
3.0 Environmental background

The following section details the environmental context of the study area. Environmental background is important in providing the context for the archaeology of an area. The physiographical, geological and soil landscapes of an area can influence the type and frequency of historic or Aboriginal places and/or sites that are likely to exist in the area.

3.1. Topography

The study area is within the Cumberland Lowland physiographic region, which forms the centre of the Sydney Basin. The Cumberland Lowlands are surrounded by the Hornsby Plateau to the north-east, the Blue Mountains Plateau to the west and the Woronora Plateau to the south.

The topography of the study region is generally characterised by low-lying, gently undulating plains, low hills with broad rounded crests, and ridges with gently inclined slopes. Local relief is 10-30 metres, with slopes generally less than 5%, but sometimes up to 10%. Crests and ridges are broad (200-600 metres) and rounded, with convex upper slopes grading into concave lower slopes. The landscape is dissected with gently undulating low rises on the Tertiary terraces of the Hawkesbury/Nepean River system. The areas adjacent to Eastern Creek comprise flat to gently sloping alluvial plains with occasional terraces or levees providing low relief (Bannerman and Hazelton 1990).

3.2. Geology and soil landscapes

The study area is underlain by the Wianamatta Shale Group, one of the two major geological formations within the Cumberland Plain. The Wianamatta Shale Group is divided into two subgroups; the Ashfield Shale and the Bringelly Shale. Bringelly Shale predominates across the Cumberland Plain, while Ashfield Shale is confined largely to the margins.

The geology of the dissected terraces adjacent to drainage lines within the study region includes three depositional phases of Tertiary alluvial and colluvial origin. The lowest deposit is the St Marys formation. This is overlain by the Rickabys Creek gravel formation, which is of varying thickness, topped by the Londonderry Clay formation. All of these formations are derived from sandstone and clay. Erosion of the surface has led to exposure of all three formations in different locations.

The study area is broadly situated within three different soil landscapes (Bannerman and Hazelton 1990). The western section of the study area comprises the fluvial South Creek soil landscape, which includes the floodplains of Eastern Creek and its tributary's and a small portion of the fluvial Berkshire Park soil landscape close to Vineyard Station. The remainder of the study area is situated within the residual Blacktown soil landscape.

The Blacktown soil landscape represents a residual soil landscape. Residual landscapes are dominated by sites where deep soils have formed from the *in situ* weathering of parent materials. This has presumably taken place over long periods of time where the rate of soil formation has been greater than the rate of erosion. The Blacktown soil landscape represents a very old land surfaces pre-dating the human settlement of Australia. Essentially, archaeological material, representing the last c.20,000 years BP will be found mixed within a single stratigraphic unit (the topsoil), or will be part of deposits that have shifted from their original position. As such the majority of contextual data that assists archaeologists to reconstruct detailed site histories through the high resolution patterning has been lost.

The South Creek and Berkshire Park soil landscapes, being fluvial, have the potential to contain stratified, *in situ* archaeological deposits. These soil landscapes represent a high probability of containing detailed contextual archaeological data under certain conditions. These conditions include factors such as the burial of surface or subsurface *in situ* archaeological remains effectively sealing them from subsequent disturbance. From an archaeological perspective this has the greatest potential to yield significant contextual information, allowing us to build a more detailed picture of past Aboriginal settlement patterns.

3.3. Hydrology

The Cumberland Lowlands are characterised by a dense drainage network of predominantly northward-flowing channels; little of the Cumberland Plain would be more than one kilometre from either a temporary or permanent source of water. Three major creeks drain the Cumberland Plain: Rickabys Creek, South Creek and Eastern Creek. These three creeks flow into the Hawkesbury-Nepean River system and are fed by numerous tributaries and smaller creeks.

The western section of the current study area is within the Eastern Creek floodplain and crosses several small tributaries leading into Eastern Creek. Several small drainage channels, lagoons and swamps also occur over the broader study region. Some of these may have represented semi-permanent water sources prior to European impact. However, European activities, such as the construction of dams, weirs and reservoirs, have altered the natural flow of some of the original watercourses in the area. Isolated waterholes or natural wells and swamps are also likely to have been present in areas within the study region. Again, European land use practices are likely to have obscured or destroyed the majority of these features.

3.4. Vegetation

The state of the natural environment can inform the likelihood of the presence of sites both surface and sub surface. Typically, landscapes comprised of remnant natural vegetation will have a higher probability of retaining sites such as scar trees and in the absence of erosion, surface sites. There is also a greater probability of minimal disturbance to the soil profile, whereby intact surface horizons, which have not been disturbed through agricultural practices, have a higher probability of retaining undisturbed archaeological deposits. Few areas adjacent to the rail corridor comprise an undisturbed natural landscape. Large scale tree clearance practices have minimised the likelihood of the presence of scar trees, however, intact ground strata have been observed (Parsons Brinckerhoff 2008) and may be indicative of minimal disturbance through agricultural practices.

Various ecological and biodiversity surveys previously undertaken within the broader Riverstone-Vineyard-Schofields area indicated that, prior to European occupation, five main vegetation communities would have dominated the region: Castlereagh Ironbark Forest, Shale/Gravel Transition Forest, Grey Box Woodland, Grey Box-Ironbark Woodland and Riparian Vegetation (Benson 1981).

Castlereagh Ironbark Forest

Castlereagh Ironbark Forest is found on Tertiary alluvial deposits of the Cumberland Lowlands, particularly on deep, well-drained reddish clay soils. Broad-leaved Ironbark (*Eucalyptus fibrosa*) is the dominant tree species, generally forming pure stands, but it may also be associated with Mugga Mugga Ironbark (*Eucalyptus sideroxylon*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). A small tree layer of White Feather Honey Myrtle (*Melaleuca decora*) and an understorey of sclerophyllous shrubs to two metres high is generally conspicuous. No particular species predominates in the understorey, although the pea family Fabaceae is well represented. Shrub species, which may be locally abundant, include Coastal Parrot-Pea (*Dillwynia tenuifolia*), Hop Bush (*Dodonaea falcata*), Silky Hakea (*Hakea sericea*), Paperbark (*Melaleuca nodosa*), Heathland Mirbelia (*Mirbelia rubiifolia*) and Bronze Bush Pea (*Pultenaea villosa*).

Shale/Gravel Transition Forest

The dominant tree species in Shale/Gravel Transition Forest include Red Ironbark (*Eucalyptus fibrosa*), common to Tertiary alluvium, and Grey Box (*Eucalyptus moluccana*), common to Wianamatta Shale. There is also a high proportion of Red Ironbark (*Eucalyptus sideroxylon*) present. The understorey is made up of White Feather Honey Myrtle (*Melaleuca decora*) and an occasional Rough-barked Apple (*Angophora floribunda*), with sparse clumps of Paperbark (*Melaleuca nodosa*). Shrubs include Hickory Wattle (*Acacia falcata*), Coastal Parrot-Pea (*Dillwynia tenuifolia*), and Gorse Bitter Pea (*Daviesia ulicifolia*), while herbs include Climbing Saltbush (*Einadia nutans*).

Grey Box Woodland

Grey Box Woodland and Grey Box-Ironbark Woodland were once the major associations covering most of the undulating country of the central Cumberland Plain, where the average annual rainfall is 700-800 millimetres. The dominant taxa include Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*). Other eucalypts present include Red Ironbark (*Eucalyptus fibrosa*), with a dense understorey of Paperbark (*Melaleuca nodosa*), Cabbage Gum (*Eucalyptus amplifolia*), Broad-leaved Apple (*Angophora subvelutina*) and Rough-barked Apple (*Angophora floribunda*). Five species of *Acacia* and nine members of the Fabaceae family, with a wide variety of twiners, herbs and grasses, make up the understorey.

Grey Box- Ironbark Woodland

Grey Box-Ironbark Woodland occurs on slightly elevated shale areas. The dominant canopy species are Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). Associated tree species include Thin-leaved Stringybark (*Eucalyptus eugenoides*), Broad-leaved Apple (*Angophora subvelutina*) and Rough-barked Apple (*Angophora floribunda*). The medium-density understorey includes *Acacia parramattensis*, *Bursaria spinosa*, *Dillwynia sieberi*, *Indigofera australis* and *Ozothamnus diosmifolius*. The medium to high density ground layer is dominated by grasses and includes *Aristida vagans*, *Chloris truncata*, *Glycine tabacina*, *Panicum simile* and *Themeda australis*.

