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Sydney Metro – Western Sydney Airport

Appendix J
Aboriginal Archaeological Report

Sydney Metro – Western Sydney Airport

Aboriginal Archaeological Report

April 2021

Sydney Metro – Western Sydney Airport

Aboriginal Archaeological Report

April 2021

Client: Sydney Metro

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Glossary terms and abbreviations

Term	Definition
AAR	Aboriginal Archaeological Report
Aboriginal archaeological sensitivity	Area retains potential for the presence of surface and/or subsurface Aboriginal archaeological deposits. Areas of Aboriginal archaeological sensitivity, when compared to areas of low potential, would be expected to have higher artefact counts, densities and assemblage richness values expected. Archaeological features such as knapping floors and hearths are also more likely to occur in these areas. The integrity of deposit(s) will be dependent on the nature of localised land disturbance activities and geomorphic phenomena.
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, song lines and places) cultural practices and traditions associated with past and present-day Aboriginal communities
Aboriginal object	Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW
Aboriginal place	Any place declared to be an Aboriginal place under Section 94 of the *National Parks and Wildlife Act 1974* (NSW)
ACHAR	Aboriginal Cultural Heritage Assessment Report
ACHMP	Aboriginal Cultural Heritage Management Plan
AEPR	Airports (Environment Protection) Regulations 1997
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System - a register of New South Wales (NSW) Aboriginal heritage information maintained by Environment, Energy and Science (EES), which is a group within the NSW Department of Planning, Industry and Environment
AHIP	Aboriginal Heritage Impact Permit
ASIR	Aboriginal Site Impact Recording
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
BP	Before Present is a term used by archaeologists and geologists referring to dates obtained by radiocarbon dating. The “present” in this case is not the present day, which is constantly changing and therefore is unable to be used as a consistent point from which to measure. Instead the year 1950 was chosen to be used as the “present” for this term
CBD	Central Business District
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CHL	Commonwealth Heritage List
CMA	Catchment Management Authorities
CMP	Conservation Management Plan

Term	Definition
construction footprint	The total extent of land required for the construction of the project, including ancillary facilities, services and land temporarily required for construction (incorporating construction elements such as compounds, access tracks and worksites)
CSSI	Critical State Significant Infrastructure
DEOH	Defence Establishment Orchard Hills
DPC	Department of Premier and Cabinet
DPIE	NSW Department of Planning, Industry and Environment. As of 1 July 2020 management of Aboriginal Cultural Heritage in NSW moved from DPIE to Heritage NSW in the Department of Premier and Cabinet (DPC)
earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock
EES	Environment, Energy and Science, which is a division within the NSW Department of Planning, Industry and Environment (DPIE). As of 1 July 2020 management of Aboriginal Cultural Heritage in NSW moved from DPIE to Heritage NSW in the Department of Premier and Cabinet (DPC)
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Planning Instruments
erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle
floodplain	An area of land which is inundated by floods up to and including the probable maximum flood event (i.e. flood prone land)
GPS	Global Positioning System
GSV	Ground Surface Visibility
heritage item	Any place, building or object listed on a statutory heritage register
HHMP	Historical Heritage Management Plans
HMP	Heritage Management Plan
ILUA	Indigenous Land Use Agreements
impact	Influence or effect exerted by the project or other activity on the natural, built and community environment
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MLD	Maximum linear dimension
NHL	National Heritage List
NNTT	National Native Title Tribunal
NPW Act	*National Parks and Wildlife Act 1974*
NTA	*Native Title Act 1993*

Term	Definition
OEH	Office of Environment and Heritage
PAD	Potential Archaeological Deposit
paleochannel	Ancient river systems eroded deeply into the landscape and infilled with saturated alluvial sediments
RAP	Registered Aboriginal Party
RNE	Register of the National Estate
road reserve	A legally defined area of land within which facilities such as roads, footpaths and associated features may be constructed for public travel
SEARs	Secretary's Environmental Assessment Requirements
SEPP SRD	*State Environmental Planning Policy (State and Regional Development) 2011*
SSI	State Significant Infrastructure
Sydney Metro - Western Sydney Airport (the project)	The Sydney Metro - Western Sydney Airport between St Marys and Western Sydney Aerotropolis comprises a new north-south metro railway around 23 kilometres in length, creating passenger rail access to Western Sydney Airport, the Aerotropolis and a connection with the T1 Western Line
Western Sydney Aerotropolis	This includes the land surrounding Western Sydney International (including Bringelly, Luddenham, Kemps Creek, Badgerys Creek and Rossmore) where commercial and residential property development is proposed, supported by key infrastructure. This will include commercial and industrial precincts, and agricultural land, as well as transport corridors
Western Sydney Airport	The Australian government-owned organisation responsible for delivering and operating Western Sydney International

Executive summary

The *Greater Sydney Region Plan* (Greater Sydney Commission, 2018a) sets the vision and strategy for Greater Sydney to become a global metropolis of three unique and connected cities; the Eastern Harbour City, the Central River City and the Western Parkland City. The Western Parkland City incorporates the future Western Sydney International (Nancy-Bird Walton) Airport (hereafter referred to as Western Sydney International) and Western Sydney Aerotropolis (hereafter referred to as the Aerotropolis).

Sydney Metro – Western Sydney Airport (the project) is identified in the *Greater Sydney Region Plan* as a key element to delivering an integrated transport system for the Western Parkland City. The project would be located within the Penrith and Liverpool Local Government Areas (LGAs) and would involve the construction and operation of a new metro railway line around 23 kilometres in length between the T1 Western Line at St Marys in the north and the Aerotropolis in the south (the area to be called Bradfield). This would include a section of the alignment which passes through and provides access to Western Sydney International.

The project is characterised into components that are located outside Western Sydney International (off-airport) and components that are located within Western Sydney International (on-airport), to align with their different planning approval pathways required under State and Commonwealth legislation.

The project has been declared as a Critical State Significant Infrastructure (CSSI) project. In October 2020, M2A (a joint venture between WSP and AECOM Australia Pty Ltd) prepared an Aboriginal Cultural Heritage Assessment Report (ACHAR) for inclusion within the Environmental Impact Statement. The ACHAR reported the results of initial archaeological survey works undertaken for the project. Due to limited property access and COVID-19 related restrictions, a full program of archaeological survey and test excavation had been unable to occur prior to exhibition of the ACHAR and Environmental Impact Statement. Mitigation measures outlined in the ACHAR, therefore, included requirements for further survey, testing and Aboriginal community consultation as access to land parcels became available, with the intention that a revised ACHAR would be prepared and attached to the Submissions Report for the Project.

