of flake sustains a breakage at its distal end either because it was detached from the nucleus by a bending force that created a second, transverse break or was broken transversely by a bending force after it was detached (such as when it struck the ground during knapping or subsequently by treadage at the site).

flake fragment - A category comprising flake fragments without areas of fracture initiation but which display sufficient fracture surface attributes (normally conchoidal markings) for identification as a lithic artefact fragment.

flake rotation contact damage - the fine flake scars damage on the distal end of a flake (such as a microlith backing flake) a fraction of a second after it has been created and before it separates fully from the nucleus. This fracturing is caused by the continued application of load or force to the flake as its upper part moves outwards and away from the nucleus.

flaked piece - A flaked piece is defined as any piece of rock clearly derived from the process of conchoidal fracture, but for which no attributes exist to identify it as a core, a flake or any other identifiable technological category.

flake portion - a proximal portion retains the area of flake initiation, a distal portion exhibits a flake termination. Longitudinally broken flakes and ones with an oblique break are also recognised.

flake scraper - A flake with retouch along at least one margin. The character of the retouch strongly suggests shaping or rejuvenation of a cutting edge.

flat - a landform element which is planar or near horizontal; creek flat - flat adjacent to a creek usually a floodplain.

floodplain - valley floor flat adjacent to a stream which is flooded by the 'annual' flood (often considered to be the flood with a recurrence interval of about 1.6 years).

fluvial - pertaining to a stream or river.

fracture or flake initiation - the point or area defining the beginning of a flake-forming fracture (always found at the top of the top of the flake scar or ventral (inside) surface of the flake (see also 'initiation surface').

fresh breakage or fracture - fracturing of a lithic item during archaeological excavation or sieving. Such fracture, which has no adhering sediment or sediment stain, may be caused by trowel, pick, shovel or earth moving machinery.

geometric microlith - a group of microliths distinguished by their various geometric plan-shapes such as triangle, trapeze and rectangle.

geometric microlith (segment) - subtype of microlith with an orange-segment plan shape. This variety may be the most common microlith west of the Great Dividing Range.

heat fracture - fractures cause by heating the stone, either from natural causes, a campfire, or intentional heat treatment. Generally, these are undesirable effects though larger pieces of stone fractured by heat sometimes are used as cores or made into implements because of their convenient shape or size. Attributes indicating heat fracture include colour change, cracking, crazing, potlidding and creation of highly irregular fracture surface topography (often referred to as 'crenation' or 'crenulation'.

hammerstone /anvil - A piece of stone with such evidence of use in the form of diagnostic abrasion and other fracture damage.

heat treatment - the intentional slow heating of stone, such as silcrete, above 300°C to improve its flaking properties.

hertzian cone - see 'Cone crack initiation'

hinge termination - when the end of the flake or fracture continuously turns at ninety degrees to the surface of the nucleus or outside surface of the flake (see also 'retroflexed hinge termination').

indeterminate retouched piece - in artefact or piece of an artefact with retouch along at least one margin. The purpose of this retouch cannot be determined, though some items are probably fragments of microlithic items, scrapers or utilised flakes listed above

implement (of stone) - synonym for a stone tool, usually denoting a tool that has been shaped by flaking (retouch).

initiation - see 'fracture or flake initiation'.

initiation on an arris - commencement point of a flake-forming fracture on a ridge aligned at approximately a right angle to edge of the initiation surface (striking platform).

initiation platform - see 'initiation surface'.

initiation surface - the surface of a stone (sometimes called a platform) that is struck with a hammerstone at low angle for the purpose of detaching a flake. This surface is where a flake-forming crack commences; commonly part of it is retained on the flake. The load applied to this surface may be delivered by a hammerstone or by continuous increasing pressure with a length of dense wood or bone (a pressor or pressure flaking tool).

isolated find - a single stone artefact, not located within a rock shelter, and which occurs without any associated evidence of Aboriginal occupation within a specified radius, such as 60 metres (depending on which archaeological convention is used). This term is normally useful only in the context of surface archaeological survey results and subsurface testing results. Isolated finds may be constituent components of background discard, or indicative of obscured, remnant and disturbed sites.

knapping episode - a series of flaking events (see also 'knapping event')

knapping event - a single act of flaking a piece of stone resulting in the *in-situ* deposition of stone flaking debris. Such an event may occur as part of a series of events

lamination - a fine layer within the matrix of a lithic material. This layer is less than 2 mm thick.

lance **-** a thin, lance-like ridge, usually found in series, on the primary fracture surface of a stone flake. This feature results from a rapid change of direction in the fracture front at the side of the fracture where they meet the surface of the core (nucleus).

lateral margin (of a flake) - the edge along the side of a flake, running from the flake's initiation surface to its termination.

lithic - in an archaeological context, items of a hard, usually siliceous, stone of a type selected by Aborigines for tool making. These items are often nondescript fragments but some also finely shaped implements.

lithic assemblage (of stone) - a collection of whole and fragmentary stone artefacts and manuports obtained from an archaeological site, either by collecting items scattered on the present ground surface (see lithic scatter) or by controlled excavation (see also 'stone artefact').

lithic fragment - a nondescript lithic item that does not have sufficient morphological attributes to identify it as a complete artefact or a portion of an artefact. The lithic fragment category comprises items which are identified only to the level of manuport fragments, even though it contains nondescript flaking shatter and fragments of flakes not individually identifiable as such. Some fragments exhibit attributes characteristic of heat stress, such as occurs during bushfire, hearth fire or intentional heat treatment. Evidence of heat fracture on lithic fragments (and identifiable artefacts) has been recorded in the comments for each entry. Depending on the nature of the cultural sediment and non-Aboriginal land-use practices this group may also contain a small number of non-artefactual fragments exhibiting fresh fracture surfaces.

lithic item -	a piece of stone exhibiting fracture surfaces and not identified as a natural piece of stone.
lithic manuport -	see manuport.
lithic reduction strategy -	see reduction strategy.
manuport -	an object or fragment of an object (called item in this report) carried by human agency to the locality in which it is found.
margin -	(of a stone item) the surface immediately adjacent to an edge, the letter being the intersection of two margins.
microblade -	an elongated (usually conchoidal) flake with one or more longitudinal ridges (arrises) running down the flake's outer (dorsal) face. Technically, they are at least twice as long as they are wide. This variety of flake is detached from a microblade core.
microblade (blade) -	a small elongated stone flake with at least one ridge along the length of its outside surface. Ordinarily they are less than about 50 mm long. Technically, their length is at least twice their width. This variety of flake is detached from a microblade core. Microblades often are of silcrete, chert and quartz. It is believed that most were intended to be knapped into spear barbs. A utilised microblade has evidence of use on its sides or ends. Microblades were first made about 4-5,000 years ago, but most of them may be less than 2000 years old. Microblades are often of chert or silcrete. It is believed that they were fashioned into spear barbs during recent prehistoric times, within the last few thousand year).
microblade broken -	A broken microblade (either proximal or distal portion as specified in the comments)
microblade core -	a small core from which regularly shaped bladelets have been struck. Some microblade cores have only one or two microblade facets; others have numerous facets emanating from more than one initiation surface (striking platform).
microblade portion -	a piece of broken microblade (either proximal, distal or longitudinal portion)
microdebitage -	flaking waste or debris (debitage) up to 10 mm in maximum size. There is no uniform metrical definition of micro-debitage and some archaeologists specify a maximum size of 5 mm.
microlith (synonym 'backed blade') -	a variety of small, delicately retouched implements of various shapes such as asymmetric (bondi) point, segment, crescent, triangle, trapeze, rectangle and oblique ended. These implements are commonly thought to have been spear barbs.
microlith backing flake -	a retouch flakelet pressed off a microlith preform in the process of creating an abruptly angled thick margin (a mode of flaking called 'backing retouch'). This type of flake usually has a slight to pronounced outrépasse (or plunging) termination (Cotterell and Kamminga 1979, 1987, 1992). This termination on such small flakes reveals that the nucleus (the preform) was only a few millimetres high).

microlith preform - a microblade with some degree of initial backing retouch, often along the distal end. Recognised portions are proximal, distal and fragment.

mottles (on stone surface) - masses or blotches of subdominant colours in an area of stone surface.

mottles (in soil/sediment) - masses or blotches of subdominant colours within a soil mass. Often evidence of poor drainage or extensive bioturbation.

mudstone - a sedimentary rock of fine grained quartz and other mineral particles. The term often is used when it is not possible to define the rock more precisely as a claystone, siltstone or shale. Siliceous cement between mud particles provides strength. When completely silicified, the rock will fracture conchoidally (see 'conchoidal flake').

nodules - regular or irregular cemented masses or nodules within the soil. Also referred to as concretions and buckshot gravel. Cementing agents may be iron and/or manganese oxides, calcium carbonate, gypsum etc. Normally formed in situ and commonly indicative of seasonal waterlogging or a fluctuating chemical environment in the soil such as: oxidation and reduction, or saturation and evaporation. Nodules can be redistributed by erosion. (See also 'concretion')

nondescript core or core fragment - A core (or core fragment) of generally amorphous shape.

nucleus - see 'core', 'polyhedral core', 'tabular nucleus'.