Riparian Vegetation

River-flat forest was once found on the fertile Quaternary alluvial soils of the present Hawkesbury-Nepean River system floodplain. Tall trees included Broad-leaved Apple (*Angophora subvelutina*) and Forest Red Gum (*Eucalyptus tereticornis*). In places, vines such as *Stephania japonica*, *Clematis glycinoides* and *Pandorea pandorana* formed thick tangles amongst shrubs of *Hymenanthera dentata*, *Bursaria spinosa* and *Clerodendrum tomentosum*. Along the riverbanks grew denser vegetation, with River Oaks, *Casuarina cunninghamiana* and smaller trees, *Acacia binervia*, *Tristaniaopsis laurina*, *Backhousia myrtifolia* and *Melia azedarach*.

4.0 Aboriginal Background

This section details the archaeological and ethnographic setting of the study area. This information can be contextualised, where appropriate, within the known environmental parameters and ultimately used to predict the likelihood of archaeological sites occurring within particular environments.

4.1. Ethnohistorical accounts of traditional Aboriginal lifestyles

The majority of information about the socio-cultural structure of Aboriginal society before European contact is heavily reliant upon early European accounts. After European arrival in 1788, the lifestyle of the local Aboriginal people underwent a period of great disruption and irreversible transformation. It should be recognised, therefore, that any information that exists may be flawed. This information was recorded by European observers who did not fully understand or appreciate the culture they were witnessing. Furthermore, the culture itself was exhibiting signs of the great change and disruption brought about by European arrival.

The Aboriginal people living in the western region of Sydney when the First Fleet arrived were the Darug (note: Darug is also commonly spelt *Dharug*, *Daruk*, and other variations in historical texts) linguistic tribal group. The Darug are thought to have occupied land stretching from the Hawkesbury River in the north, to Appin in the south, and west into the Blue Mountains. The western region of Sydney has produced some of Australia's oldest Aboriginal artefacts. Deep gravel beds at Penrith have revealed stone tools dating to at least 30,000 years ago. Rock shelters in the Blue Mountains have provided evidence of Aboriginal presence in the area to at least 22,000 years ago and another rock shelter at Castlereagh has yielded evidence of Aboriginal occupation dating back 15,000 years. However, the majority of sites found on the Cumberland Plain date to the last 3,000 years (Kohen 1986: 10, Karskens 1991: 11-12).

The Darug people c.1788, appear to have lived in small socio-economic units of around 50 people. They were essentially hunters and gatherers with a wide and varied diet. Plant food sources included berries, fruits, nuts and roots. Their main source of meat appears to have been possums and gliders that were commonly found in open woodland, but snakes, lizards, goannas, bandicoots, rats, small wallabies, insects and birds, such as quail, were also eaten. Creeks were an important source of many foods in the Darug diet. Tortoises, eels, freshwater mussels, yabbies, freshwater fish, platypus and water birds were collected, along with eggs of larger birds such as swans (Karskens 1991: 13-14, Kohen 1986: 16-18).

Changes in settlement patterns are also evident in the archaeological record. Up to 7,000 years ago, rock shelters seem to be the main occupation site used by Aboriginal peoples in the western region of Sydney. Between 4,000 and 1,500 years ago, both rock shelters and open campsites were used. From 1,500 years ago to the spread of European settlement, open campsites were favoured. Much of the archaeological evidence relating to Aboriginal occupation of the region has been found on creek and river banks. This has led to the supposition that the Darug spent most of the year near rivers and creeks, moving into the forest during winter (Karskens 1991: 12-13).

Very little of the material culture of the Darug survives apart from stone tools. The stone used to manufacture tools generally came from two sources: the gravel beds of the Nepean River or silcrete outcrops adjacent to South and Eastern creeks. Basalt pebbles were used for chopping tools and hatchet heads, while chert and silcrete were fashioned into items such as scrapers, spear barbs and cutting tools (Kohen 1986: 19).

The earliest meetings between European and Aboriginal people were marked by friendliness, but this soon changed. Conflict quickly arose as two different economic systems competed '... for the same rich soil to provide food' (Kohen 1986: 24). The new settlers cleared the bush, destroyed traditional food sources, drove off game, and prevented the Darug from gaining access to traditional hunting and gathering areas. One of the earliest incidents occurred in July 1891 when '... a large body of natives appeared in the grounds of one of the new settlers of Prospect Hill, who, alarmed at the sight of a number of natives ... fired off his musquet [sic] ...' (Kohen 1986: 23). Aboriginal people burned his hut in retaliation, but were subsequently fired on by another of the settlers (Kohen 1986: 23-24, Karskens 1991: 14-15).

The remnants of the tribal bands — that had once spread across the whole of the Cumberland Plain — began settling on estates near South Creek, at Eastern Creek and at Bells Creek. Traditional practices continued, but the Darug began to depend more and more on food, clothing and shelter provided by Europeans. Various attempts were made around this period to 'civilise' the Aboriginal population. Governor Macquarie set up the Native Institution c.1814 to educate Aboriginal children and he made a number of land grants (in what is now

Blacktown) to Darug people, with the hope of introducing farming techniques to the Aboriginal community. Both of these initiatives largely failed, with the Native Institution and the Blacktown settlement abandoned by c.1833. Later, in the second half of the nineteenth century, Government policy would see Aboriginals restricted to missions and reservations under the control of non-Aboriginal supervisors (Kohen 1986: 26-27, Karskens 1991: 15-17).

4.2. Natural resources and their uses

4.2.1. Material culture

The material culture of the Aboriginal people of the Sydney region was diverse, using materials derived from a variety of plants, birds and animals as well as stone. It is the analysis of this material culture, particularly stone artefacts, that enables archaeologists to estimate an approximate occupancy framework for the region. A short summary of the types of material used by the Aboriginal people of the Sydney region is provided below.

Spears in the Sydney region were usually made of a grasstree spike (for the shaft) with a hardwood point. Stone, bone, shell or wood were sometimes used as barbs (Turbet 2001: 40). Thin and straight spear-throwers were made from wattle (Turbet 2001: 40). Fishing spears were usually tipped with four hardwood prongs with bone points (Attenbrow 2002: 117, 119, Turbet 2001: 42). Fish were also caught by means of shell or bird talon fish hooks (Attenbrow 2002: 117, Turbet 2001: 45). Archaeological evidence from the Mt Trefle rockshelter/midden suggests that tidal traps or nets might have also been used for fishing in the Sydney region (Attenbrow and Steele 1995).

Bark of various types was used for making such diverse items as wrappings for new-born babies, shelters, canoes, paddles, shields and torches (Attenbrow 2002: Table 10.1).

Resin from the grasstree was used as an adhesive for tool and weapon making (Attenbrow 2002: 116, Turbet 2001: 36).

The durability of stone material makes it the best artefact to document the past existence of people. Stone was commonly used for tools, and apart from discarded shell in middens, is the most common and visible material found in archaeological sites of the region. Stone was used for axe heads, spear barbs, and as woodworking tools, amongst other things.

The western part of the Cumberland Plain is known to contain a variety of flakeable stone materials (stone suitable for the making of stone tools). Pebbles, cobbles and boulders of 'silcrete, silicified wood, quartzite and quartz may occur at the Georges River near Moorebank (Attenbrow 2002: 43, also Corkhill 1999: figure 7.3). Corkhill has noted the presence of silcrete in the Georges River valley south of, and less than roughly 15 kilometres from, Liverpool (Corkhill 1999: figure 7.3). Silcrete, which is commonly found in Aboriginal archaeological sites because of its usefulness as a flakeable stone, is generally found in the Sydney region in 'Tertiary palaeochannel remnants and in younger gravels eroded from these channels' (Corkhill 1999: 72).