This Aboriginal Archaeological Report (AAR) also forms an appendix to the Submissions Report for the project. This document has been compiled in accordance with Requirement 11 of Heritage NSW's C*ode of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b) (Code of Practice). It is intended that this report be read in conjunction with the revised ACHAR. The purpose of this document is to provide details of the survey and text excavation undertaken to date and the results of these works in relation to identified sites and areas of Aboriginal archaeological potential.

The study area for the project was defined as a 58 kilometre by nine kilometre area, which was the subject of a series of Aboriginal Heritage Information Management System (AHIMS) searches to determine the presence/absence of previously recorded Aboriginal sites and to gain sub-regional Aboriginal site distribution data. The primary focus in relation to assessing likely direct impacts was on the construction footprint within the study area; which covers the total extent of land required for the construction of the project, including ancillary facilities and services and land temporarily required for construction (incorporating construction elements such as compounds, access tracks and construction footprint). A buffer of 200 metres surrounding the construction footprint has also been considered in relation to impacts, as there is a regular 200 metre error for centroid coordinates in the AHIMS register due to legacy data issues with changing datum use over time. Areas proposed for power line routes and surface areas above subsurface tunnels were also considered, with consideration given to the risk of impacts from ground movement or vibration in the above tunnel areas.

Searches of the AHIMS database for the study area resulted in the identification of a total of 360 Aboriginal sites, out of which 328 were valid, 30 had previously been destroyed and further investigation had identified that two were not of Aboriginal origin (reclassified Not a Site). Of the valid sites, a total of 10 were found to have centroids registered within the bounds of the construction footprint (eight on-airport and two off-airport) and a further two were found to have associated areas of Potential Archaeological Deposit (PAD) that extended partially into the off-airport construction footprint. Of the two with centroids located within the off-airport area, one was identified as having

been destroyed under the conditions of an Aboriginal Heritage Impact Permit (AHIP). The other was a valid artefact scatter site (45-5-2640) located in the Aerotropolis Core construction footprint.

Surveys of accessible sections of the construction footprint were initially undertaken over four non-consecutive days in February, March, April and June 2020 (Thursday 27 February, Wednesday 4 March, Tuesday 28 April 2020 and Friday 12 June 2020). At this stage of the project, access was only available for limited sections of the construction footprint, due to private property access restrictions and COVID-19 constraints. In all instances, surveys were conducted by a combined field team of one M2A archaeologist and a representative from the relevant Local Aboriginal Land Council (LALC), being either Gandangara LALC and Deerubbin LALC.

Two new sites were identified during these initial field surveys, consisting of one isolated artefact and one artefact scatter. These were recorded as WSI-IA1-20 and WSI-AS1-20 respectively. Both sites were located outside the bounds of the construction footprint within the bounds of Western Sydney International. The location for previously recorded artefact scatter site 45-5-2640 was inspected at this time, but no surface expression of artefacts was identified, most likely due to high levels of vegetation obscuring the ground during the inspection.

Further access was provided to some of the properties within the off-airport construction footprint between October 2020 and February 2021. During this time these areas were subject to survey, with test excavations also undertaken in several areas of identified Aboriginal archaeological sensitivity. Participants from various RAP groups were in attendance for the fieldwork, including representatives from A1 Indigenous Services, Arugung Aboriginal Cultural Heritage Site Assessments, Corroboree Aboriginal Corporation, Cubbitch Barta, Darug Custodian Aboriginal Corporation, Deerubbin Local Aboriginal Land Council, DNC, Gandangara Local Aboriginal Land Council, Gunyuu, Kamilaroi Yankuntjatjara Working Group, Murra Bidgee Mullangari Aboriginal Corporation, Tocomwall, Wailwan Aboriginal Group and Walbunja.

Three surface sites, consisting exclusively of artefact scatters, were identified as a result of additional survey works within the study area. They were designated as SMWSA-AS1, SMWSA-AS5 and SMWSA-AS6. Two of these sites (SMWSA-AS1 and SMWSA-AS5) are located wholly outside the construction footprint (although SMWSA-AS1 is in a surface area above proposed subsurface tunnels). Site SMWSA-AS6 is located wholly inside of the construction footprint, in the off-airport construction corridor (southern).

Areas of subsurface Aboriginal archaeological potential within the construction footprint were determined based on the presence of surface sites, consultation with RAPs and identification of sensitive landforms (including areas of low disturbance in close proximity to water sources). Landform elements adjacent to Blaxland Creek, Cosgroves Creek and Badgerys Creek as well as several of their tributaries, were assessed as retaining potential for the presence of subsurface Aboriginal archaeologically deposits where they had not been subject to gross levels of past disturbance.

Due to generally low levels of visibility across identified areas of sensitivity within the construction boundary, systematic test excavations were undertaken in these areas. Test pits measuring 50 centimetres by 50 centimetres were excavated, across each area, with test pits spaced at 50 metre intervals. Between October 2020 and February 2021 a total of 196 test pits were excavated across identified areas of Aboriginal archaeological sensitivity. Of these, 22 test pits (11.2 per cent) were found to contain Aboriginal objects, with densities ranging from one to five objects per 0.25 metres squared. Collectively, a total of 42 lithic items were identified which satisfied the technical criteria for identification as artefacts.

Taking into account the results of all archaeological survey and test excavation works undertaken for the project up to and including February 2021, a total of 10 Aboriginal archaeological sites are recognised as being wholly within the off-airport section of the construction footprint, with two sites that have Potential Archaeological Deposits (PAD) curtilages partially extending into it. Identified sites consist of three valid previously recorded artefact scatter sites, being B22 (45-5-2640) BWB (45-5-5298) and CCE T3 (45-5-5297). Survey identified another artefact scatter site (SMWSA-AS6), while test excavation has identified five artefact scatters (SMWSA-AS2, SMWSA-AS3, SMWSA-AS4, SMWSA-AS7 and SMWSA-AS8) and three isolated artefact sites (SMWSA-IA1, SMWSA-IA2 and SMWSA-IA3) within the off-airport construction footprint.