outrépasse termination - a flake ending that turns inwards within the nucleus taking off part of its base. This occurs when the fracture front approaches the bottom of a nucleus and must turn in one direction or the other, as the stresses on either side of the fracture front cannot be equal. If the fracture front turns sharply towards in the other direction the flake will terminate in a hinge. A modest to pronounced outrépasse termination is common on microlith backing flakes and occasionally is seen on microblades.

pebble - by geological definition, a waterworn stone less than 64 mm in diameter (about the size of a tennis ball). Archaeologists often refer to waterworn stones larger than this as pebbles though technically they are cobbles.

pH - acidity or alkalinity of soil or water. Expressed in logarithmic units either side of 7 which is neutral, <7 = acid, >7 = alkaline.

pit - a below ground level ('sub-surface') testing location, either excavated by hand and sometimes referred to as a *spade pit* or *shovel pit*, or excavated by machine, such as with a backhoe or machine auger and sometimes referred to as a *trench*.

platform faceting - a series of transverse removal of flakes to set up the platform of a microblade core. These flake detachments create ridges where the margins of the scars meet or overlap, and such ridges provide surface prominences that are the hammerstone's point of contact. These ridges allow for more precise flaking of microblades.

platform preparation - flaking the surface of a core's initiation platform (platform faceting) and removal of any overhanging edge (spur removal) to create a suitable topography and geometry for microblade detachment (see also 'platform faceting' and 'spur removal flake').

polyhedral core (or core fragment) - a core (or core fragment) of generally amorphous shape with flake initiations orientated at different directions.

potlid - A piece of lithic material that has a generally convex or dome-shaped ventral surface, often with evidence of fracture initiation from a location within the surface and not from the edge.

preform - a flake or blade selected for shaping by retouch into an implement. For inclusion in this category an artefact must have some degree of retouch (see also 'retouch' and 'blank').

pressor - a piece of stone, bone or wood used for applying pressure (rather than impact) in the knapping of piece of stone into a tool.

primary fracture surface - One of the two conjoining fracture surfaces created on a nucleus and flake after the flake has detached. The primary fracture surface on the flake is called the ventral surface.

proximal - the top part of a flake beginning with the initiation surface or ridge. It is the same for an implement (or tool). The opposite end of flake is called the distal end.

quarry - a site where stone was obtained by excavation from bedrock with extraction tools of simple design (see also Stone procurement site or place).

quartz - a mineral composed of crystalline silica SiO^2. Quartz is a very stable mineral that does not alter chemically during weathering or metamorphism. It is hard, usually colourless or white ('milky'). In its massive form quartz occurs as geodes or veins, from which pebbles are formed by weathering. Despite the often unpredictable nature of fracture in quartz the flakes often have sharp cutting edges. Quartz is common and abundant, and the Aborigines used it throughout Australia to make convenient light-duty cutting tools.

quartzite - A hard, silica rich stone formed from a sandstone that has been recrystallised by heat (meta-quartzite) or strengthened by slow infilling of silica in the voids between sand grains (orthoquartzite). The essential difference between sandstone and quartzite is that major fracture will propagate around the larger grains in sandstone and through the grains in quartzite.

Quaternary - The most recent geological time period. Divided into the Holocene and the Pleistocene. Began 1.8 million years ago (see also 'stone procurement site').

rainwash - downslope movement of soil materials or sediment in raindrop agitated surface flow of water.

redirecting flake - redirecting flakes usually take the form of a long narrow flake, somewhat similar too a normal microblade but with flake scars in series along one or both sides of the dorsal (outside) face of the flake or blade which are oriented at 90° to the direction of the primary fracture surface (the ventral face). These series of dorsal scars may or may not have fracture initiation areas and therefore must have been struck along a margin of the core, others have none.

reduction process - the process of removing flakes from a core, or of manufacturing an implement by flaking and/or grinding, or progressively rejuvenating a tool's working edge.

reduction strategy - strategy of flaking and/or grinding a piece of stone in predetermined stages to produce an implement.

rejuvenation flake - see 'edge rejuvenation flake'.

residues on stone tools - residue analysis concerns the identification of tool use activities from preserved organic and inorganic residues of worked materials. These residues may be compacted into small flake scars on the edges of utilised artefacts or adhere strongly to their surfaces. Routine examination of residues is aided by low-magnification microscopy.

retouch or retouching - an area of flake scars on an artefact resulting from intentional shaping, resharpening, or rejuvenation after wear or breakage. In resharpening a cutting edge the retouch is invariably found only on one side (see also 'indeterminate retouched piece', retouch flake' etc).

rhyolitic tuff - indurated rhyolitic tuff, often misidentified as indurated mudstone or chert in previous archaeological consulting reports. Rhyolitic tuff is a lithified volcanic ash (fine dust) showing good conchoidal fracture. This lithic material was favoured by the Aborigines of the Hunter Valley and the Sydney Basin regions. Commonly the stone is grey in colour but a range of surface and matrix colouration is the result of mineral charged water. White and red colouration is sometimes the result of heating, which occurs when pieces of the stone are in a hearth or when a bushfire sweeps though a former camping ground (see also 'mudstone').

ring crack - the circular or semicircular crack from which a Hertzian cone crack grows.

sandstone - a cemented or compacted rock consisting of detrital grains which range in size from 2 mm. Because of its chemical stability quartz often comprises the majority of the grains. The nature of the cement is denoted by terms such as argillaceous (clayey), calcareous, ferruginous and tuffaceous sandstone.

sieve damage - fracture damage on lithic items caused by abrasive contact with the sieve mesh during the process of sieving. This occurs more commonly with wet sieving of clayey sediment.

silcrete - (also known as 'porcellanite' and 'grey billy') A hard, fine grained siliceous stone flaking properties similar to quartzite and chert. It is formed by the cementation and/or replacement of bedrock, weathering deposits, unconsolidated sediments, soil or other material by a low temperature physico-chemical process. Silcrete is essentially composed of quartz grains cemented by microcrystalline silica (SiO^2). Mineral composition is highly variable, but it comprises more than 85% silica, and includes aluminium, iron and titanium in small but significant amounts. The bonding matrix is often composed of microcrystalline quartz or chalcedony. Clasts are most often quartz grains but may also include chert or chalcedony or some other hard mineral particle. Mechanical properties and texture are equivalent to the range exhibited by chert at the fine-grained end of the scale to silcrete at the coarse-grained end. Silcrete is used by Aborigines for stone tool manufacture throughout most of Australia.

site integrity - the degree of post-depositional disturbance to a site.

size class of artefact - Artefact size is the maximum size (diameter) in any direction as measured on a grid, and is recorded in size categories numbered from 1 to 4 or higher as applicable:

snap fracture - a variety of bending fracture seen on acute edges of stone artefacts. The fracture mechanics forming these breakages is the same as when breaking a bar or chocolate. They occur both in tool use and accidentally in many different circumstances

spit - an arbitrary interval of excavated depth in an archaeological excavation, such as in: spit 2 was the layer of deposit excavated between 10 and 20 cm below ground level.

step terminated fractures - breakages in stone where the end is formed by a second fracture orientated at about ninety degrees to the primary fracture forming the flake scar.

step-terminated flake - A flake with an abrupt right angle termination. There are two varieties of step-terminated flakes – one where the flake has snapped transversely, and the other where a separate subsequent fracture has propagated at ninety degrees to the first.

stone artefact - a piece or fragment of stone showing evidence of intentional human creation or modification.

stone layer - a sheet or layer of gravel sized materials found within a body of soil material. Commonly formed at the lower limit of bioturbation and often contains a concentration of artefacts.

stone material - (synonymous with 'lithic material', 'stone type' and 'raw material' which is a less specific but commonly used term).

stone procurement place (or site) - a place where stone is obtained for making into artefacts. As a prehistoric site type in Australia, stone procurement places range on a continuum, from pebble beds in watercourses (where there may be little or no archaeological evidence of human activity) to extensively quarried outcrops of bedrock where there is clear evidence of procurement activity, such as quarry pits, discarded hammerstones and large consolidated cultural deposits of primary flaking debris. (See also quarry) stone tool - a piece of flaked or ground stone used in an activity or fashioned for use as a tool. A synonym of stone tool is implement, which is more often used by archaeologists to describe a flake tool fashioned by more delicate flaking (retouch).

technological attributes analysis - methods of reconstructing reduction sequences in stone technology (see reduction sequence). Discrete and metrical attributes of artefacts are identified, recorded and examined mathematically.

termination (of a flake) - the distal end.

thermal shatter - see 'heat fracture'.

tuff - lithified volcanic ash.

use fractures - breakages on the edges of stone tools resulting from tool use (see also 'use-wear').

use-wear - microscopic and macroscopic damage to the surfaces of stone implements resulting from its use. Routine examination for use-wear is aided by low-magnification microscopy. Major use-wear forms are edge fractures, use-polish and smoothing, abrasion, and edge rounding and bevelling.

ventral face - the inside surface of a flake created during the flake's formation. The speed of the fracture ranges from about 200 metres to over one kilometre per second (see also 'dorsal face').

volcanic stone - rock types formed by volcanic activity display a wide range of mechanical and flaking properties. Freshly fractured volcanic stone tends not to have fine, durable edges suitable for cutting. Only a few types are utilised for making stone tools, often ones that are shaped by grinding.

working edge - the edge of a tool in contact with the worked substance or material during its usage.