Before the development of radiocarbon dating, retouched flake (a stone flake that has been modified or refined) types were used as chronological and cultural markers following European relative dating techniques. Typological lists were developed in order to document a succession of different cultures through time, based on the presence of implements 'typical' of the culture represented. An early example of this approach in Australia is Tindale's three-stage cultural sequence for south-eastern Australia, modelled from the results of excavations at Devon Downs in South Australia (Hale and Tindale 1930).

Two more stages were grafted onto the south-eastern Australian cultural sequences after an excavation conducted on Kangaroo Island (Tindale and Maegraith 1931). As the functional identification of tools was based on morphological characteristics, the appearance of new shapes was sufficient for archaeologists to consider the presence of a new cultural group (e.g. Tindale's 1968 definition of archaeological culture). The end of the 1950s saw a motivation to expand cultural sequences from regional to a wider scale, with Tindale applying his five stage cultural sequence to every assemblage in continental Australia, barring resemblances to those he observed in South Australia (Tindale 1957).

McCarthy's cultural sequence for NSW was also extended to South Australia and Arnhem Land (McCarthy 1958). However, Mulvaney took a different approach in the development of a cultural model based on his excavations at Kenniff Cave, at Mt Moffatt, Carnarvon National Park in Queensland (Mulvaney and Joyce 1965). He recognised two phases for the Holocene that were based on the presence or absence of hafting (fitting with a handle or mounting) technology of stone implements; in particular, the use of smaller implements in order to facilitate their hafting.

It was at the beginning of the 1970s that the current scheme dividing Australian assemblages into two traditions was developed. The Australian Core Tool and Scraper Tradition (ACTST) was developed by Allen and Jones from lithic material excavated at Lake Mungo, western NSW (Bowler *et al.* 1970). This tradition was named in reference to the tool types recovered from the excavation following Jones and Allen's premise that 'the assemblage ... is typical of other old Australian industries' (Bowler *et al.* 1970:52). Only 19 implements (retouched artefacts) were recovered *in situ* and only 16 of these were used in the development of this tradition, since three retouched artefacts were classified as 'others'. These are core tools (horse-hoof cores), steep edge scrapers and flat scrapers, and are thought to characterise the period of site occupation between 32,000 and 25,000 BP. No clear evidence was presented to suggest that such a tradition was in place until the last 6,000 years BP, nor does it explain why this tradition can be found throughout Australia in the Pleistocene (from 2 million years ago) and early Holocene period (beginning approximately 11,000 years ago).

The Australian Small Tool Tradition (ASTT) was developed by Gould (1969) from his lithic analysis of Puntutjarpa Rockshelter, Western Australia. It includes several tool types, all characterised by their small size, as well as their capability to accommodate a haft. While Gould advocates an Australian archaeological record free of marker fossils, his small-tool tradition suffers from the same problem posed when marker fossils were in place; namely, that they were very restricted in space and time. With a continental-scale tradition based on the size of implement types, Gould created a tradition that had the sole merit of encompassing a wider geographic portion of the Australian continent.

As introduced previously, a sequence of changes in stone tool types in eastern NSW was identified by archaeologist F.D. McCarthy who named it the 'Eastern Regional Sequence' (McCarthy 1976: 96-98). McCarthy identified 'Capertian,' 'Bondaian' and 'Eloueran' phases of the sequence, which together appear to span the last 15,000 years in the Sydney region. Broadly, Capertian assemblages contain tools that are generally larger in size than later assemblages, but also contain smaller tools, such as thumbnail scrapers and dentated saws.

In the past eight years however, the chronological appearance of backed artefacts (artefacts worked to have one or more steep edges), such as Bondi points, Elouera and geometric microliths, was questioned. Recent studies (Hiscock and Attenbrow 1998; Hiscock 2002; McNiven 2000; Slack *et al.* 2004) advocate for an earlier appearance of backed artefacts among the Australian lithic assemblage. Of particular interest is Hiscock and Attenbrow's (1998) claim that backed artefacts in south-eastern Australia appeared during the Early Holocene (beginning approximately 11,000 years ago) and were produced in large quantities during the Mid Holocene (Hiscock 2002) contradicting McCarthy's (1976) Mid Holocene appearance.

Edge ground implements appear in the Sydney region assemblages for the first time at about 4,500 to 4,000 years ago. Bondi points and geometric microliths, thought to be spear barbs (although they may have had other uses), are found in large quantities at coastal sites in the region. Eloueras are believed to be wood-working tools.

From about 1,600 years ago, Bondi points and geometric microliths began to drop out of use in the coastal parts of the Sydney region, but were in use on the Cumberland Plain up to around 650 to 500 years ago. Whilst in coastal areas, the use of both quartz and the bipolar flaking technique increased, the toolkit of Cumberland Plain Aboriginals appears to have remained the same. Silcrete and chert/tuff remained the prevailing materials, probably due to the plentiful supply of raw materials on the Plain. Attenbrow argues that this dichotomy between the type of raw material used in coastal areas and the hinterland may be due to a change in 'clan' boundaries and/or changing trading networks. This would have affected access arrangements to essential raw materials, consequently bringing about an adaptive change to more readily available materials and the adoption of techniques to deal with that change (Attenbrow 2002: 153-159).

4.2.2. Raw material resources

Stone raw material sources known to have been used by Aboriginal populations on the Cumberland Plain are found in the three major geological formations; the Cranebrook Formation, the Rickabys Creek Formation, and the St Marys Formation.

Cranebrook Formation

This Quaternary alluvial formation stretches along the Nepean River from near Penrith to the Castlereagh area and consists of a gravel horizon comprised of granite, porphyry, chert, quartz, quartzite and silcrete (Gobert 1976, Smith 1988).

Rickabys Creek Formation (or Rickabys Creek Gravels)

This late Tertiary - early Pleistocene formation occurs between Richmond and Windsor in the north, to Dunheved and Cranebrook in the south and between Marsden Park and Shanes Park in the east and Castlereagh and Agnes Banks to the west, and consists of alluvial deposits of gravel, sand, silt and clay. The rock types found in the gravels include quartz, quartzites, chert, granite, indurated mudstones, some silcrete and sandstone (Gobert 1976, Smith 1988).

St Marys Formation

This well-consolidated Tertiary formation is the most abundant known source of silcrete in the Cumberland Plain. They are typically light reddish or yellowish brown in colour. Indurated mudstones are also found in limited quantities in this formation (Smith 1988). Three small outcrops also occur along Eastern Creek between Riverstone and Vineyard (Smith 1988).

4.2.3. Food

A range of land mammals were hunted for food in the study area, including kangaroos, possums, wombats and echidnas as well as native rats and mice (Attenbrow 2002: 70). Birds, such as the muttonbird and brush turkey, were eaten and it is recorded that eggs were a favourite food (Attenbrow 2002: table 7.3, p75-76). Attenbrow has noted that 'Sydney vegetation communities include over 200 species that have edible parts, such as seeds, fruits, tubers/roots/rhizomes, leaves, flowers and nectar' (Attenbrow 2002: 76). Observations from the earliest European settlers describe Aboriginal people in the Sydney region roasting fern-roots, eating small fruits the size of a cherry, as well as a type of nut and the root of 'a species of the orchid', amongst other types of plant food. As Attenbrow points out, however, the settlers' lack of knowledge of the local plant species made identification of the various plants used difficult (Attenbrow 2002: 76-79).

Fish and shellfish were important food resources to the people of the Port Jackson area, as evidenced by the observations of the first European settlers and the numerous shell middens found along the shorelines of the coast and bays. However, these are less frequent in the hinterland areas of the Cumberland Plain. Ethnohistorical accounts suggest that canoes were used in the same way on inland waterways (Tench 1793). Therefore, it can be argued that freshwater fish and shellfish would have also been a valuable food resource away from the coast.

4.2.4. Water

Fresh water sources for Aboriginal groups would have included Eastern Creek, Killarney Chain of Ponds and First and Second Ponds creeks. However there are no ethnohistorical accounts documenting the use of freshwater in the Sydney region (Attenbrow 2002).

4.2.5. Past environmental conditions

Information on past climate is important, as climate influenced the location and type of resources available (e.g. vegetation, fauna), which in turn affected mobility and settlement patterns of Aboriginal groups frequenting the Cumberland Plain. Variations in climatic conditions during the past 10,000 years have influenced the type of vegetation cover, as well as the type and abundance of certain species. In moister conditions, for instance, the extent of dry sclerophyll forests would have decreased, while rainforest would have increased. Drier conditions would have favoured more open conditions.