An assessment of the scientific significance of all newly and previously recorded Aboriginal sites within the off-airport portion of the construction footprint has been carried out, with significance ratings offered on the basis of the assessed research potential, rarity and representativeness of each site on a local and regional scale. Of the 12 sites wholly or partially within the off-airport construction footprint, a total of eight sites have been assessed as having low scientific significance and four as having moderate scientific significance. No sites of high scientific significance have been identified within the off-airport construction footprint.

Proposed ground disturbance activities within the construction footprint are anticipated to impact all of the 12 Aboriginal archaeological sites identified within it, with a total loss of value for the 10 sites wholly within the off-airport construction corridor, and partial impacts to those two with PAD curtilages partially extending into it. There are also further areas of subsurface Aboriginal archaeological sensitivity that have not yet been subject to survey or test excavation due to landholder access limitations on the project to date.

Mitigation measures have been developed to manage potential impacts to the known and potential Aboriginal cultural heritage values of the study area. These mitigation measures are contained in full in the Revised ACHAR.

1. Introduction

The Greater Sydney Region Plan (Greater Sydney Commission, 2018a) sets the vision and strategy for Greater Sydney to become a global metropolis of three unique and connected cities; the Eastern Harbour City, the Central River City and the Western Parkland City. The Western Parkland City incorporates the future Western Sydney International (Nancy-Bird Walton) Airport (hereafter referred to as Western Sydney International) and Western Sydney Aerotropolis (hereafter referred to as the Aerotropolis).

Sydney Metro – Western Sydney Airport (the project) (see Figure 1-1) is identified in the Greater Sydney Region Plan as a key element to delivering an integrated transport system for the Western Parkland City. The project would be located within the Penrith and Liverpool Local Government Areas (LGAs) and would involve the construction and operation of a new metro railway line around 23 kilometres in length between the T1 Western Line at St Marys in the north and the Aerotropolis in the south (the area to be called Bradfield). This would include a section of the alignment which passes through and provides access to Western Sydney International.

The project is characterised into components that are located outside Western Sydney International (off-airport) and components that are located within Western Sydney International (on-airport), to align with their different planning approval pathways required under State and Commonwealth legislation.

The project has been declared as a Critical State Significant Infrastructure (CSSI) project. In October 2020, M2A (a joint venture between WSP and AECOM Australia Pty Ltd) prepared an Aboriginal Cultural Heritage Assessment Report (ACHAR) for inclusion within the Environmental Impact Statement (Sydney Metro, 2020). The ACHAR reported the results of initial archaeological survey works undertaken for the project. Due to limited property access and COVID-19 related restrictions, a full program of archaeological survey and testing had been unable to occur prior to exhibition of the ACHAR and Environmental Impact Statement. Mitigation measures outlined in the ACHAR, therefore, included requirements for further survey, testing and Aboriginal community consultation as access to land parcels became available, with the intention that a Revised ACHAR would be prepared and attached to the Submissions Report for the Project.

This Aboriginal Archaeological Report (AAR) has been compiled in accordance with Requirement 11 of Heritage NSW's C*ode of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b) (Code of Practice). It is intended that this report be read in conjunction with the Revised ACHAR. The purpose of this document is to provide details of the survey and text excavation undertaken to date and the results of these works in relation to identified sites and areas of Aboriginal archaeological potential. This document also updates and refines the known data and defined areas of Aboriginal archaeological sensitivity within the off-airport construction footprint, beyond what was possible for the earlier ACHAR prepared at the time of exhibition for the Environmental Impact Statement. Further consultation and fieldwork undertaken since then has enabled the development of further knowledge and has been taken into consideration in this report as well as the Revised ACHAR. Recommendations and mitigation measures have also been updated accordingly.

This report documents all archaeological field investigations undertaken for the project up to and including February 2021. An accompanying review of relevant environmental, archaeological and ethnohistorical information for the study area provides a framework for presenting and discussing the results of the archaeological fieldwork undertaken to date. Appropriate management measures have been developed as a result of the assessment results, which have defined the potential impacts of the proposed development on both known and potential Aboriginal archaeological resources and are included in full in the associated Revised ACHAR.

The draft of this AAR was provided to RAPs for comment on 17 February 2021. Ultimately, a total of 13 responses were received, although one of these was relevant for 42 RAPs operating under the Murrin Administrative Services. Twelve RAP respondents indicated that they supported the AAR, with no changes required. The thirteenth respondent provided comments on the documents but did not directly address this point. The responses received from the RAPs are summarised and provided in full in Appendix H of the Revised ACHAR.

1.1 The proponent

The proponent for this investigation is Sydney Metro, a registered Australian company (ABN: 12 354 063 515) based in Sydney, NSW.

1.2 Description of the project

Key operational features of the project are shown on Figure 1-1 and would include:

- around 4.3 kilometres of twin rail tunnels (generally located side by side) between St Marys (the northern extent of the project) and Orchard Hills
- a cut-and-cover tunnel around 350 metres long (including tunnel portal), transitioning to an in-cutting rail alignment south of the M4 Western Motorway at Orchard Hills
- around 10 kilometres of rail alignment between Orchard Hills and Western Sydney International, consisting of a combination of viaduct and surface rail alignment
- around two kilometres of surface rail alignment within Western Sydney International
- around 3.3 kilometres of twin rail tunnels (including tunnel portal) within Western Sydney International
- around three kilometres of twin rail tunnels between Western Sydney International and the Aerotropolis Core (the area to be called Bradfield)
- six new metro stations:
  - four off-airport stations:
    - St Marys (providing interchange with the T1 Western Line)
    - Orchard Hills
    - Luddenham Road
    - Aerotropolis Core
  - two on-airport stations:
    - Airport Business Park
    - Airport Terminal
- grade separation of the track alignment at key locations including:
  - where the alignment interfaces with existing infrastructure such as the Great Western Highway, M4 Western Motorway, Lansdowne Road, Patons Lane, the Warragamba to Prospect Water Supply Pipelines, Luddenham Road, the future M12 Motorway, Elizabeth Drive, Derwent Road and Badgerys Creek Road
  - crossings of Blaxland Creek, Cosgroves Creek, Badgerys Creek and other small waterways to provide flood immunity for the project
- modifications to the existing Sydney Trains station and suburban rail network at St Marys (where required) to support interchange and customer transfer between the new metro station and the T1 Western Line
- a stabling and maintenance facility and operational control centre located to the south of Blaxland Creek and east of the proposed metro track
- new pedestrian, cycle, park-and-ride and kiss-and-ride facilities, public transport interchange infrastructure, road infrastructure and landscaping as part of the station precincts.