APPENDIX 5

HUMAN ACTIVITIES INDICATED BY THE LITHIC ITEMS RECOVERED FROM TEST PITS

Area 3

Nature of Human Activity	Pit Number										
	1	2	3	4	6	7	8	10	11	12	13
human presence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)					✓		✓			✓	✓
generalised stone knapping	✓	✓						✓	✓		✓
microblade production		✓									✓
discard and probable on-site use of stone implement											

Area 4

Nature of Human Activity	Pit Number							
	3	10	13	16	17	18	19	20
human presence	✓	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)	✓		✓	✓				
generalised stone knapping		✓					✓	✓
microblade production			✓	✓				
discard and probable on-site use of stone implement								

Area 5A

Nature of Human Activity	Pit Number	
	7	8
human presence	✓	✓
heat shatter (either natural or cultural cause)		✓
generalised stone knapping	✓	✓
microblade production		
discard and probable on-site use of stone implement		

Area 5B

Nature of Human Activity	Pit Number
	1
human presence	✓
heat shatter (either natural or cultural cause)	
generalised stone knapping	✓
microblade production	
discard and probable on-site use of stone implement	

Area 5C

Nature of Human Activity	Pit Number			
	3	5	7	9
human presence	✓	✓	✓	✓
heat shatter (either natural or cultural cause)		✓	✓	
generalised stone knapping	✓			
microblade production	✓			✓
discard and probable on-site use of stone implement				

Area 6

Nature of Human Activity	Pit Number								
	3	5	6	7	9	15	16	27	29
human presence	✓	✓	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)				✓		✓	✓		✓
generalised stone knapping		✓	✓		✓		✓		
microblade production	✓	✓	✓		✓		✓	✓	✓
discard and probable on-site use of stone implement								✓	

Area 7

Nature of Human Activity	Pit Number		
	1	22	37
human presence	✓	✓	✓
heat shatter (either natural or cultural cause)			✓
generalised stone knapping	✓	✓	
microblade production	✓		
discard and probable on-site use of stone implement			

Area 8

Nature of Human Activity	Pit Number									
	1	7	11	13	15	16	19	22	24	32
human presence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)		✓	✓	✓					✓	
generalised stone knapping	✓					✓				✓
microblade production										
discard and probable on-site use of stone implement										

Area 9

Nature of Human Activity	Pit Number						
	7	8	9	13	14	16	17
human presence	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)	✓	✓		✓		✓	✓
generalised stone knapping			✓	✓		✓	✓
microblade production			✓		✓	✓	
discard and probable on-site use of stone implement			✓				

Area 10

Nature of Human Activity	Pit Number					
	1	2	3	4	5	6
human presence	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)	✓	✓	✓	✓	✓	✓
generalised stone knapping	✓	✓	✓	✓	✓	✓
microblade production	✓	✓		✓	✓	
discard and probable on-site use of stone implement					✓	✓

Area 11

Nature of Human Activity	Pit Number						
	1	2	4	6	8	9	12
human presence	✓	✓	✓	✓	✓	✓	✓
heat shatter (either natural or cultural cause)		✓	✓	✓	✓	✓	
generalised stone knapping	✓	✓	✓	✓	✓	✓	✓
microblade production							✓
discard and probable on-site use of stone implement							✓

APPENDIX 6

TABLES SHOWING ARTEFACT DENSITY PER PIT

TEST AREA 3

Pit	Spit	Artefact No.	Density (m²)
1	1	1	1.053
2	1	6	6.318
3	1	1	1.053
4	1	2	2.106
6	2	1	1.053
7	1	1	1.053
8	1	1	1.053
10	2	1	1.053
11	1	4	4.212
11	2	2	2.106
12	2	1	1.053
13	1	4	4.212

TEST AREA 4

Pit	Spit	Artefact No.	Density (m²)
3	2	4	4.212
10	1	1	1.053
13	1	2	2.106
13	2	4	4.212
16	2	4	4.212
17	2	1	1.053
20	2	1	1.053
21	1	1	1.053
22	2	2	2.106

TEST AREA 5A

Pit	Spit	Artefact No.	Density (m²)
7	2	1	1.053
8	1	3	3.159

TEST AREA 5B

Pit	Spit	Artefact No.	Density (m²)
1	1	1	1.053

TEST AREA 5C

Pit	Spit	Artefact No.	Density (m²)
3	1	4	4.212
5	1	2	2.106
7	1	1	1.053
9	1	1	1.053

TEST AREA 6

Pit	Spit	Artefact No.	Density (m²)
3	1	1	1.053
5	1	3	3.159
6	1	2	2.106
7	1	1	1.053
9	1	2	2.106
15	1	1	1.053
16	1	28	29.484
16	2	4	4.212
16	3	1	1.053
27	1	3	3.159
29	1	1	1.053

TEST AREA 7

Pit	Spit	Artefact No.	Density (m²)
1	1	1	1.053
1	2	3	3.159
22	1	1	1.053
37	1	1	1.053

TEST AREA 8

Pit	Spit	Artefact No.	Density (m²)
11	1	2	2.106
13	1	2	2.106
15	1	1	1.053
16	1	1	1.053
19	1	5	5.265
22	1	1	1.053
24	1	1	1.053
32	1	1	1.053
1	1	1	1.053
7	1	1	1.053

TEST AREA 9

Pit	Spit	Artefact No.	Density (m²)
8	1	1	1.053
8	2	1	1.053
7	2	1	2.106
9	1	2	1.053
9	2	1	2.106
9	3	1	3.159
13	1	1	1.053
14	1	1	1.053
16	2	3	3.159
16	3	1	1.053
17	3	1	1.053

TEST AREA 10

Pit	Spit	Artefact No.	Density (m²)
1	1	1	1.053
1	2	9	9.477
2	1	7	7.371
2	3	8	8.424
3	1	1	1.053
3	2	1	1.053
3	3	1	1.053
4	1	2	2.106
4	3	6	6.318
4	2	2	2.106
4	4	1	1.053
5	2	1	1.053
5	3	5	5.265
5	5	1	1.053
6	2	2	2.106
6	3	4	4.212

TEST AREA 11

Pit	Spit	Artefact No.	Density (m²)
1	3	1	1.053
2	1	10	10.53
4	2	7	7.371
6	1	3	3.159
6	2	3	3.159
8	1	1	1.053
9	1	5	5.265
9	2	2	2.106
12	1	9	9.477

APPENDIX 7

SUMMARY OF PIT DATA AND

SOIL PROFILE DESCRIPTIONS

TEST AREA 3

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-13	Turf and topsoil to 11 cm – consisting of brown friable soil over dark soil.
	2	13-27	Dark brown compact soil to top of clay layer.
	3	27-37	Clay layer to base of pit.
2	1	0-27	Turf to 3 cm top soil of dark brown friable soil to 27 cm.
	2	27-38	Dark brown top soil to top of clay layer.
	3	38-45	Loose clay to compact clay base of yellow dark brown mottled clay.
3	1	0-14	Turf to 3 cm over dark brown friable soil to 14 cm.
	2	14-26	Dark brown compacted soil 14-18 cm over clay to base, consisting of light brown/orange mottled clay.
4	1	0-16	Turf to 2 cm over dark brown moist soil/clay mixture.
	2	16-36	Soil/clay mixture to dark brown/orange clay base.
5	1	0-13	Turf to 3 cm over dark brown friable soil.
	2	13-28	Dark brown soil to 25 cm over clay base at 28 cm, consisting of orange clay.
6	1	0-18	Turf to 3 cm over light brown friable soil to 18 mm over beginning of clay.
	2	18-27	Top of clay to clay base of pit consisting of dark brown/yellow clay.
7	1	0-15	Turf to 2 cm over dark brown friable soil to 1 cm over beginning of clay (dark brown).
	2	15-22	Dark brown soil over dark brown/orange mottled clay to base of pit.
8	1	0-9	Turf to 2 cm over dark brown friable soil.
	2	9-18	Dark brown/orange mottled clay to base of pit.
9	1	0-16	Turf to 2 cm over dark brown friable loam to top of clay layer.
	2	16-23	Dark brown/orange clay to base of pit.
10	1	0-12	Turf to 2 cm over dark brown friable soil over beginning of dark brown clay.
	2	12-17	Dark brown clay to base of pit.
11	1	0-8	Turf to 1 cm over dark brown friable soil.
	2	8-15	Dark brown/light brown clay to base of pit.

Pit Number	Spit Number	Depth (cm)	Description
12	1	0-5	Turf to 1 cm over dark brown friable soil.
	2	5-13	Clay to base of pit (dark brown/orange mottled clay).
13	1	0-8	Turf to 1 cm over dark brown friable soil to 8 cm.
	2	8-18	Clay (dark brown/yellow mottled clay) to base of pit.