Around 10,000 BP, the weather was similar to the present. However, as the temperature and sea-level continued to rise, conditions became much wetter than today; a phenomenon that started around 18,000 BP due to increasing temperature. Increasing temperature, rainfall and rising sea levels culminated around 6,000 BP. The resultant wetter and warmer climate continued until about 4,000 BP, when it returned to cooler and drier conditions. These climatic conditions lasted until 1,500 BP. In the last 1,000 years, rainfall and temperatures increased slightly to reach current conditions.

As past climatic conditions varied, changes in the availability of water would have occurred, influencing the way Aboriginal people moved around the landscape and the way they used the natural resources of the land as fauna and flora resources were redistributed.

4.3. Regional archaeological context

Although European observers recorded various aspects of the lifestyles of Aboriginal people in the Sydney region from the beginning of white settlement in the late eighteenth century, it wasn't until the late nineteenth century that archaeological investigations of Aboriginal archaeological sites commenced (Attenbrow 2002: 5). Since then, over 4,000 archaeological

sites have been recorded across the region, and hundreds have been excavated (Attenbrow 2002: 48).

Most commonly, sites contain engraved or pigmented images, midden material, or open scatters of archaeological material, such as stone artefacts (Attenbrow 2002: Figure 5.6). Present archaeological evidence suggests that human occupation of Australia began between 60,000 and 40,000 years BP. Research continues, and dates for the earliest examples of occupation are under constant revision. Similarly, dates for the initial occupation of the Sydney region are contested.

At present, the oldest date in the study area is from Cranebrook Terrace on the Nepean River approximately 30-40 kilometres north-west of the Project site, which gives a date of 41,300 BP (Nanson *et al.* 1987). The dated layer where stone artefacts were found consisted of alluvial deposits, which are often the subject of redeposition. Although the integrity and age of the deposit was first questioned (Lourandos 1997; Mulvaney and Kamminga 1999), a recent analysis (Nanson *et al.* 2003) suggests initial occupation of Cranebrook Terrace occurred between 50,000 and 40,000 years BP (Stockton and Nanson 2004).

The oldest accepted archaeological site in the Sydney region is the KII Rockshelter on the banks of Shaw's Creek on the Nepean River, north of Penrith. This site is dated to about 14,700 years ago (Kohen *et al.* 1981) and is approximately 30-40 kilometres west of the study area. To the south, along the coast north of Shell Harbour, the site of Bass Point, an open shell midden, has been dated to 17,010±650 BP (Bowdler 1976). More recently Jo McDonald's (2003a; 2005) work at the RTA-G1 site at 109-113 George Street, Parramatta, revealed deep stratified archaeological deposits dating to the late-Pleistocene.

The vast majority of dated sites in the Sydney region are less than 5,000 years old, although the prevalence of sites dating to the last 5,000 years may be a result of the last significant rise in sea level, approximately 6,000 years ago. This rise in sea level would have submerged many of the older sites along the coastal fringe; however, this is not sufficient to explain the evident increase in sites not only in the Cumberland Plain and NSW, but also part of a larger trend observed throughout Australia (e.g. Attenbrow 2004; David and Chant 1995; David and Lourandos 1997, 1998; Lourandos 1997).

Several explanations exist to explain these changes. Archaeologists have interpreted the increase in site establishment as an increase in population size. In spite of more stressful environmental conditions (i.e. a decrease in bioproduction), indications of increasing site use, as well as the establishment of new sites, suggest that the population size remained steady or continued to grow throughout the mid to late Holocene, from 6,000 years ago (Lourandos 1997:302). In response to decrease in bioproduction, the size of the Aboriginal population could have contracted. Instead, Aboriginal people implemented changes in the way they moved across the landscape in order to sustain a larger population size, such changes included changes to social structure, territory and alliances, as well as technological changes reflected in the stone technology (e.g. introduction of hafting technology). These changes were reflected in the technological organisation of people living at the end of the early Holocene about 6,000 BP and broadly match the appearance of specific stone tool types (e.g. backed artefacts).

Changes observed throughout the mid and particularly late Holocene have been the subject of much inquiry within Australian archaeology. While few archaeologists contest their timing, the explanations are subject to much debate (Lourandos and Ross 1994). Previously demographic change, influenced by levels of bioproduction, was used to explain the changes. Lourandos' (1980, 1983) work in south-western Victoria was the base for a general intensification model that went beyond demographic changes as a causal explanation to incorporate socio-cultural changes (see also Lourandos 1984, 1985, 1993). His model of interpretation (1997:318) sees demographic change as both the cause and effect of a socio-economic reorganisation. This reorganisation was observed and/or inferred from the archaeological data by 'increased cultural regionalisation (denoting territoriality), increased ritual and territorial markers (denoting more 'closed' social structures), and complex, widespread exchange patterns (denoting expansion of alliance systems)' (Lourandos 1997:29).

4.4. The Cumberland Plain

Archaeological investigations undertaken during the last 20 years have provided a large body of data about the nature of Aboriginal use and occupation of the greater Sydney region.

One of the first comprehensive investigations of the archaeology of the Cumberland Plain was a review of documented recordings of Aboriginal site types and locations in the northern Cumberland Plain conducted by Smith (1988) on behalf of the NSW National Parks and Wildlife Service. The study area covered in this report is limited in the north and west by the

Hawkesbury-Nepean River, in the east by the Hornsby Plateau and the beginning of the Hawkesbury Sandstone Formation east of Kellyville, around Cattai Creek. Kellyville and Penrith on the eastern and western sides of the Plain form the southern limit of the study area.

At the completion of the study, there were approximately 400 known sites on the Plain, over 90% of which were reported to be small, open campsites (less than 50 artefacts, commonly disturbed or dispersed). Artefacts were reported to be predominantly debitage of silcrete, indurated mudstone, quartz, chert, basalt and quartzite. The average artefact density at any given site was identified as one artefact every 0.75 square metres.

More recent research has contributed new information and helped to refine the original models and observations of occupation behaviour and site distribution on the Cumberland Plain. Over the last 25 years, investigation of the archaeology of the Cumberland Plain has intensified due to the spread of urban development and the need for environmental impact assessments following the introduction of the EP&A Act. However, the majority of investigations conducted within this framework have been restricted by small study areas as defined by individual developments and limited project briefs. One of the largest and most comprehensive studies of the area involves a series of ongoing excavations of a range of sites within a variety of environmental land units at Rouse Hill, Parklea, and Kellyville (Jo McDonald Cultural Heritage Management Pty Ltd 1999, 2002*a*, 2002*b*). The principal findings of these investigations, which originally commenced in 1993, include the following:

- Sites adjacent to permanent water courses are more complex than sites on ephemeral or temporary watercourses (either as a result of the focus by large groups of people and/or as the focus of repeated visitation by small groups of people over a long period of time). Prime site locations were found to be major confluences, especially along principal watercourses.
- The highest frequencies of high-density trenches (up to 100 artefacts per cubic metre) were excavated in alluvium and occurred on shale along Caddies Creek or on the hill-slopes immediately adjacent to this major creek line.
- Alluvial areas, along with some intact hill-slope zones, possessed the greatest potential to retain intact archaeological deposits below the plough zone. At Rouse Hill the plough zone was generally observed to extend to a depth of 30 centimetres, while artefact deposits extended to a depth of up to 70-90 centimetres.
- Hill-slope zones and ephemeral or temporary watercourses that contained sites generally showed evidence of limited occupation, likely to be characterised by single visits by small groups. Lower artefact densities were generally observed. Just two of the 84 test trenches investigated in these contexts produced artefact densities greater than 20 artefacts per cubic metre. Nevertheless, one-off knapping events were also identified in the latter contexts.
- Sites on the interface of shale and sandstone geologies generally appear to represent repeated occupations by small groups, or single occupations by larger groups. Large, long-term occupation sites do not appear to be characteristic of this type of landscape unit.
- The complexity of the archaeological record was found to be greater than previously recognised on the basis of surface recordings and limited test excavations. Knapping floors, backed blade manufacturing sites, heat treatment locations and generalised camp sites inclusive of the processing of plant and animal materials were also found.
- It is postulated that artefact density at a particular site can be correlated with site function. For example, backed blade knapping floors characteristically possessed high artefact densities (greater than 100 artefacts per square metre), whereas in locations where other activities were carried out, or were more dominant, such as tool maintenance, densities were lower (at 20-100 artefacts per square metre).
- Silcrete was found to be the preferred raw material at most sites. However, despite no raw material sources known in the study locality, conservation strategies did not appear to be in evidence. Rather, a wide range of reduction stages was recorded at many sites, including de-cortication, primary and secondary flaking, and bipolar knapping using anvils. Removal of cores from activity areas for continued use elsewhere and caching of large cores were also documented.
- Numerous sites contained a range of raw materials of stone, perhaps reflective of repeated visitation over time, whilst others were restricted largely to silcrete and may reflect one-off, specialised events, such as cortex removal.