The project would also include:

- turnback track arrangements (turnbacks) at St Marys and Aerotropolis Core to allow trains to turn back and run in the opposite direction

- additional track stubs to the east of St Marys Station and south of the Aerotropolis Core Station to allow for potential future extension of the line to the north and south respectively without impacting future metro operations
- an integrated tunnel ventilation system including services facilities at Claremont Meadows and at Bringelly
- all operational systems and infrastructure such as crossovers, rail sidings, signalling, communications, overhead wiring, power supply, lighting, fencing, security and access tracks/paths
- retaining walls at required locations along the alignment
- environmental protection measures such as noise barriers (if required), on-site water detention, water quality treatment basins and other drainage works.

1.2.1 Off-airport project components

The off-airport components of the project would include the track alignment and associated operational systems and infrastructure north and south of Western Sydney International, four metro stations, the stabling and maintenance facility, two service facilities and a tunnel portal.

The key project features and the design development process are described in more detail in Appendix B of the Submissions Report.

1.2.2 On-airport project components

The on-airport components of the project would include the track alignment and associated operational systems and infrastructure within Western Sydney International, two metro stations and a tunnel portal.

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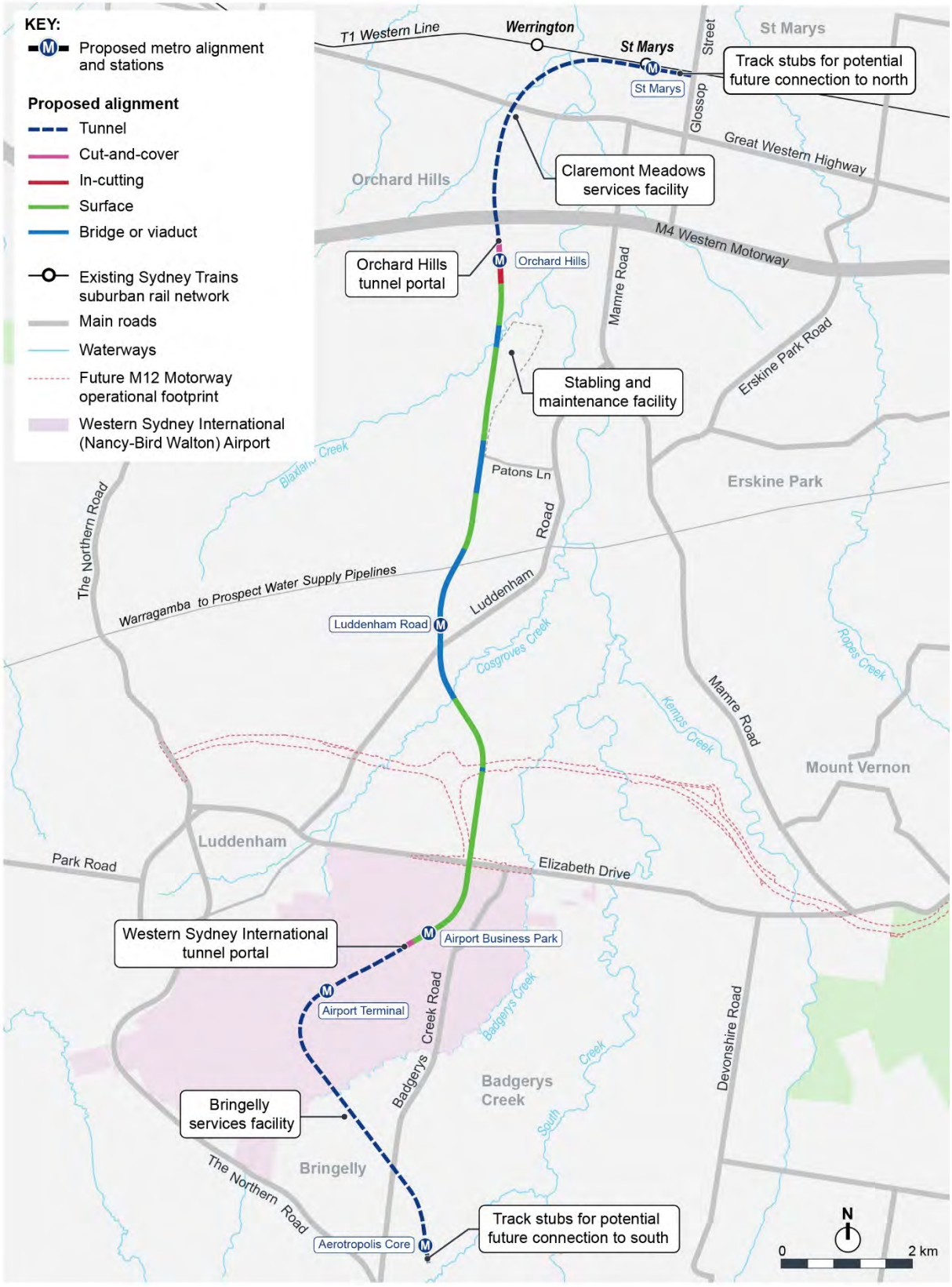