TEST AREA 4

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-20	Topsoil of fine silty brown loam to 9 cm then a grey silty loam with some clay and gravels (ironstone).
	2	20-28	Continues the grey brown gravelly soil – silty with increased clay content with depth – becoming more clayey (yellow) base.
	3	28-30	Down onto hard and compact red clay – some minor ironstone. Very difficult to extract deposit.
2	1	0-12	Topsoil of a brown loam to 8 cm then onto a grey brown silty loam with some minor gravels – ironstone.
	2	12-24	Continues the same mottled grey brown silty soil with increased clay with deposit – base of pit is more grey red clay – speckled with ironstone and some minor charcoal.
	3	24-29	Down onto red clay from about 27 cm.
			• Note: Located about 10 m from spring dam on creek line.
3	1	0-21/30	Topsoil of brown loam – some humic matter depth of 9 cm then a brown silty soil with some minor ironstone gravels. Tree roots present.
	2	30-38	Soil continues - same pale brown, slight increase in clay roots still present.
	3	38-44	Some pale brown silty soil – onto the red mottled clay from 40 cm. Some ironstone and charcoal specks.
4	1	0-14	Topsoil of dark brown humic loam to 5 cm then into pale grey brown mottled fine silty loam – some very small ironstone gravels.
	2	14-23	Soil continues – possibly increase in clay and gravels slightly more yellow in colour.
	3	23-30	Down onto the red/yellow mottled clay – comes in at about 26 cm.
5	1	0-15	Top 5 cm is brown loam then onto a pale brown silty soil – some minor ironstone.

Pit Number	Spit Number	Depth (cm)	Description
	2	15-21	Down onto brown red clay at about 17 cm. Mottled – some root matter and charcoal.
6	1	0-19	Almost no topsoil – onto a brown clay from the start. Mottled clay layer from 12 cm – upper section is loamy clay.
			Located only 3-4 m from creek bank.
7	1	0-14	Brown loamy clay to about 5 cm then onto a brown clay deposit. Increase in clay with depth.
8			Brown clay
9	1	0-7	Turf to 1 cm over light brown friable soil almost to top of clay layer.
	2	7-16	Clay (light brown/yellow mottled colour) to base of pit.
10	1	0-5	Turf to 1 cm over light brown friable soil to top of clay layer.
	2	5-15	Light brown/yellow mottled clay to base of pit.
11	1	0-11	Turf to 2 cm over dark brown friable loam to 11 cm.
	2	11-18	Compacted dark brown loam/clay to top of natural clay layer.
	3	15-26	Light brown/yellow clay to base of pit.
12	1	0-11	Turf to 2 cm over dark brown friable topsoil to top of dark brown clay (compacted soil) layer.
	2	11-18	Compacted soil (dark brown semi-friable) to loose clay to 18 cm.
	3	18-28	Clay (light brown/yellow mottled colour) to base of pit.
13	1	0-8	Turf to 1 cm of light brown friable soil – to top of clay/compacted soil layer.
	2	8-18	Light brown clay to base of pit with some charcoal specs showing through.
14	1	0-8	Turf to 1-2 cm over yellow clay to base – only 2-3 cm of degraded soil over clay.
15	1	0-7	Turf to 1 cm over light brown friable soil to clay layer of light brown/yellow clay at base of pit.
16	1	0-7	Turf to 1 cm over loose friable brown soil for approximately 3-5 cm over compacted soil/clay.
	2	7-18	Light brown clay to base of pit.
17	1	0-7	Turf to 3 cm over dark brown friable loam to 7 cm.
	2	7-17	Dark brown clay to base of pit.

Pit Number	Spit Number	Depth (cm)	Description
18	1	0-12	Turf to 1 cm over light brown friable soil to 5cm over light brown clay to base of pit.
19	1	0-14	Turf to 2 cm over loose light brown friable soil to 10 cm over light brown/orange mottled clay to base of pit.
20	1	0-12	Turf to 2 cm over dark brown friable soil to 10cm over dark brown compacted soil/clay.
	2	12-20	Light brown clay to base of pit.
21	1	0-12	Turf to 2 cm over loose, friable dark brown soil to 11 cm over dark brown compacted soil/clay.
	2	12-23	Dark brown clay to base of pit at 23 cm.
22	1	0-10	Turf to 1 cm over dark brown friable soil 7 cm over compacted dark brown soil/clay to 10 cm.
	2	10-19	Dark brown clay to base of pit.
23	1	0-13	Turf to 2 cm over dark brown, friable topsoil to 13 cm.
	2	13-19	Dark brown compacted soil/clay and dark brown clay to base of pit.
24	1	0-13	Turf to 2-3 cm over dark brown friable soil to 13 cm.
	2	13-22	Dark brown clay to base of pit.
25	1	0-14	Turf to 3cm over dark brown friable soil to 12 cm over compacted soil/clay.
	2	14-23	Dark brown clay from 14 cm to bottom of pit.
26	1	0-13	Turf to light brown friable soil to 11 cm over darker brown compacted soil to 13 cm.
	2	13-21	Dark brown compacted soil to brown/orange mottled clay to base of pit at 21 cm.

TEST AREA 5A

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-5	Turf to 3 cm over light brown friable soil to 4 cm grading quickly to clay of mottled light brown and orange.
2	1	0-13	Turf to 3 cm over dark brown friable soil grading to dark brown compacted soil.
	2	13-21	Dark brown compact soil grading to dark brown heavily compact clay.

Pit Number	Spit Number	Depth (cm)	Description
3	1	0-12	Turf to 3 cm over dark brown friable soil grading to clay of mottled light brown and orange.
	2	12-80	Dark brown and orange mottled clay grading to yellow/mustard coloured clay at base.
4	1	0-10/16	Brown 'loam' to 8 cm grading to a hard clayey red and brown mottled 'loam'.
5	1	0-15	Brown loam to 5 cm grading to a gravelly friable brown clayey 'loam'.
	2	15-20	Mottled reddish brown clay containing small sized ironstone.
6	1	0-16	Grey brown silty 'loam' to about 5 cm grading to a more clayey 'loam', contains some ironstone gravel.
	1	16-20	Increasing clay content, speckled with ironstone and minor amounts of charcoal.
7	1	0-16	Grey brown silty 'loam', contains some minor gravels, grades into a grey brown silty 'loam' with a slight increase in clay towards the base.
	2	16-21	Friable grey/brown 'loam' with gravels to c.18 cm, gravel content increases with speckles of ironstone, colour more a yellow/brown.
	3	21-70	Light brown mottled orange clay.
8	1	0-18	Grey brown 'loam' to 4 cm grading to a gravelly clayey 'loam' containing ironstone.
	2	18-20	Mottled grey and brown clay with a higher clay content, ant holes evident in base of spit.
9	1	0-16	Red clay with a very minor topsoil layer, charcoal present.
10	1	0-15/20	Brown 'loam" and clay mixed topsoil grading into a yellow clay. Scattered burnt patches.
11	1	0-13	Grey/brown loam to c. 2-5 cm over a red clay.
12	1	0-16	Grey/brown 'loam' to 11 cm grading into yellow/red clay.
13	1	0-16/26	Brown 'loam' topsoil to about 8 cm grading into a very hard red clay, less ironstone evident in the spit than in lower pits.
14	1	0-11	Brown 'loam' topsoil to 8 cm grading into a red clay, roots in the base of the spit, some charcoal also present.
15	1	0-17	Brown 'loam' topsoil to 11 cm grading into a brown/red clay.
16	1	0-17/23	Reddish brown clayey 'loam' to 12 cm, most of the topsoil has been eroded, grades into a solid red clay from a transition of brown/red clay.

TEST AREA 5B

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-10	Turf to 3 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.
	2	10-50	Bands of orange/brown clay to base.
2	1	0-10	Turf to 3 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.
3	1	0-10	Turf to 3 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.
	2	10-70	Clay to base.
4	1	0-14	Turf to 3 cm grading quickly to clay of mottled light brown and orange.
5	1	0-18	Turf to 3 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.

TEST AREA 5C

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-18	Turf to 3 cm grading quickly to clay of mottled light brown and orange.
2	1	0-5	Turf to 3 cm grading quickly to clay of mottled light brown and orange.
3	1	0-6	Turf to 1 cm grading quickly to clay of mottled light brown and orange.
	2	10-50	Light/dark brown clay to base.
4	1	0-14	Turf to 1 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.
5	1	0-14	Turf to 3 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.
6	1	0-10	Turf to 3 cm over light brown friable soil grading to light brown and orange mottled clay.
7	1	0-10	Turf to 1-3 cm grading quickly to clay of mottled light brown and orange.
8	1	0-13	Turf to 3 cm over brown friable soil to 10 cm grading to clay.
	2	13-25	Light brown friable soil grading to clay of mottled light brown and orange.
9	1	0-16	Turf to 3 cm over light brown friable soil grading of light brown and orange mottled clay.

Pit Number	Spit Number	Depth (cm)	Description
10	1	0-13	Turf to 3 cm over light brown friable soil grading of light brown and orange mottled clay.
11	1	0-18	Turf to 3 cm over light brown friable soil grading of light brown and orange mottled clay.