- The two Early Bondaian dates (c. 4,000 BP) recovered provide a context for backed blade manufacture in the study area. The later date for heat treatment pits PK/CD1=2 (c. 1,000 BP) is also significant, as it is commensurate with evidence documented for this strategy in the Hunter Lowlands and other regions.

4.5. Local archaeological context

A number of archaeological studies have been carried out in areas in, and immediately around, the Project study area. These studies represent smaller-scale investigations, conducted within a heritage/planning context in response to specific proposed developments.

In 1981 Dallas conducted an Aboriginal archaeological survey of approximately 800 hectares south of the Western Freeway, between Mulgoa Creek and Bringelly Road. The survey was prepared for the Housing Commission of NSW, as part of an environmental impact investigation. Dallas' survey identified 27 Aboriginal sites, of which 20 were open campsites and seven were isolated finds. The sites located by Dallas were either in hill-top or elevated situations or close to creeks. The majority of the stone artefacts recorded by Dallas were flakes or flaked pieces, generally of silcrete or chert. A small number of the artefacts were quartz.

An Aboriginal archaeological survey of Quakers Hill, Schofields and Riverstone was conducted in association with a local environmental study of these suburbs in 1982. Seven open artefact scatters and four isolated finds were located during the survey. The open artefact scatters fall into two groups: open campsites associated with the eastern tributaries of Eastern Creek; and stone tool manufacturing and open campsites above and alongside Eastern Creek. Stone artefacts found during the survey were generally silcrete, chert or quartz, and primarily flakes, flaked pieces and cores (Dallas (1982).

The Riverstone Meatworks holdings of about 15 square kilometers were subject to a comprehensive Aboriginal archaeological survey during which 14 Aboriginal sites were recorded. Nine of the sites were open campsites and five were isolated finds. Aboriginal Site DEC 45-5-210 was known to exist along Eastern Creek prior to the survey and is not included amongst the sites listed above. All the sites were found in alluvial areas, on the banks of creeks or small streams. The number of stone artefacts per site ranged from less than five to more than 50 (excluding DEC 45-5-210: stone artefacts from that site number more than 100). Most of the stone artefacts found were silcrete; however, indurated mudstone, fine-grained basic rock, chert and quartz stone tools were also found. The artefact assemblage included flakes (some with evidence of use-wear retouch); flake pieces; cores (3); grinding stone fragments (2); a semi-discoidal steep scraper; a broken elouera; and a backed blade of chert with evidence of use on the worked edge. Several scarred trees were noted, but none of these were definitely of Aboriginal origin (Haglund and Stockton 1983).

Four areas in Glendenning, Arndell Park, Huntingwood and Colyton industrial estates were surveyed for Aboriginal archaeological sites on behalf of Blacktown City Council (Kohen 1985). A total of 25 Aboriginal sites were found. Isolated finds accounted for nine of the sites, with the remainder appearing to have been open campsites. The isolated finds were found in a variety of landscape forms (both natural and artificial) ranging from tracks, creek banks, ridge tops, erosion scars and creek flats. Open campsites displayed a similar variety of landform contexts: tracks, creek flats, creek banks, a rise, alongside a dam, and the surrounds of an open drain. The stone artefacts found comprised steep scrapers, chert blades, flakes and flake pieces (some with used edges), cores, an elouera adze flake, thumbnail scraper, hammer stone, scrapers and a basalt fragment thought to be from an edge-ground hatchet head. The majority of the stone artefacts were silcrete, but artefacts of basalt, chert, quartz and quartzite were also found. Only one of the open campsites recorded contained 50 or more artefacts. In proximity to the site identified as Southeast Plumpton 5 there were at least seven eucalyptus trees (north side of the road) bearing symmetrical scars up to 60 centimetres long. In 1979 similar scarred trees were recorded on the south side of the road in the same area.

An archaeological reconnaissance of the proposed regional waste disposal depot at Schofields was completed for the Metropolitan Waste Disposal Authority. The site of the proposed development was 92 hectares between Townson Road, Eastern Creek and Plumpton Ridge. McDonald sampled 12 areas of the study site and recorded eight isolated finds. McDonald (1986) concluded that the western side of the study area presented as a continuous background scatter between identified concentrations of artefacts; thus isolated finds were only recorded on the lower slopes and creek banks. Over 90% of the stone artefacts found were silcrete, although artefacts of chert, indurated mudstone and quartz were also present, along with tuff, volcanic rock and petrified wood. Evidence of grinding activity was also observed (McDonald 1986).

A survey of the proposed Daruk training centre, near Penrith was undertaken in 1986 (Brayshaw & Associates in association with Crooks, Mitchell, Peacock, Stewart Pty Limited). The study area covered approximately 94 hectares and was bound in the east by Richmond Road and Llandilo Road in the south. The survey found one open campsite and two isolated finds. A previous survey of the area recorded two open campsites in the vicinity of the study area, but only one of these sites was found again. The open campsite and one of the isolated finds were found on vehicle tracks, while the third site was found at the bottom of a drainage channel. The stone tools found on the newly recorded sites consisted of two flaked pieces, one flake, and two cores, all of silcrete.

An archaeological investigation of an open campsite found at Vineyard (referred to as Vineyard 1) for the State Rail Authority of NSW was conducted in 1987 (Brayshaw McDonald Pty Ltd). The site is on a low ridge at the headwaters of a minor drainage line running into Killarney Chain of Ponds. This site was originally recorded in 1986, along with an isolated find at Clarendon. Five spade probes were undertaken at the study site and surface samples were collected in four areas across the site. Silcrete was the predominant raw material of artefacts found, and flaked pieces the most common type of artefact. Only two stone artefacts appear to have been found during spade probes. Two-hundred and sixty Aboriginal artefacts were collected from the four sample areas. Brayshaw had previously recorded the presence of 117 artefacts at the site and an isolated find. Of the 260 stone artifacts, 94.6% were silcrete, 1.9% were quartzite, 1.2% were quartz, 1.2% mudstone, 0.8% volcanic rock and 0.4% were listed as 'other'. A total of 252 of the artefacts found were flaked pieces, five were flakes and two were cores.

A survey of the Cumberland Plain was carried out as part of a management study of Aboriginal sites, commissioned by the National Parks and Wildlife Service (Laurajane Smith 1988). As part of this survey, 15 areas were surveyed in the north section of the Plain, with 79 open campsites identified, and 29 isolated finds. Initial analysis indicates that the sites across the survey area were dominated by debitage and most contained only a few, if any, used pieces, cores or implements. Sites containing largely chert and indurated mudstone tended to be confined to the western area of the Cumberland Plain between the Nepean River and South Creek.

An assessment of the Riverstone Land Release Area for the Blacktown City Council investigated an area extending from Bandon Road, Vineyard, along the eastern side of the railway to Schofields, east along Schofields Road to First Ponds Creek, and then back to Bandon Road along the western side of First Ponds Creek and Windsor Road (Darwala-Lia 1999). This survey located, or re-located, nine Aboriginal sites. Of the nine sites, eight were open campsites and one was an isolated find. Two of the open campsites were on ridge tops, three were on slope features, and two were on creek terraces or flats. The isolated find was on a slope feature overlooking a creek flat. Common to nearly all of the sites was an artefact assemblage of primarily debitage flakes and flaked pieces, with occasional cores, used flakes and a small quality of blade flakes. A broken-backed blade and stone axe were also recorded. The vast majority of the stone artefacts were silcrete.