Figure 1-1 Project alignment and key features

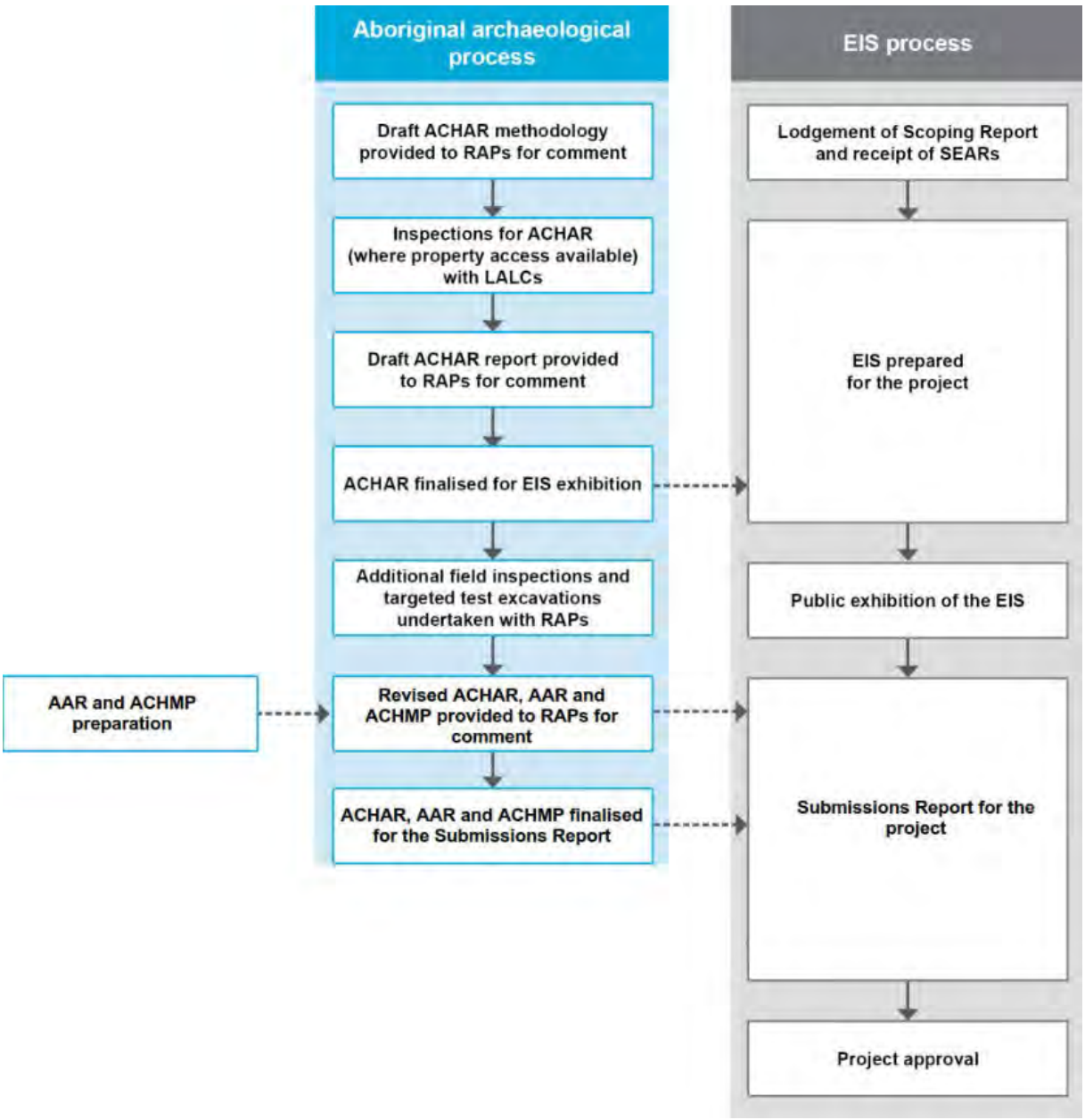


Figure 1-2 Aboriginal archaeological assessment, reporting and management process flowchart

1.2.3 Project construction

Construction of the project would involve:

- enabling works
- main construction works, including:
  - tunnelling and associated works
  - corridor and associated works
  - stations and associated works
  - ancillary facilities and associated works
  - construction of ancillary infrastructure including the stabling and maintenance facility
- rail systems fitout
- finishing works and testing and commissioning.

These activities are described in more detail in Appendix B of the Submissions Report.

The construction footprint for the project is shown on Figure 1-3.

Main construction works for the project are expected to commence in 2021, subject to planning approval, and take around five years to complete. An overview of the construction program is provided in Appendix B of the Submissions Report.

1.3 The study area and construction footprint

Details of the wider assessment undertaken for this project are included in the Revised ACHAR. As the technical report referring specifically to the archaeological investigations, this AAR contains details of the research undertaken to investigate previously recorded AHIMS in relation to the study area and construction footprint.

The size of the study area was defined by the AHIMS searches undertaken for this assessment. The three combined searches covered an approximate area of 58 kilometres by nine kilometres, centred on the construction footprint. References to the study area refer this area covered by the AHIMS searches, which includes the construction footprint as well as the permanent power supply alignment that is proposed between the southern end of the stabling and maintenance facility construction area and an existing Endeavour Energy substation at Erskine Park (the Mamre Zone Substation) and the temporary power supply alignments that are proposed from Claremont Meadows and Kemps Creek.

While the primary impacts of this project would be direct impacts to known sites and areas of archaeological sensitivity within the bounds of the construction footprint, the larger study area provides context for those sites and areas in the surrounding region. It also allows for considerations of the project within a broader landscape. The risks for accidental and indirect impacts to sites outside the bounds of, but in close proximity to, the construction footprint were considered as part of the assessment for sites within 200 metres of the construction footprint. The reason for a 200 metre buffer is that the most common form of coordinate inaccuracy in the AHIMS register is due to the incorrect datum being applied to a site coordinate, which results in a variance of approximately 200 metres. Including a buffer of this size will capture any sites with such coordinate errors, as well as sites whose registered centroids are outside the construction footprint but are large enough to extend across the boundary. The potential for indirect impacts to occur, such as visual and related to vibration/settlement, have also been considered. The primary risk with regard to indirect impacts is that any subsidence in areas above tunnelling activity could impact upon either known sites or areas of archaeological sensitivity.

The construction footprint is defined by the boundary shown on Figure 1-3. The construction footprint crosses through multiple land holdings within the Penrith and Liverpool Local Government Areas (LGAs), including existing road reserves and various parcels of private land. It also passes through three areas of Commonwealth land, being Defence Establishment Orchard Hills (DEOH), the Royal Australian Air Force Telecommunications Unit at Bringelly and Western Sydney International.

For ease of reference in this assessment, the off-airport area has been divided up into the following construction areas:

- St Marys
- Claremont Meadows services facility
- Orchard Hills
- Stabling and maintenance facility
- Off-airport construction corridor
- Luddenham Road
- Bringelly services facility
- Aerotropolis Core.