TEST AREA 6

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-10	Light brown sandy loam, moderate clay and little humic content. Crumbly texture; yellow/red podsolic clay at approximately 7.5 cm depth. About 75% clay, 20% loam, minimal humic content. Still within root zone, some ant activity an associated disturbance.
2	1	0-10	Crumbly red/brown loam. Predominantly loam with approximately 10% clay, little humus; red/yellow podsolic clay at approximately 7.5 cm depth. About 75% clay, with patchy humic inclusions. Still in root zone. Some animal disturbance in form of ant activity.
3	1	0-14	Light brown sandy loam with very low humic content. Crumbly texture. Red/yellow podsolic clay layer at 9.5cm with approximately 75% clay, 25% sand, little humic content, chiefly in patchy distribution associated with charred tree roots. Still in root zone, some evidence of past mud cracks with sandy infill. Soil disturbance in the form of ant activity.
4	1	0-14	Light brown sandy loam with crumbly texture. Mostly sand with moderate clay wand little humic content. Orange/red clay with crumbly texture at approximately 7 cm. 75% clay, about 20% sand with very little humic content. Some disturbance by ant activity.
5	1	0-15	Light brown sandy loam with crumbly texture; 60% sand, 39% clay and little humic content. Orange/red podsolic clay layer commencing at approximately 8.5 cm depth. Crumby texture with approximate clay content 75%, approximately 24% sand with patchy humic content apparently associated with tree roots. Some soil disturbance due to ant activity. B horizon commences at approximately 5cm depth towards Eastern end of pit.
6	1	0-16	Very light, sandy soil, very fine grained, loosely packed and slightly lower in humic content than the same horizon in pits 1-5. Some fine gravels.
	2	16-26	Very crumbly, relatively loosely packed yellow/orange podsolic clay layer commencing at approximately 20 cm depth. Clay layer grades from sandy layer to predominantly sandy soil with yellow/orange clay nodules to a yellow/orange clay.

Pit Number	Spit Number	Depth (cm)	Description
7	1	0-16	Light orange brown sandy loam. Gradation from topsoil through same soil type with nodules of orange clay to an orange clay base level. B horizon commences at approximately 13 cm depth. Some soil disturbance, the result of ant and insect larvae activity as well as tree roots from nearby eucalypts.
8	1	0-7	Light brown/orangey sandy loam; very fine grained, silty texture.
8	2	7-20	Light orange podsolic clay layer commencing at approximately 15 cm depth. Some gradation from A to B, though to a lesser extent than in pits 6 and 7.Significant soil disturbance within clay layer to centre and South West of pit due to ants nest. Some associated disturbance within rest of pit.
9	1	0-17	Light brown sandy loam, fine grain, crumbly texture. Orange podsolic clay commencing at approximately 11cm depth at south-eastern end of pit, grading down to commencement at approximately 15 cm at centre of North East face of pit. Some gradation of increased clays interspersed with topsoil towards horizon B. Some disturbance by ant activity.
10	1	0-20	Orangey/ brown sandy loam with crumbly texture. Scant fine gravels. Gradation into B horizon with increase in orange clay content from 1 cm depth to a clay base level at approximately 16 cm depth. This layer is a crumbly orange sandy/silty clay. Soil disturbance due to ant/insect activity.
11	1	0-15	Orangey/brown sandy loam with a crumbly texture and tendency to clump/clod (?). Gradual increase in clay content from approximately 9.5 cm depth to B horizon – base clay layer at depth approximately 12 cm. Root zone extends to about 11 cm. Clay is orangey red and crumbly of texture. Some soil disturbance.
12	1	0-12	Red/brown silty loam with some reedy/orange clay nodules and a crumbly, clumpy texture. A slight gradation of yellow-orange clay within the silty loam down to an orange/red clay base level commencing at depth of approximately 11 cm. Root zone extends to depth approximately 10 cm with some onion grass bulbs. Some tree roots and ant activity at base of pit.
13	1	0-10	Light brown sandy loam, loosely packed with a crumbly texture. Root zone extends to approximate depth of 8 cm. Some burnt tree roots at base of spit. Distinct A2 horizon at depth approximately 8 cm with texture change to less crumbly, more silty or fine grain sandy texture in same light brown sandy loam.
	2	10-20	Orange/red clay layer at depth approximately 19.5 cm. Little gradation. Rather, a relatively clean, clear distinction in sediment type. Much disturbance by ants.
14	1	0-10	Yellow brown sandy loam with sandy to crumbly texture. Occasional cobble-sized shaley stones within top approximate 6 cm.

Pit Number	Spit Number	Depth (cm)	Description
	2	10-20	Gradation of increasing clay from approximately 10 cm depth to a hard-packed red clay layer commencing at depth approximately 18 cm. Considerable disturbance for entire depth of pit by ants nest.
15	1	0-10	Light brown sandy loam with crumbly texture. Changes to a more compacted, sandy texture; A2 average depth 6cm, range 5-7 cm.
	2	10-20	Gradation of increasing orange clay from approximate depth 9 cm to packed orange/red clay base at depth approximately 17 cm. Some disturbance by ants.
16	1	0-5	Very light brown leached sandy loam. Sandy texture.
	2	5-10	Light brown sandy loam with crumbly texture.
	3	5-10	Gradation of clay content from depth approximately 7 cm to solid B horizon – clay base level at depth approximately 13.5 cm. Orange clay soil, crumbly in texture.
17	1	0-15	Very light brown sandy loam with crumbly texture. A2 horizon commences with the same material or very similar, though sandier texture and ostensibly more heavily compacted. Both levels contain intermittent near-cubic approximately 5 mm maximum gravels.
	2		B commences at approximate depth 24 cm after gradation of increasing orange clay content at approximate depth 10 cm. B horizon with crumbly orange clay. No more gravels as in A1 and A2.
18	1	0-10	Light brown sandy loam with crumbly texture; gradual increase in clay content commencing at depth approximately 10 cm. A2 comprises similar soil to A1 but with slightly sandier/siltier texture. Some discrete charcoal fragments within clay/loam mixture zone of A2.
	2	10-20	B commences at depth approximately 20 cm as a dark orange clay layer. Some insect activity.
19	1	0-15	Very light brown sandy loam with clumpy, crumbly texture. Transition to a sandier consistency of sandier soil type, sandy/silty texture.
	2	15-20	B horizon commences at approximate depth 17 cm after gradual increase in clay content from depth approximately 13 cm. this layer an orange clay soil with slightly crumbly texture.
20	1	0-20	Very shallow, darker brown, slightly sandy loam with clumpy, crumbly texture. Grades quickly into B horizon of red orange clay at depth approximately 2.5 cm. Some insect activity causing soil disturbance.
21	1	0-15	Brown loam with clumpy, crumbly texture. Grades in from depth approximately 11 cm with increasing clay content to an orange clay layer at depth approximately 14.5 cm.
22	1	0-15	Light brown sandy loam with crumbly texture. Slightly compacted with a tendency to clump.

Pit Number	Spit Number	Depth (cm)	Description
	2	Sand fill feature	Commences at approximate depth 8 cm with sandier texture to similar brown sandy loam. With a gradual increase in clay content from depth approximate 12 cm this layer ceases with B horizon of orange clay, again with a crumbly texture indicating the presence of sand in the clay-rich matrix. Extending from Southern wall of pit towards the North West was a very light (leached) compacted sandy feature measuring approximately maximum 50 x 60 cm, aug depth 26 cm. Scattered within this sandy matrix are discrete fragments of charcoal and occasional nodules of compacted clay. • Most likely the feature is the result of a burning event of a fallen tree, creating a hollow which has been subsequently infilled by fine, sandy sediment with some porous and weathered ironstone or similar gravels.
23	1	0-20	Brown sandy loam with crumbly texture. Interspersed with angular gravels (maximum 5 mm). Small degree of gradual clay increase towards a B horizon – red orange clay layer at approximate 14 cm depth.
24	1	0-17	Light brown sandy loam with crumbly texture. Some angular gravels of varying size, maximum 7 x 5 mm. Yellow/orange clay layer commencing at depth approximately 16 cm. Has crumbly texture and has had some disturbance by insect activity.
25	1	0-15	Light brown sandy loam with crumbly texture. Moderate disturbance due to insect and tree root activity. B horizon commences at approximate depth 15 cm with slight increase in clay from approximate depth 13 cm. This layer is an orange clay with crumbly texture.
26	1	0-15	Light brown sandy loam with crumbly texture, relatively loosely compacted over slightly more compacted brown silty/sandy loam at 9cm. Then orange clay layer commencing with only slight gradation of increased clay content from depth approximate 14 cm to a crumbly clay layer at approximately 15 cm. Some charcoal fragments most likely associated with burnt tree roots, consistent with modern tree root activity. Also some disturbance due to ant activity.
27	1	0-15	Brown silty/sandy loam, crumbly texture, grass root activity to depth approximately 10 cm. Gradation of orange clay content from approximate depth 8.5 cm to packed clay layer marking B horizon at depth approximately 10.5 cm. Clay layer crumbly of texture and clumps of tightly packed and very hard clay pellets in vicinity of copious ant nesting activity.
28	1	0-14	Light brown sandy loam with crumbly texture. Increasing clay content from depth approximately 8 cm towards dark orange packed clay layer marking the B horizon at depth approximately 12 cm. Some disturbance by ant activity. Some discrete charcoal fragments maximum 7 mm concentrated in transition from A to B.