A desktop study (Jo McDonald Cultural Heritage Management Pty Ltd 2002b) carried out in relation to the Rouse Hill Development Area Sewerage Master Plan found 153 Aboriginal sites recorded on the *DEC Sites Register* (now the DECC AHIMS register) immediately west of the of the Rouse Hill Project. The study stretched from near Cattai Creek in the east to land surrounding the banks of South Creek in the west. Of the sites recorded, 143 were open campsites, eight were isolated finds and two were scarred trees.

In 2002 an Aboriginal heritage assessment of the Riverstone Trotting Track was undertaken for Blacktown City Council (Helen Brayshaw Heritage Consultants). The trotting track is to the east of Eastern Creek and south of Garfield Road West. The survey found one open campsite on the floodplain of Eastern Creek, about 150 metres from the creek and six metres above the bed of the creek. Two stone artefacts were found: one silcrete flake and one silcrete piece, possibly a core fragment.

A survey was conducted for the Proposed Upgrade of Windsor Road between Mile End Road and Boundary Road, Vineyard (Therin 2003). The study area was located on Windsor Road within the suburbs of Rouse Hill, Box Hill and Riverstone. The area was bound in the north by the intersection of Windsor Road and Boundary Road, and in the south by the intersection of Windsor Road and Mile End Road. The survey located five Aboriginal sites. Of the five sites, three were open campsites and two were isolated finds. One of the open campsites was found on a vehicle track associated with Second Ponds Creek. This site is part of the Aboriginal site DECC 45-5-2290 previously recorded by McDonald (1993). The other open campsite was found close to the crest of a high hill. An isolated find was located on the eastern edge of Windsor Road and another on an unsealed service track on the western side of Windsor Road. This site

was within 100 metres of a previously recorded Aboriginal site (DECC 45-5-2526). The existence of an isolated find on the southern access ramp to the weigh bridge was also recorded. All the stone artefacts found were silcrete, with the exception of one flaked piece of mudstone. The artefact assemblage consisted of one core, the remainder comprising flakes or flaked pieces.

During an assessment of lots 9, 12 and 21 Mile End Road, Rouse Hill, a previously recorded open campsite DECC 45-5-906 was re-inspected and several sites were assessed to be potential archaeological deposits (Jo McDonald Cultural Heritage Management Pty Ltd 2003*b*). A total of seven silcrete fragments were recorded in the field, six of which were described as debris, with the additional one described as a possible core fragment. An open artefact scatter, RH/SP9 (DECC Site # 45-5-2290), located on the confluence of Second Ponds and Caddies creeks, was identified (McDonald 1993) during an archaeological assessment for the Rouse Hill Infrastructure Project involving a survey of the routes of proposed sewerage and water facilities for the Rouse Hill area. An intensive open area excavation and analysis was subsequently undertaken (McDonald 2001). Three excavations comprising 27.5, 26.0 and 98.5 square metres recovered moderate to high-density assemblages of artefacts of a variety of different lithic types. Features included three knapping floors in silcrete, a knapping floor of silicified tuff, and one possible assemblage of quartz artefacts. Limited core reduction of silcrete, silicified tuff, quartz, petrified wood, quartzite, igneous materials and other fine-grained materials was also registered. The largest excavated area (the open plan excavation) revealed that 60.1% of the artefacts were manufactured from silcrete, 25.9% silicified tuff and 12.9% quartz with all remaining categories comprising only 1.2% of artefacts. The assemblages were estimated to date between 3,000 and 1,000 years BP (McDonald 2001).

4.6. DECC AHIMS sites

A search of the DECC AHIMS database conducted 31 October 2008 revealed a total of 39 Aboriginal places located within two kilometres of the rail corridor. These 39 sites represent locations at which one or many archaeological features, such as open camp sites, PADs or artefacts, have been recorded. It should be noted that the list of sites recorded in the DECC database is not exhaustive, as only formally recorded sites are included. Therefore, there exists a possibility that unrecorded sites exist in the study area. Table 4-1 lists the 39 sites recorded within the region of the study area, while Figure 4-2, 4-3 represents the percentage of site types within the region of the study area. It can be seen that the most common site types recorded in the region are open camp sites.

The majority of sites listed are situated on the western side of the rail corridor and are associated with the alluvial flats and river terraces of the Eastern Creek floodplain. These sites comprise open camp sites, isolated finds and PADs. They are generally situated within 1km of the western boundary of the study area, however, nine open camp sites (45-5-0503, 45-5-0497, 45-5-0471, 45-5-3374, 45-5-0358, 45-5-2321, 45-5-0582, 45-5-0312 and 45-5-0313) are situated within 200m of the said boundary.

At the time of production of this report, DECC was in the process of digitising its repository of archaeological reports, and as such the reports associated with the AHIMS sites listed above were not available for review. Site cards for all above listed sites, excluding 45-5-3374, were however available and are summarised below.

Site Card 45- 5- 0503

This site comprises a small scatter of silcrete flakes in a localised erosion scour. It is situated along a lower slope immediately above the alluvial flat of Eastern Creek, approximately 180m from the rail corridor near the Aerodrome runway at Quakers Hill. It is suggested that this site forms a part of a wider site complex, which includes 45-5-0497 and 45-5-0471.

Site Card 45- 5- 0497

This site comprises a small scatter of stone artefacts, which are composed predominantly of silcrete. The site is situated at the southern end of the Aerodrome runway at Quakers Hill and is probably continuous with other recorded artefact scatters on the Aerodrome. It is situated approximately 300m from the rail corridor.

Site Card 45- 5- 0503

This site comprises approximately 106 artefacts consisting of backed blades, thumb nail scrapers and cores of silcrete and chert. This site would have once constituted an extensive open camp site, which has been impacted by the Aerodrome runway. It is situated within 250m of 45-5-0503 along the alluvial flat of Eastern Creek.

Archaeological sites 45-5-0503, 45-5-0497 and 45-5-0358 may be considered as a wider archaeological landscape whereby camp sites are situated along the terraces of creek lines associated with the Eastern Creek floodplain. While these sites are individually recorded they would have once represented an extensive Aboriginal occupation area.

Site Card 45- 5- 0358

This site is situated within Oppy Reserve along the confluence of two tributaries to Eastern Creek 200m north east of the rail corridor near Lalor Road at Quakers Hill. The site is extensive as it covers most of the reserve and artefacts are recorded as present along most of the tracks throughout the park. An area of PAD was targeted for test excavations along the creek flats of the tributary, prior to the installation of the Metropolitan Water, Sewerage and Drainage Board pipeline. *In situ* material was found in part of the site, with radio carbon dating returning a date of 3450± 60 BP. At the time of investigation, it was recommended that this site be avoided by the proposed development. The site card notes that the development went ahead regardless and that future works in the area are likely to encounter *in situ* sub surface remains.

Site Card 45- 5- 2321

Archaeological site 45-5-2321 is situated approximately 165m from the junction of Hambeldon and Lalor Roads, 200m north east of the rail corridor at Quakers Hill. The site consists of over 50 red silcrete flakes scattered over an area approximately 90 x 30m. It was recommended that sub surface testing be undertaken prior to the construction of the Quakers hill overpass. It is not known whether testing took place as reports were not available from DECC at the time of production of this report.

Site Card 45- 5- 0582

Archaeological site 45-5-0582 is located 100m west of the rail corridor along a hill top between Otago and Victoria Roads at Vineyard. The site comprises several pieces of silcrete and chert flaked artefacts. Other possible artefacts were noted, but treated with caution because silcrete boulders outcrop on the hill and may have been shattered naturally. No evidence of quarrying was found.

Site Card 45- 5- 0312

Archaeological site 45-5-0312 is situated along an in filled tributary of Eastern Creek situated at the northern end of the ash track, which runs adjacent to the rail corridor from the meatworks at Riverstone. The site comprises two pink silcrete secondary flakes and there is little likelihood for the presence of an undisturbed deposit in the vicinity of these finds. This site is situated 80m south west of the rail corridor.