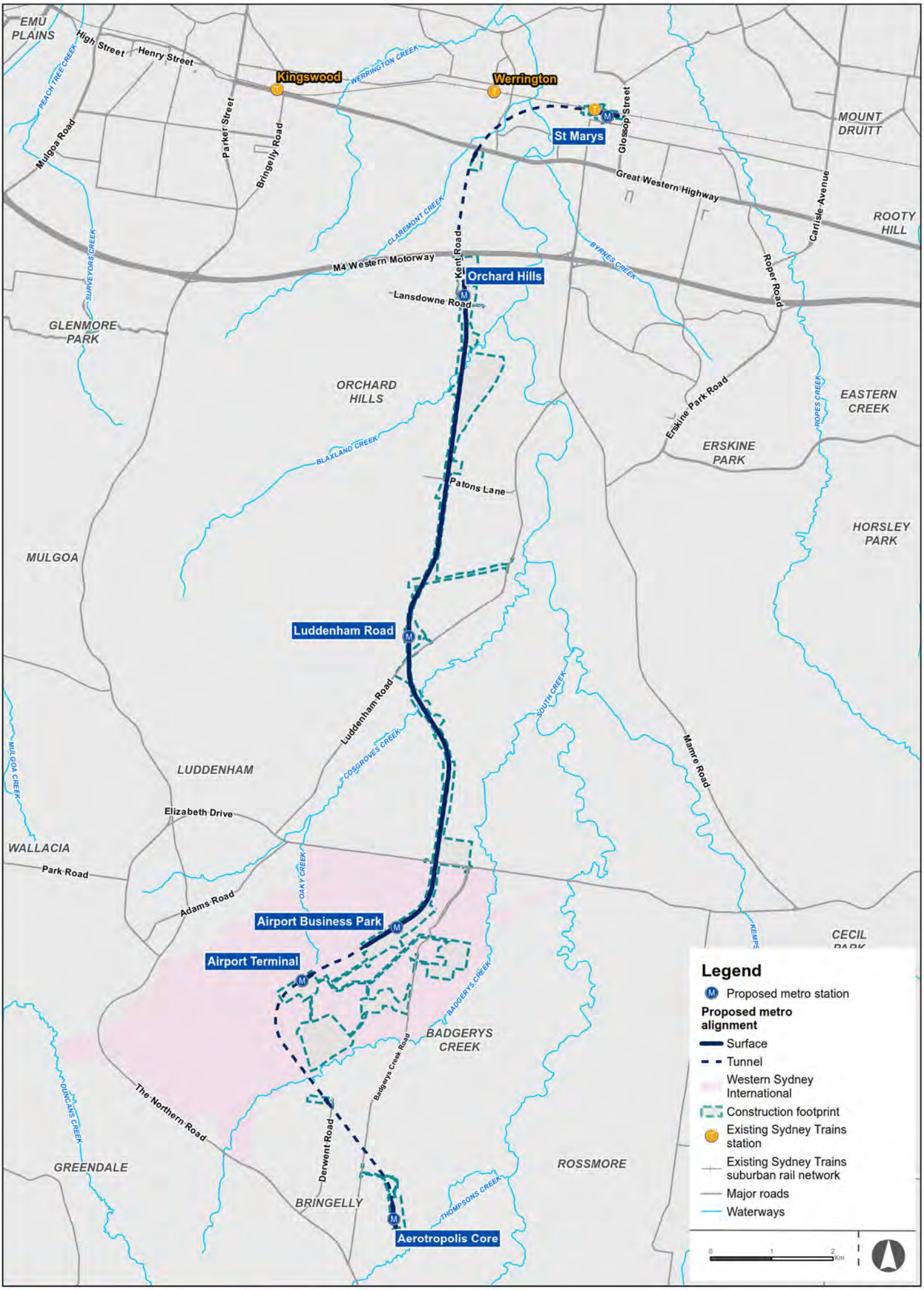
For ease of reference in this assessment, the on-airport area has been divided up into the following construction areas:

On-airport (within the Stage 1 construction impact zone)

- On-airport construction corridor
- Airport Business Park
- Western Sydney International tunnel portal
- Airport terminal
- Airport construction support site

On-airport (outside the Stage 1 construction impact zone)

- Airport construction support site.



Sydney Metro – Western Sydney Airport

Construction footprint overview

Figure 1-3

Indicative only, subject to design development

1.4 Objectives of AAR

This AAR is technical report prepared as a result of undertaking archaeological investigations, as per the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (NSW Department of Environment Climate Change & Water, 2010). While the Revised ACHAR is a written report documenting the process of investigation, consultation and assessment, the AAR is written to provide in detail the archaeological investigations and the technical results of the survey and test excavation investigations. The purpose of this document is to provide details of the survey and text excavation undertaken to date and the results of these works in relation to identified sites and areas of Aboriginal archaeological potential.

Please note there is some repetition of content between the Revised ACHAR and AAR. This is to meet the format and content requirements of each as stand-alone reports.

1.5 Report structure summary

This report is structured under the following headings:

1 Introduction – this section, has provided an overview and background context on the project, including the legislative and statutory controls of relevance to the assessment

2 Environmental Context – provides a description the existing environment of the study area and its associated archaeological implications, including a basic summary of the landscape and its implications for Aboriginal sites

3 Archaeological Context – provides a summary of the regional and local archaeological context of the project

4 Archaeological survey – presents the findings of the preliminary field inspections and subsequent archaeological surveys undertaken for the project

5 Archaeological test excavation – presents the findings of the archaeological test excavation program

6 Scientific significance assessment – outlines the identified scientific values and heritage significance of sites identified within the off-airport construction footprint

7 Impact assessment – lists the areas of archaeological potential, and the potential impacts of the project on Aboriginal heritage, including a cumulative impact assessment

8 Cumulative Impact Assessment – outlines the cumulative impact of development across the broader region on known and potential Aboriginal sites and values

9 Recommendations – provides an overview of the management and mitigation approach for the project

10 References – provides a full list of the references used to inform this technical paper.

1.6 Project team

The primary author of this report is Dr Darran Jordan (Principal Archaeologist), who has a PhD in archaeology from the University of Sydney and has been working as a heritage specialist for over 15 years. Report inputs and fieldwork activity were also undertaken by Dr Andrew McLaren (Principal Archaeologist), Geordie Oakes (Principal Archaeologist), Luke Wolfe (Senior Archaeologist) and Julia Atkinson (Professional Archaeologist).