Pit Number	Spit Number	Depth (cm)	Description
29	1	0-17	Light red brown sandy loam. Increasing clay content from depth approximately 10 cm towards packed red orange clay base forming the B horizon. Within transitional clay/loam section there are broken, weathered silty, flat cobbles maximum length 10 cm.
30	1	0-17	Light brown sandy loam with crumbly texture extending to depth of approximately 10 cm. Here a gradation of increased clay content commences towards base. B Horizon – commences at approximate depth of 17 cm as hard packed light orange clay layer. Some disturbance by roots of nearby trees. Some charcoal fragments most likely resulting from prior burning of earlier tree roots. Sparse distribution of small almost cubic gravels.

TEST AREA 7

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-10	Brown 'loam' with some small gravels grades quickly into a yellow clayey layer.
	2	10-17	Grades quickly into a reddish clay at c. 13 cm with some charcoal present in small patches.
2	1	0-13	Red clay, almost no A horizon.
4	1	0-14	Hard brown clayey 'loam' to 6-7 cm then grades quickly to red clay.
5	1	0-14	Brown clayey 'loam' to 2-3 cm then grades quickly to very hard and dry red clay.
7	1	0-24	Brown 'loam' to 6 cm grades quickly to a brown/red clayey layer with some dark staining then into a red clay at 17 cm. There is some variability in the colour of the clay from red to brown/red.
8	1	0-15	Brown clayey loam to 7 cm then grades quickly into a brown clay.
9	1	0-10	Dark brown 'loam' to 3 cm grades quickly to a grey brown siltier 'loam'. Some faint traces of red clay at base.
	2	10-17	Grey brown silty loam, red clay more obvious in base.
	3	17-24	Grades quickly to a red clay at 18-20 cm, variation in colour from red to yellow. Charcoal present in base.
11	1	0-7/13	Brown 'loam' to 1-2 cm then grades quickly into red clay.
12	1	0-10	Light brown silty 'loam' with minor clay content, parts of spit are a yellow (burnt?) silty clay, traces of red clay at base.
	2	10-23	Same as above until c. 12 cm then grades quickly to clay, red to yellow colour variations.

Pit Number	Spit Number	Depth (cm)	Description
14	1	0-16	Brown 'loam' to c. 10 cm grades quickly to a firmer brown/yellow clayey silty 'loam'. Some iron stone present.
	2	16-25	Yellow clay, bioturbation from ant activity and roots, ironstone visible in profile at 15 cm, some flecks of charcoal.
15	1	0-13	Brown 'loam' to 10 cm grades quickly into an orange/red clayey soil, ants and roots present.
	2	13-28	Becomes a solid clay at about 15-16 cm, some ironstone gravels present at interface, ants continue.
17	1	0-8	Light yellow/brown silty 'loam', flecks of charcoal and roots present.
	2	8-15/18	Same as above.
	3	15/18-26	Grades quickly to a solid red clay at about 18cm.
18	1	0-10	Red/brown clayey 'loam', ant activity.
	2	10-13/20	Continues as above, appears to be B horizon.
19	1	0-11/17	Brown clayey 'loam', grades to a red/brown clay, topsoil is only 1-2 cm deep.
20	1	0-13/21	Brown 'loam' to 2-5 cm over a brown gravelly clay, colour varies from yellow to brown, gravels include some shale and ironstone with some large 2-8 cm nodules.
21	1	0-15	Brown 'loam' to 1-2 cm grades quickly into a red/brown clay which is very hard and blocky, highly bioturbated.
22	1	0-8	Brown 'loam' to 2-5 cm grades quickly into a clayey brown/red 'loam', ironstone gravels present, patchy areas present at the base of the spit.
	2	8-18	Grades quickly into a solid red clay at about 12 cm.
23	1	0-8	No topsoil present, straight into red clay with only 2-3 cm of loamy clay at the top.
24	1	0-5	Brown loamy clay.
	2	5-12	Grades quickly into red clay at about 8cm.
25	1	0-10	Grades quickly from a dark grey 'loam' into a yellow clay. Soil unlike any in the vicinity.
26	1	0-12	Brown clayey 'loam' to 3cm grades quickly into a red/brown loamy clay and into a red clay at 9cm. Some charcoal present.
27	1	0-8/14	Brown clayey 'loam' to 6cm then grades into red clay.

Pit Number	Spit Number	Depth (cm)	Description
28	1	0-12/17	Reddish/brown clayey 'loam' to about 2-3 cm then grades quickly into a red clay.
29	1	0-15	Brown 'loam' to 3-4 cm then grades quickly into a red clay.
30	1	0-13	Brown/grey silty 'loam' to 6cm, grades into a mottled grey/brown 'loam' / red clay, a number of tree roots evident.
31	1	0-15	Shallow topsoil of light brown 'loam' grades quickly to a mottled red and brown clay.
32	1	0-13	Shallow topsoil and turf above a light brown clay.
33	1	0-15	Loose friable light brown soil to 3-5 cm grades quickly to a light brown and orange mottled clay.
34	1	0-12	Turf to 3-5 cm grading quickly to clay of mottled light brown and orange.
35	1	0-15	Turf to 3 cm grading quickly to clay of mottled light brown and orange.
36	1	0-12	Turf to 3 cm grading quickly to clay of mottled light brown and orange.
37	1	0-10	Turf to 3 cm grading quickly to clay of mottled light brown and orange.
38	1	0-20	Turf to 3 cm over light brown friable soil grading quickly to clay of mottled light brown and orange.

TEST AREA 8

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-14	Turf to –3 cm over dark brown friable soil over light brown/orange mottled clay.
2	1	0-15	Turf to 1 cm over clay base of light brown/orange mottled clay.
3	1	0-21	Turf to 3 cm over brown/orange mottled clay base.
4	1	0-17	Turf to 0-3 cm over brown/orange mottled clay base.
5	1	0-18	Turf to 3 cm over brown/orange mottled clay base.
6	1	0-15	Turf to 3 cm over brown/orange mottled clay base.
7	1	0-21	Turf to 3 cm over brown/orange mottled clay to base of pit.
8	1	0-19	Turf to 3 cm over brown/orange mottled clay base.
9	1	0-10	Turf to 1 cm over brown/orange clay base.
10	1	0-20	Turf to 2 cm over brown/orange mottled clay base.

Pit Number	Spit Number	Depth (cm)	Description
11	1	0-19	Turf to 3 cm over brown/orange mottled clay to base of pit.
12	1	0-17	Turf to 2 cm over brown/orange clay to base of pit.
13	1	0-15	Turf to 2 cm over brown/orange mottled clay base.
14	1	0-15	Turf to 3 cm over brown/orange clay to base of pit.
15	1	0-15	Turf to 2 cm over orange brown clay to base of pit.
16	1	0-14	Turf to 2 cm over brown/orange clay to base of pit.
17	1	0-28	Turf to 2 cm over brown/orange clay to base of pit.
18	1	0-8	Turf to 2 cm over brown/orange clay to base of pit.
19	1	0-17	Turf to 2 cm over brown/orange clay to base of pit.
20	1	0-14	Turf to 2 cm over orange/brown clay to base of pit.
21	1	0-10	Turf to 2 cm over orange brown clay to base.
22	1	0-10	Turf to 2 cm over brown/orange clay to base of pit.
23	1	0-12	Turf to 2 cm over brown/orange mottled clay to base of pit.
24	1	0-14	Turf to 2 cm over orange/brown clay to base of pit.
25	1	0-16	Turf to 2 cm over orange/brown mottled clay to base of pit.
26	1	0-15	Turf to 2 cm over orange/brown clay to base of pit.
27	1	0-17	Turf to 2 cm over orange/brown clay to base of pit.
28	1	0-14	Turf to 2 cm over brown/orange clay to base of pit.
29	1	0-15	Turf to 2 cm over orange/brown clay to base of pit.
30	1	0-15	Turf to 2 cm over orange/brown clay to base of pit.
31	1	0-14	Turf to 2 cm over orange/brown clay to base of pit.
32	1	0-16	Turf to 3 cm over orange/brown mottled clay base to bottom of pit.
33	1	0-14	Turf to 2 cm over orange/brown clay to base of pit.
34	1	0-19	Turf to 2 cm over orange/brown clay to base of pit.
35	1	0-15	Turf to 2 cm over orange/brown clay base to bottom of pit.
36	1	0-16	Turf to 2 cm over dark brown friable soil to almost top of clay layer but still some organic material.

Pit Number	Spit Number	Depth (cm)	Description
36	2	16-34	Brown/orange mottled clay to base of pit.
37	1	0-12	Turf to 2 cm over orange brown mottled clay to base of pit.
38	1	0-14	Turf to 2 cm over orange/brown mottled clay to base of pit.
39	1	0-18	Turf to 3 cm over orange/brown clay to base of pit.
40	1	0-13	Turf to 2 cm over orange/brown clay to base of pit.
41	1	0-12	Turf to 2 cm over brown/orange clay to base of pit.