Site Card 45- 5- 0313

Archaeological site 45-5-0313 is situated along a high ridge between two tributaries of Eastern Creek, near to where the electricity easement crosses the rail corridor between Victoria and Otago Streets. This site is approximately 500m west of the rail corridor. This site comprises a series of artefact scatters, predominantly comprising of red and yellow silcrete primary flakes. Sections of this site have been disturbed through land use impacts, however there is a possible undisturbed deposit along the western end of the site.

Table 4.1 Aboriginal archaeological/cultural heritage sites recorded within two kilometres of the rail corridor

AHIMS site ID	Site name	Site description – AHIMS site card
45-5-0312	QH6; Quakers Hill	Open camp site
45-5-0313	QH7; Quakers Hill	Open camp site
45-5-0358	QH2; Quakers Hill	Open camp site
45-5-0359	QH3; Quakers Hill	Open camp site
45-5-0360	QH4; Quakers Hill	Open camp site
45-5-0471	Eastern Creek 4; Schofields Aerodrome	Open camp site
45-5-0497	Eastern Creek 3; Schofields Aerodrome	Open camp site
45-5-0498	Eastern Creek 5; Schofields Aerodrome	Open camp site
45-5-0502	Schofields 1; Schofields (public road)	Open camp site
45-5-0503	Eastern Creek 6; Schofields Aerodrome	Open camp site
45-5-0579	Vineyard 1; Riverstone Meatworks	Open camp site
45-5-0582	Vineyard 4; Riverstone Meatworks	Open camp site
45-5-0994	Station Road; 1ST;1	Open camp site
45-5-2321	QHB-1	Open camp site
45-5-2352	IA 1	Isolated find
45-5-2353	IA2	Isolated Find
45-5-2525	EC-OS-2	Open camp site
45-5-2527	EC-OS-5	Open camp site
45-5-2528	EC-IF-1	Isolated find
45-5-2530	EC-OS-3	Open camp site
45-5-2531	EC-OS-6	Open camp site
45-5-2532	EC-OS-4	Open camp site
45-5-2590	CCS1	Artefact
45-5-2610	SEC1-Schofields Eastern Creek 1	Aboriginal gathering place

AHIMS site ID	Site name	Site description – AHIMS site card
45-5-2611	SEC2 – Schofields Eastern Creek 2	Modified tree
45-5-2717	PAD-OS-13	Artefact
45-5-2794	PAD-OS-12	Artefact
45-5-2821	RTT1	Artefact
45-5-2845	WBH8	Artefact
45-5-2852	WSO-OS-14	Artefact
45-5-2995	PAD14	Potential archaeological deposit
45-5-3007	PAD11	Potential archaeological deposit
45-5-3009	PAD15	Potential archaeological deposit
45-5-3010	PAD16	Potential archaeological deposit
45-5-3121	Quakers Hill ISF	Artefact
45-5-3248	WSP02	Artefact
45-5-3356	SCR/UPG2	Artefact
45-5-3374	Reycroft 1	Artefact
45-5-3516	FD1	Artefact

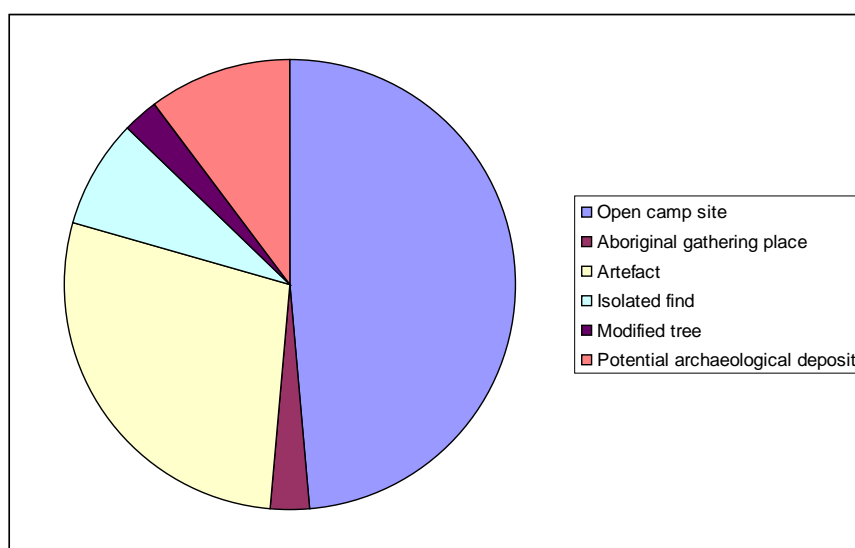


Figure 4- 1 Percentage of site types registered with AHIMS within two kilometres of the study area

4.7. Aboriginal sites recorded in the local context

Establishing predictive models to assist in identifying potential locations of Aboriginal cultural heritage or archaeological sites within a given region can be problematic. On one hand, particular site types are, by their nature, inextricably linked to the landscape or features within it. For example, grinding grooves exist only where there is suitable rock, and generally some water to assist the grinding process. Rock shelters containing art or artefacts are likewise natural features within the landscape that have been modified by cultural processes — they can only exist where suitable rock formations exist. Some site types, such as known significant cultural or dreaming places, while significant parts of the cultural landscape, cannot always be linked to a particular type of landscape formation.

In the middle of the two extremes, are groups of site types that are not linked with specific landscape or landform units. Open artefact scatters are the most obvious example of this group. However, due to their presumed more practical or utilitarian use, inferences concerning probable site locations can be made. While artefact scatters may be the result of many different types of activity, larger scatters are often assumed to be the remains of some sort of camp or occupation site, which would generally be located near a source of freshwater and other resources, and on suitable ground.

4.7.6. Open campsites; stone artefact scatters and isolated finds

Open campsites comprise scatters of artefacts located on the surface and/or in subsurface contexts. They may constitute the remains of hunting and gathering activities, domestic camps, or the manufacture and maintenance of stone tools. The density of artefacts may vary considerably between and across individual sites. These sites are classed as ‘open’, that is, occurring on the land surface unprotected by rock overhangs, and are sometimes referred to as ‘open camp sites.’

Isolated finds are artefacts that occur without any associated evidence for prehistoric activity or occupation. They are generally defined as single artefacts located more than a certain distance from any other artefact. Frequently used distances are 30, 60, or 100 metres. The distance used depends on variables such as ‘background’ artefact densities, land use disturbance, geomorphic processes, and research design objectives. Isolated finds can generally occur anywhere in the landscape and may represent the random loss or deliberate discard of artefacts, or the remains of dispersed artefact scatters.

Stone artefact scatters and isolated finds represent the most prevalent site types identified in the Riverstone-Vineyard-Schofields region, most commonly identified on flat to gently sloping land close to reliable water sources. A large proportion of the natural topography and landform units of the study area conform to these site location criteria — particularly those areas close to Eastern Creek, First Ponds Creek, Second Ponds Creek and Killarney Chain of Ponds —consequently there is a high potential for stone artefact scatters and isolated finds to occur within the region of the study area. Sites may contain few or many artefacts and potential subsurface archaeological deposits.

4.7.7. Quarry sites

These sites are typically exposures of geological raw material where evidence for human collection, extraction, and/or preliminary processing has survived. Typically, these involve the extraction of siliceous or fine-grained igneous and meta-sedimentary rock types for the manufacture of artefacts, or the removal of ochre. The presence of quarry/extraction sites depends on the availability of suitable rock formations and ochre sources.

Based on the underlying geology, the potential for quarry sites to occur within the region of the study area is considered high.

4.7.8. Scarred trees

Scarred trees result where bark was removed from a tree as a direct or indirect result of the manufacture of various goods and implements, or the result of making foot-holes in a tree to collect food or facilitate the removal of bark. Aboriginal scarred trees can be expected to occur on all landform units within the study area where suitable old-growth native timber remains; however, the greatest density of scarred tree sites tends to occur close to known occupation areas generally associated with significant water sources.