2. Environmental context

2.1 Landscape context

The nature and distribution of Aboriginal archaeological sites is closely linked to the environments in which they occur. Environmental variables such as topography, geology, hydrology and vegetation will have played a critical role in influencing how Aboriginal people moved within and utilised their respective Country. Amongst other things, these variables affected the availability of suitable campsites, drinking water, plant and animal resources and raw materials for the production of stone and organic implements. Accordingly, any attempt to predict or interpret the character and distribution of Aboriginal sites in a given landscape must take such environmental factors into account. At the same time, an assessment of historic land use activities and geomorphic processes, both contemporary and historic, allows predictions to be made concerning the survival, visibility and integrity of any existing Aboriginal archaeological materials.

2.2 Physical setting

The project is located approximately 40 kilometres west of the Sydney Central Business District (CBD), between the suburbs of St Marys and Bringelly and within the Penrith and Liverpool LGAs. The project comprises a predominately linear stretch of land, aligned roughly north to south, approximately 23 kilometres in length. The total construction footprint (approximately 439 hectares (ha)), encompasses a small complex at the existing St Marys Station and a larger, mostly continuous portion located between the Great Western Highway and the intersection of Badgerys Creek Road with the Northern Road, just south of Western Sydney International.

Most of the study area is flat to gently undulating land, with floodplains, gentle slopes and rises. A large portion of the area has been cleared for past pastoral activities and is dominated by pasture grasslands. Portions of the study area (particularly at its northern extent) have been more heavily developed for residential and commercial purposes. Roadways run through the study area, connecting the various parts of the landscape. Extant connections of the deeper past are present in the form of waterways that cross the study area in multiple places. Although the waterways are indicative of the landscape of the past it is important to note that due to meandering, over time the routes may have changed with the present alignments not necessarily reflecting one consistent route throughout the history of this area. Similarly, increased erosion caused by clearing and development is likely to have channelised the waterways, which may have been shallower and broader or consisted of chains of ponds in the past.

2.3 Topography

The topography of the construction footprint is typical of Bannerman and Hazelton's (1990) Cumberland Lowlands physiographic region and can be broadly characterised as flat to undulating, with floodplains, ridges and flat topped terraces dissected by the drainage depressions of larger watercourses and their tributaries. Landforms within the construction footprint are dominated by undulating slopes and crests, with higher and steeper terrain rising gradually in the south. Elevations within the construction footprint average at approximately 57 metres Australian Height Datum (AHD) but range from low-lying alluvial flats of 26 metres AHD surrounding the Badgerys Creek and Blaxland Creek stream channels, to moderately inclined mid and upper slopes further from larger watercourses. The highest point within the construction footprint consists of a crest in the far southwest, with an elevation of 94 metres AHD.

2.4 Hydrology

The project is located within the South Creek catchment – defined by a network of tributaries that originate in the higher terrain south of Catherine Field and combine into larger and more permanent waterways as they drain north towards Windsor. South Creek is a dominant feature of the catchment and is located as a perennial fourth order stream between 200 metres and two kilometres east of the project for the majority of the alignment. Tributaries of South Creek cross through the project at multiple points. These include various ephemeral streams throughout the construction footprint such

as Cosgroves Creek and the higher order perennial streams of Badgerys Creek in the south and Blaxland Creek in the north, at a point just southwest of its confluence with South Creek.

Historic land use practices such as damming, vegetation clearance and flood-mitigating construction across the construction footprint have affected natural stream flows. As such, modern stream alignments may not fully represent the locations and extents of waterways that existed during periods of Aboriginal occupation. However, the Quaternary surface geology underlying the major streams and floodplains within the construction footprint suggests South Creek and its larger tributaries have not substantially deviated from their current alignments since at least the Pleistocene era.

The implications of this hydrology are that sections of the construction footprint would have contained sufficient freshwater to support the year-round and/or repeated activities of past Aboriginal groups, while other portions further from reliable streams may have only been utilised infrequently, or opportunistically. As such, there is potential for higher densities of archaeological material associated with the sections of the construction footprint in close proximity to South Creek, Badgerys Creek and Blaxland Creek. Sensitivity has been assessed across multiple landforms for the study area, taking into consideration not only proximity to water, but also the presence of other previously recorded sites, past disturbance and any other cultural features shared during consultation.

2.5 Surface geology

Reference to the 1:100,000 Geological Series Sheet for Penrith (9030) (Clark & Jones, 1991) indicates that the surface geology of the construction footprint comprises a mixture of Middle Triassic Bringelly Shale (Rwb) and Quaternary Alluvium (Qal), with a small section of Tertiary St Marys Formation (Ts) located to the far north.

Bringelly Shale is strongly associated with the presence of undulating hills in the region and mantles most of the construction footprint, closely corresponding with the observed topography. Bringelly Shale, deposited in a swampy alluvial plain, is the uppermost formation of the Wianamatta Group and consists of shale, carbonaceous claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff (Clark & Jones, 1991).

Quaternary Alluvium (Qal), characterised by quartz and lithic “fluvial” sand, silt and clay, extends in roughly southwest to northeast running bands across sections of the construction footprint that cross major streams (Clark & Jones, 1991). Quaternary Alluvium is closely associated with perennial waterways and floodplains within the region of the project and is of potential Aboriginal archaeological significance as a primary source of raw stone materials. Exposed silcrete boulders have been observed along the eastern bank of South Creek in the vicinity of the construction footprint to the north of Elizabeth Drive (AAJV, 2019:109).

St Marys Formation (Ts) extends into the far eastern side of the existing St Marys Station portion of the construction footprint and is characterised by laterised sand and clay with ferricrete bands containing silcrete, sandstone and shale boulders (Clark & Jones, 1991). This formation has been investigated at the nearby Plumpton Ridge (approximately seven kilometres northeast of the construction footprint) and found to contain quarry sites, with extensive evidence of silcrete extraction and preparation (Kelleher Nightingale Consulting Pty Ltd, 2009; National Heritage Studies Pty Ltd, 1990).