TEST AREA 9

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-15	Brown sandy loam with crumbly texture. Increasing clay content from depth approximately 6 cm, some light orange clay nodules. Some discrete angular gravels are sparsely distributed from a depth approximately 7 cm, maximum dimension approximately 12 mm and of dark grey, very finely crystalline rock. A2 commences at approximate depth 8 cm with overall increase in clay content and more compacted soil structure.
	2	15-20	Uneven boundary of clayey loam to packed yellow – orange clay layer marking B horizon. Running East West in approximate centre of pit floor a narrow line of charcoal most likely representing a burnt sapling or tree root. B horizon commenced at approximate depth 20 cm.
2	1	0-15	Light brown sandy loam with crumbly texture. Continuation of patchy distribution of red/orange clay at base of spit 1. Gradually increased clay content from approximate depth 10 cm.
	2	15-20	From northwest corner to southeast corner, floor of spit 2 divided by patch of red orange clay. Northeast side clay, southwest side light brown sandy/silty loam. Packed clay layer commences at depth 20 cm, though patchy distribution of red clay continues beyond 30 cm depth.
	3	20-30	Angular gravels, maximum dimensions approximately 12 mm distributed from depth 10 cm (marking A2 horizon and more compacted loamy soil) to bottom spit 3.
3	1	0-10	Brown, slightly sandy loam with crumbly texture marking the A1 horizon. A2 – marked by a change at approximate depth 10 cm to a sandier, light brown sandy loam. Light distribution of angular gravels maximum length 12 mm, along with discrete fragments of charcoal of similar size.
	2	10-20	Gradual change to a very light sandy/silty loam with sparsely distributed gravels and rounded quartz pebbles.

Pit Number	Spit Number	Depth (cm)	Description
	3	20-30	Yellow orange clay commencing at approximate depth 26 cm. Base level still containing light distribution of gravels, angular and rounded.
4	1	0-10	Very dark loamy topsoil layer with crumbly texture and high humic content, grading from approximate depth 3cm into a very light brown, very fine silty loam, marking A2.
	2	10-20	Within A2 is a distribution of small, angular gravels of maximum dimension approximately 6 mm. B horizon commences with a hard packed yellow clay layer at approximately 20 cm depth. Angular gravels continue into the clay. Again, patchy distribution of red clay. Root layer ceases at approximately 14 cm depth. Little disturbance by ant activity.
5	1	0-20	Light brown sandy loam with a crumbly texture. Occasional discrete fragments of charcoal maximum dimension approximately 15 mm. Patchy distribution of red clay at same stratigraphic level as A horizon.
	2	20-30	Continuation of brown sandy loam. Centrally located in western wall of pit was a cross section of charcoal tree stump or fallen tree. 35 cm wide and commencing at depth 20 cm, the charcoal distribution extends easterly across the spit floor. Charcoal reduced to narrow line on opposite East wall. Immediately adjacent is a distribution of light brown silty soil consistent with fluvial infill following tree felling. Packed clay layer of red orange clay commencing at depth 30 cm marks B horizon.
6	1	0-11	Light brown silty soil with crumbly texture. Little humic content. A2 – commences at approximately 10 cm depth with very fine, light brown silty compacted soil. sparse distribution of angular gravels – dark, finely crystalline rock – maximum dimension 8 mm. Some oxidised small, broken, weathered cobbles maximum 3 cm.
	2	11-15	Some patchy red-orange clay concentrated on Eastern wall of pit and extending approximately 80 cm towards west.
	3	15-25	B horizon commences at 25 cm with red-orange clay layer. NB Area extending from southern wall northwards into floor of spit by 1 m, and measuring maximum 50 cm in width is a fill of leached, very light silty soil with gravels ranging from 3 mm to 1.5 cm in maximum dimension most likely a feature associated with fallen tree and subsequent soil infill.
7	1	0-10	0-6 cm brown to dark brown gravelly fine grained loam 6-10 cm+ grades quickly to a light yellow-brown gravelly fine grained sediment = 'loam' start of leached A2 horizon Large area of burnt wood (roots) at southern end of pit. Gravels are ironstone, generally small, some larger to 4 cm.
	2	10-20	Abrupt boundary onto massive red brown clay at 10 cm. Boundary level irregular – pockets of upper sediment still evident.

Pit Number	Spit Number	Depth (cm)	Description
	3	20-25	Transition layer onto red brown clay.
8	1	0-9	Brown to dark brown gravelly fine-grained loam.
	2	9-15	Grades to light brown gravelly fine grained loam. More gravel than upper. Patches of red brown clay – abrupt boundary.
	3	15-24	Transition layer into red brown clay – massive.
9	1	0-10	Dark brown gravelly fine grained loam. Ironstone gravels. Patches of red-brown massive clay in bottom of spit. Ants in west corner.
	2	10-20	Grades into light brown fine grained loams – gravelly. Massive brown red clay in southern half of pit with light sediment – 'loam' in northern half.
	3	20-25	Massive red brown clay.
10	1	0-15	Dark brown fine grained gravelly loam grading into light brown gravelly loam. Gravel gets bigger further down up to 5 cm. Gravels are ironstone. Lizard nest found in first spit.
	2	15-20	Abruptly into red brown massive clay.
11	1	0-13	Dark brown gravelly (ironstone) clay loam patches of orange clay.
	2	13-20	Grades into orange clay.
12	1	0-12	Dark brown clay loam. Patch of orange clay at eastern end.
	2	12-26	Orange brown and yellow brown crumbly clay. Patches of charcoal.
13	1	0-10	Light yellow brown fine grained light gravelly loam.
	2	10-20	Light yellow brown fine grained lightly gravelled loam. Patches of red brown massive clay.
	3	20-25/35	Massive red brown clay – still some areas of light yellow brown fine grained loam.
14	1	0-15	Brown fine grained gravelled (small size) loam. Bits of charcoal. Ants evident. At 10 cm becomes light brown fine grained gravelly loam.
	2	15-22	Light brown fine grained gravelly loam. Patches of massive red brown clay.
	3	22-23	Abruptly into red brown massive clay. Uneven surface – still light brown patch of loam in centre of pit. Appears to go down another 2 cm.
15	1	0-12	Light brown compacted fine grained gravelly loam. Ants present. Patches of massive red brown clay – abrupt transition – uneven surface.

Pit Number	Spit Number	Depth (cm)	Description
	2	12-20	Uneven surface of massive red brown clay – still some patches of light brown loam. Ants nests. Plant bulb.
16	1	0-14	Light brown fine grained gravelly (ironstone) loam. Patch of red brown clay in southern half of pit. Worms.
	2	14-20	Very uneven surface of massive red brown clay in southern half of pit about 50 cm wide. Rest of pit light brown gravelly (ironstone) clayey fine grained loam.
	3	20-25	Massive red brown clay. Small patch of gravelly loam in northern corner.
17	1	0-10	Reddish brown fine grained gravelly loam – slightly clayey. Ironstone gravels up to 4 cm.
	2	10-18	Uneven abrupt surface of massive red brown clay. Gravelly loam still in southern half of spit.
	3	18-20	Massive clay now all over spit.
18	1	0-12	Dark red brown gravelly clayey loam ironstone gravels.
	2	12-20	Dark red brown gravelly clayey loam. Some patches of red brown massive clay particularly in southwestern corner.
	3	20-26	Massive red brown clay. Uneven surface – abrupt surface.
19	1	0-16	Dark reddish brown gravelly clayey loam.
	2	16-22	Dark reddish brown gravelly clayey loam gradually increasing in clay further down.
20	1	0-10	Light yellow brown clayey gravelly fine grained loam. Ironstone gravel. Dark ash layer on surface.
	2	10-18	Light yellow brown clayey gravelly fine grained loam. Patches of red brown clay. Abrupt change – uneven surface.
	3	18-21	Red brown clay. Small patches of loam.
21	1	0-11	Light brown gravelly fine grained loam. Ironstone gravel.
	2	11-20	Light yellow brown gravelly fine grading loam grading from above. Very small patches of massive red brown clay. Abrupt change – uneven surface.
	3	20-22	Abrupt change to massive red brown clay. Small patches of loam.