Nevertheless, these cultural sites represent an extremely small proportion of the Aboriginal site types identified in the broader Riverstone-Vineyard-Schofields region. This paucity of scarred tree sites is no doubt largely due to the extensive land clearance that has occurred since European occupation and settlement in the early 19th century. Few remnant stands of native vegetation exist in the study area and the likelihood of mature trees exhibiting modification is considered to be relatively low.

Carved trees exhibit intricate, often geometric patterns carved into the outer surface and have been interpreted as possessing ceremonial significance. Carved trees appear to have been used in some areas to indicate the presence of significant burial sites, initiation sites or ceremonial grounds. Carved trees may be expected to occur on landforms where suitable old-growth timber remains; however, they may be more likely to occur in dune landscapes of aeolian sands or alluvial silt where burials have previously been documented in the greater Sydney region.

4.7.9. Rock shelters, rock engravings and axe/hatchet grinding grooves

The presence of rock shelters with art and/or deposits, rock engravings and axe/hatchet grinding grooves depends on the geological formations and landform units within a given area.

Aboriginal rock engravings, carvings or peckings are common in the sandstone areas of the central coast and the Hawkesbury region. Engravings were commonly produced using a 'hammer and chisel' method, with a hammer and a pointed stone or bone tool. Sites are commonly found on cliff tops, ridgelines, in creek beds and rock shelters where a suitable medium occurs (e.g. soft sandstone outcrops).

Axe-grinding or tool-sharpening grooves are found on flat areas of soft rock, such as sandstone, and are often near water holes or creek beds, which provided the necessary water for the sharpening process. From the shape of the grooves it is often possible to determine the type of tool that was being made or sharpened. Axe-grinding grooves are broad and shallow, while deeper grooves often indicate where bone or wood was ground.

The main underlying lithology of the study area is the Bringelly Shale Formation of the Wianamatta Shale Group and various depositional phases of Tertiary sediment of alluvial/colluvial origin. Consequently, there is a relatively limited potential for rock carvings or axe/hatchet grinding grooves to occur within the study area. Notwithstanding this, four rock shelters with art or deposit have been previously documented within the broader Riverstone-Vineyard-Schofields area, thus there is some potential for shelters with Aboriginal cultural heritage material deposits to occur within the study area.

4.7.10. Middens

Middens primarily contain waste materials resulting from meals of coastal resources, such as shellfish, and bones, and are generally found close to sea coast, estuaries, rivers and inland lakes. Few midden sites have been identified on the Cumberland Plain, and the identification of such site types within the study area is considered to be unlikely.

4.7.11. Ceremonial sites

Ceremonial sites such as stone arrangements are among the most infrequently recorded sites in the greater Sydney region and traces of these types of sites would be unlikely to survive in areas subject to significant disturbance through European settlement and development. The likelihood of such sites occurring within the study area is thus considered to be nil to low.

4.7.12. Stone arrangements

Stone arrangements are defined as:

A humanly arranged set of stones or rocks which form lines, circles as well as cairns and piles...They are sometimes found on rock platforms where engraved images occur and where they are usually identified as having a ritual or ceremonial purpose (Attenbrow 2002: 208).

No stone arrangements are known to exist in the immediate study area. Considering past land surface disturbance, such sites are considered unlikely in the study area.

4.7.13. Burials

An Aboriginal burial site is where an individual, or number of individuals, is interned. In the past, many of these burials would have been marked, for example, by stone cairns or scarred/carved trees. However, today it is unlikely that these markers would remain due to modern land use practices (e.g. clearing). Burials are commonly located in certain landscape contexts, such as, sandy alluvial floodplains (because of the ease of internment in softer sediments), or coastal midden sites.

There are no recorded burials within the study area. Nevertheless, this does not preclude the presence of Aboriginal burials in any landscape context.

4.7.14. PADs (Potential Archaeological Deposits)

PADs are areas usually associated with aggrading and/or stable landform features, or rock shelters that are considered likely to contain archaeological deposits. These landform features have been identified as being associated with likely sites of prehistoric human exploitation. PADs often do not exhibit identifiable archaeological material on the surface, but due to their proximity to the abovementioned landforms are predicted to contain sub-surface material. Land surfaces across the study area are comprised of both aggrading and stable soil landscapes, and several PAD's have been previously recorded along Eastern Creek (see Sections 3.2, 4.5 and 4.6). As such, there is a high potential for this site type to occur within the region of the study area.

4.7.15. Contact sites

Contact sites relate to places that contain evidence of Aboriginal occupation during the period of early European occupation. Evidence of this period of 'contact' could potentially comprise Aboriginal flaked glass, burials with historic grave goods or markers, and debris from 'fringe camps' where Aboriginals who were employed by, or who traded with, the white community may have lived or camped. The most likely location for contact period sites would be camp sites adjacent to permanent water, and away from the focus of European town occupation or private land use

4.8. Study area site prediction

Based on the distribution of previously recorded Aboriginal archaeological sites and the existing landforms within the study area, some statements can be made regarding the likelihood for archaeological sites to be present. However, it must be appreciated that the type and location of registered Aboriginal sites is more likely to reflect development pressures than past Aboriginal land use patterns. When considering the potential distribution of Aboriginal archaeological sites within a given area, consideration must be given not only to modern patterns of development, but also to any possible post European contact that may have had a destructive or negative impact on the integrity and context of sites.

Some main points of interest regarding the possible locations of sites can be drawn from the above summary of past archaeological work in the area as follows:

- Open artefact scatters, generally dominated by silcrete and/or quartzite artefacts, are the site type most commonly found in the region.
- Past studies have generally drawn a correlation between the presence of permanent water and the location of larger, high density sites.
- Areas adjacent to permanent water that have not been significantly disturbed by past land use activities are generally identified as having some archaeological potential for Aboriginal sites.

All previously recorded sites within the immediate vicinity of the rail corridor form part of a wider archaeological landscape. Sites are associated with the creek flats and terraces of Eastern Creek tributaries and are also common along hill tops and ridge lines, where silcrete raw material sources are available.

In light of the above, it can be concluded that areas adjacent to permanent water sources are likely to contain either surface artefacts or buried archaeological deposits. Although sites of potential, both surface and sub-surface, are commonly located in areas of relatively minimal past disturbance, the potential for surface and sub-surface deposits is also dependant on the geomorphological context of the area.

Archaeologically, the state of the soil environment informs the context in which cultural materials were deposited. The general geomorphology of a particular landscape may indicate one of several conditions, depending on whether the location is actively eroding, aggrading or in a relative state of stasis. In eroding areas, soil and sediment deposits are removed from the landscape, either removing any associated archaeological material or creating lag or deflation deposits. In aggrading environments, such as found in riverine and swamp-like environments, artefactual material is commonly buried and preserved. Artefactual material may accumulate in these areas as a result of *in situ* anthropogenic processes or secondary depositional processes such as fluvial and alluvial deposition. Sites are, therefore, likely to either represent episodic small-scale visits, as artefacts will be quickly covered over in aggrading environments, or will have been washed in from elsewhere. Large, open camp sites are more likely to be found in association with stable land surfaces, typically associated with soil development. Stable landscapes are essentially landscapes in which the rate of erosion or deposition is not greater than the rate of soil formation. As such, stable land surfaces will typically allow for the

accumulation of larger amounts of artefactual material before burial. In alluvial environments stable landscapes are generally located on river terraces set back from the river or creek bank.

The South Creek and Berkshire Park soil landscapes have archaeological potential, as they are characterised by frequent occurrences of buried soil landscapes (relict stable land surfaces) (see section 3.2). The Blacktown soil landscape also has the potential to contain sub-surface archaeological remains, as it is an old, residual landscape that has essentially remained stable over a long period of time, allowing for the accumulation of artefactual material before burial.

The rail corridor component of the study area has been subject to large-scale land disturbance and modification which has removed its potential to contain *in situ* archaeological deposits and/or sites.

The areas adjacent to the rail corridor between Quakers Hill and Schofields and Riverstone and Vineyard have seen significantly less intensive disturbance and modification. This has mostly been in the form of vegetation clearance and small scale farming. Widespread archaeological research has shown that basic land clearance and pastoral activities have a low impact on archaeological sites. Therefore, given their close proximity to water and other resources, there is a strong likelihood that they may contain archaeological sites and/or deposits.