TEST AREA 10

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-15	Light grey brown clayey fine grained/silty loam. Spots of orange.
	2	15-18/23	Grading to more clayey silty loam. More yellow. Charcoal. Small amount of ironstone gravel.
	3	18/23-30	Grading to a grey yellow silty clay.
2	1	0-12/16	Light grey brown clayey fine grained silty loam. 8-16 cm becomes lighter and increase in charcoal and clay spots.
	2	12/16-18	Light grey brown clayey fine grained silty loam. Charcoal and clay spots.
	3	18-25	Increasing clay with depth to yellow silty clay at base.
3	1	0-8	Brown loam slightly silty. Charcoal. Small amount of gravel.
	2	8-18/22	Grades quickly to light grey yellow brown. Silty loam. Large charcoal patch in southern side of pit (photo taken). Charcoal and clay scattered throughout other side.
	3	18/22-30/23	Increasing in clay and yellow with depth. Burnt wood (tree root) found in area of charcoal. Silty clay with small amount of gravel.
	4	30/23-27/30	Grading quickly to yellow silty clay. Tree roots clearly visible.
4	1	0-8	Brown clayey gravelly silty loam. Small charcoal patch at east end.
	2	8-14	Ants nest. Grading to light grey yellow brown clayey gravelly silty loam. Ironstone gravel.
	3	14-18	Grading to increasing clay silty gravelly loam – uneven change. Ironstone gravel.
	4	18-23	Grades to yellow silty clay.
5	1	0-5	Orange brown gravelly clayey fine grained loam.
	2	5-10/15	Orange brown gravelly clayey fine grained loam becoming more compact and clayey. Ironstone gravel.
	3	10/15-15/20	Gravel increasing with depth – orange brown gravelly clayey loam. Charcoal.
	4	15/20-24	Ironstone gravels increasing. Orange brown gravelly clayey loam.
	5	24-25	Light brown clayey gravelly fine grained loam.
	6	25-30	Grades quickly to yellow gravelly silty clay.

Pit Number	Spit Number	Depth (cm)	Description
6	1	0-7	Brown clayey gravelly fine grained loam.
	2	7-15	Grading to light brown clayey gravelly fine grained loam. Ironstone gravel increasing with depth. Patch of brown clay.
	3	15-20	Grades quickly to hard yellow brown gravelly clay.

TEST AREA 11

Pit Number	Spit Number	Depth (cm)	Description
1	1	0-15	Dark yellow brown clayey loam.0-5 cm friable. 5-15 cm clayey and damp. High bio content.
	2	15-25	Dark yellow brown clayey loam. Grades quickly to yellow sticky clay (in patches).
	3	25-30	Yellow clay. Some charcoal and ironstone.
2	1	0-10	Dark yellow brown clayey loam. Small patch of orange yellow clay.
	2	10-24	Grades quickly to brown yellow clay.
3	1	0-10/15	Yellow brown clayey fine grained loam.
	2	10/15-18/25	Yellow brown gravelly clayey fine grained loam grading to yellow clay – bands of clay loam. Clay running north west through pit.
	3	18-22	Brown yellow clay. Band of dark brown clayey loam running north west through clay..
4	1	0-11	Yellow brown gravelly clay loam. Ironstone gravel.
	2	11-16/19	Yellow brown gravelly clayey loam increasing in clay with depth.
	3	16/19-20/25	Brown yellow clay – grades quickly. Small patch brown loam in centre.
5	1	0-10	Brown clayey fine grained loam patch of hard oxidised sediment in north western corner. Charcoal just before this in centre western side.
	2	10-17/22	Brown gravelly clayey fine grained loam. Large patch of burnt clay and charcoal and massive clay at northern end of pit (tree root).
	3	17-20	Brown gravelly clay loam in southern half of pit.
6	1	0-10/15	Yellow brown gravelly clayey loam. Ants nest. Ironstone gravel. Area of yellow clay in 15 cm depth area of spit.
	2	10/15-18/30	Yellow brown gravelly clayey loam grades to orange yellow clay. Very compact and hard.

Pit Number	Spit Number	Depth (cm)	Description
7	1	0-10/13	Dark brown gravelly clayey loam. Ironstone gravel.
	2	10/13-15	Grading to darker brown more clayey loam. Charcoal and burnt clay present.
	3	13/15-18	More clay in the loam. Patches of yellow clay – grades quickly, uneven surface.
	4	15/18-23	Grades quickly to yellow silty clay. Charcoal patches.
8	1	0-15	Brown clayey loam.
	2	15-18	Brown gravelly clayey loam grading quickly to yellow clay. Lots of worms. Small charcoal patches. Increasing clay with depth.
	3	18-23	Grades quickly to yellow silty clay. Patches of charcoal.
9	1	0-15/20	Brown gravelly clayey loam (small size). Small bits of charcoal.
	2	15/20-24	Yellow brown sandy/silty clay – grades from clayey loam. High fine grained sand content. Small bits of charcoal.
	3	24-28	Clay content increasing and becoming more yellow.
10	1	0-15	Brown clayey loam.
	2	15-20/25	Grading to brown yellow clay. Patch of orange red clay.
	3	20-22	Grading to brown yellow clay.
	4	22-25/28	Brown yellow silty clay. Patch of orange (burnt) clay and charcoal.
11	1	0-10/15	Brown gravelly clayey loam. Patches of charcoal.
	2	10/15-25	Brown gravelly clayey loam. Patch of burnt clay and charcoal in western corner. Bluestone gravel.

APPENDIX 8

PIT PROFILE PHOTOGRAPHS

TEST AREA 3

Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Pit 7
						

Pit 8	Pit 9	Pit 10	Pit 11	Pit 12	Pit 13
					

TEST AREA 4

Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Pit 7
						

Pit 8	Pit 9	Pit 10	Pit 11	Pit 12	Pit 13	Pit 14
						

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<tr><th>Pit 15</th><th>Pit 16</th><th>Pit 17</th><th>Pit 18</th><th>Pit 19</th><th>Pit 20</th></tr>
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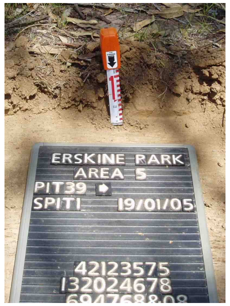
TEST AREA 5B

Pit 39 (Pit 1)	Pit 40 (Pit 2)	Pit 41 (Pit 3)	Pit 42 (Pit 4)	Pit 43 (Pit 5)
				

TEST AREA 5C

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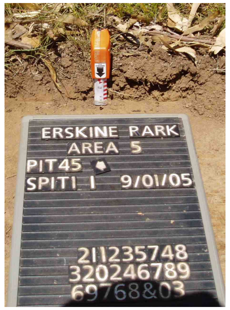
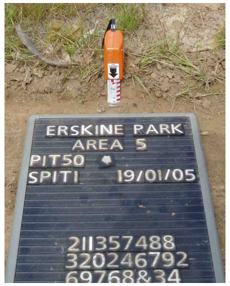
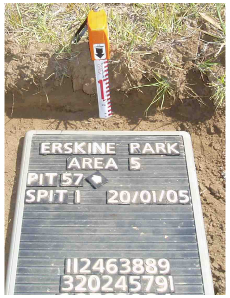
					

Pit 50 (Pit 7)	Pit 51 (Pit 8)	Pit 52 (Pit 9)	Pit 53 (Pit 10)	Pit 54 (Pit 11)
				

TEST AREA 5C

Pit 55 (Pit 1)	Pit 56 (Pit 2)	Pit 57 (Pit 3)	Pit 58 (Pit 4)	Pit 59 (Pit 5)	Pit 60 (Pit 6)	Pit 61 (Pit 7)	Pit 62 (Pit 8)
							

Pit 63 (Pit 9)	Pit 64 (Pit 10)	Pit 65 (Pit 11)	Pit 66 (Pit 12)	Pit 67 (Pit 13)	Pit 68 (Pit 14)	Pit 69 (Pit 15)	Pit 70 (Pit 16)
							

TEST AREA 6

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Pit 17	Pit 18	Pit 19	Pit 20	Pit 21	Pit 22	Pit 22
						

Pit 23	Pit 24	Pit 25	Pit 26	Pit 27	Pit 28	Pit 29
						

Pit 30

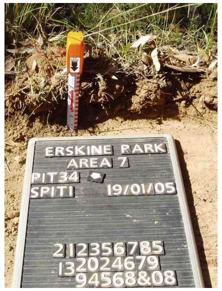

TEST AREA 7

Pit 1	Pit 2	Pit 4	Pit 5	Pit 7	Pit 9	Pit 11
						

Pit 12	Pit 14	Pit 15	Pit 17	Pit 18	Pit 19
					

Pit 20	Pit 21	Pit 22	Pit 23	Pit 24	Pit 25
					

Pit 26	Pit 27	Pit 28	Pit 29	Pit 30	Pit 31
					

Pit 32	Pit 33	Pit 34	Pit 35	Pit 36	Pit 38
					

TEST AREA 8

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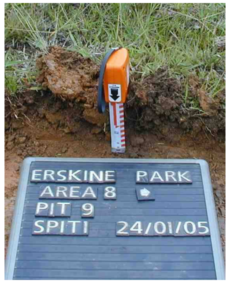
<td></td>
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Pit 33

Pit 34

Pit 35

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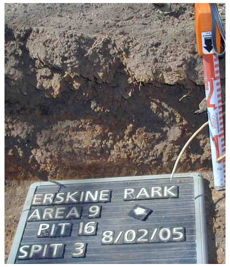
Pit 8	Pit 9	Pit 10	Pit 11	Pit 12	Pit 13	Pit 14
						

Pit 15	Pit 16	Pit 17	Pit 18	Pit 19	Pit 20	Pit 21
						

TEST AREA 10

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					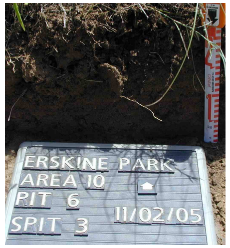

TEST AREA 11

Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6
					

Pit 7	Pit 8	Pit 9	Pit 11