2.6 Soil and geomorphology

Soils within the construction footprint have been mapped by Bannerman and Hazelton (2011) as belonging to two distinct soil landscapes: Residual Blacktown (REbt) and Alluvial South Creek (ALsc) (Bannerman & Hazelton, 2011).

Blacktown soils are associated with the slopes and underlying Bringelly Shale and occur across most of the construction footprint. They have been characterised by Bannerman and Hazelton (2011) as shallow to moderately deep, hardsetting mottled texture contrast soils, with red and brown podzolic soils on crests, which grade into yellow podzolic soils on lower slopes and in drainage lines. Blacktown subsoils are moderately to highly erodible where organic matter is low; however, topsoils vary between low and moderately erodible, as fine sand and silt contents are balanced by the presence of moderate

levels of dense organic matter. Consequently, the majority of the construction footprint has moderate potential for containing archaeological material; however, in situ material is unlikely due to erosion.

South Creek soils follow the underlying Quaternary geology across the floodplains and flats of the construction footprint. They have been characterised by Bannerman and Hazelton (2011) as deeply layered sediments over bedrock or relict soils. Where soil deposition has occurred, structured clays or loams are immediately adjacent to drainage lines, with red and yellow podzolic soils on terraces, in addition to small areas of structured grey clays, leached clay and yellow solodic soils. The soils are subject to seasonal waterlogging and have permanently high water tables. The dynamic nature of the soil landscape can encourage both high levels of erosion and deposition. As such, artefacts may be buried at depth, or removed from their original contexts. The acidity of both soil types is of potential import archaeologically, as organic materials are vulnerable to decomposition in soils of high pH (Matthiesen, 2004). If skeletal remains or shells were present at the site in the past, it is unlikely that they would survive in the archaeological record today.

As in other parts of the Cumberland Plain, existing archaeological, environmental and historic reference materials suggest that a range of geomorphic processes are likely to have affected the Aboriginal archaeological record of the site. Potentially significant phenomena from an archaeological perspective include bioturbation, erosion and alluvial/colluvial aggradation. Possible effects of these processes include:

- increased archaeological site visibility in eroded areas
- reduced archaeological site visibility in areas of sediment deposition
- horizontal and vertical translocation of artefacts
- stratigraphic mixing
- truncation of archaeological deposits
- creation of thicker and potentially stratified archaeological deposits in floodplain and slope base contexts.

2.7 Flora and fauna

Contemporary flora and fauna have both been assessed separately in the Revised Biodiversity Development Assessment Report (Appendix G of the Submissions Report). The results of that study found that there are currently five plant community types within the study area, being:

- Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- Forest Red Gum - Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin Bioregion
- Grey Box - Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin Bioregion
- *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin Bioregion
- Swamp Oak Open Forest on River flats of the Cumberland Plain and Hunter Valley.

Five threatened ecological communities were also identified in the study area, being:

- Cumberland Plain Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Shale Gravel Transition Forest in the Sydney Basin Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

The report also predicted fauna species likely to occur based on vegetation surrogates and landscape features, with a range of amphibians, reptiles, mammals and birds listed as likely to occur within the study area.

It is important to note that while the current flora and fauna species may be indicative of likely past conditions, they are not necessarily representative of the same resources that would have been available to Aboriginal people in this area in the past (not discounting that they may still have cultural significance for contemporary communities as examples of cultural resources). Native vegetation within the construction footprint has been heavily modified as a result of historic land clearance activities, with the majority cleared historically for grazing and/or cropping. With reference to Tozer's (2003) survey of native vegetation across the Cumberland Plain, the available evidence suggests that the construction footprint is likely to once have contained more widespread Shale Plains Woodland vegetation communities, with Alluvial Woodland along waterways and Shale Hills Woodland in the higher terrain to the south.

Shale Plains Woodland is the most widely distributed community on the Cumberland Plain (Tozer, 2003: 36). It is typically dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*), with Narrow-leafed Ironbark (*E. crebra*), Thin-leafed Stringybark (*E. eugenioides*) and Spotted Gum (*Corymbia maculata*) also occurring, though less frequently. A shrub stratum dominated by Blackthorn (*Bursaria spinosa*) is usually also present. Common ground stratum species for this vegetation community include Kidney Weed (*Dichondra repens*), Threeawn Speargrass (*Aristida vagans*), Weeping Grass (*Microlaena stipoides*), Kangaroo Grass (*Themeda australis*), Brunoniella (*Brunoniella australis*), Tender Tick-trefoil (*Desmodium varians*), Thin Leaf Stink Weed (*Opercularia diphylla*), *Blue Bell* (*Wahlenbergia gracilis*) and Shorthair Plumegrass (*Dichelachnemicrantha*).

Alluvial Woodland is most often dominated by Cabbage Gum (*E. amplifolia*) and Swamp Oak (*Casuarina glauca*) with Apple Box (*Angophora floribunda*) occurring less frequently (EcoLogical Australia, 2011; Tozer, 2003:32). A shrub stratum is usually evident though is often sparse and dominated by Blackthorn (*Bursaria spinosa*). A dense ground cover of grasses such as Basket-grass (*Oplismenus aemulus*), Weeping grass (*Microlaena stipoides*), Bordered Panic (*Entolasia marginata*) and Forest Hedgehog Grass (*Echinopogon ovatus*) is also typical as is the presence of herb species such as Forest Nightshade (*Solanum prinophyllum*), Whiteroot (*Pratia purpurascens*) and Native Wandering Jew (*Commelina cyanea*). Alluvial Plain Woodland is typically associated with minor watercourses draining soils derived from Wianamatta Group shales.

Shale Hills Woodland is similar to Shale Plains Woodland; however, it is predominately found at higher elevations and on steeper slopes in more rugged terrain (Tozer, 2003:35). The community is dominated by Grey Box (*E. moluccana*) and Forest Red Gum (*E. tereticornis*), with fewer instances of Narrow-leafed Ironbark (*E. crebra*). A small tree stratum of Hickory Wattle (*Acacia implexa)* and other *Eucalyptus* species is common. Shrub stratums consist of Sweet Bursaria (*Bursaria spinosa*), with rarer instances of Sickle-leafed Wattle (*A. falcata*), Coffee Bush (*Breynia oblongifolia*), Australian Indigo (*Indigofera australia*) and Sticky Hop Bush (*Dodonaea viscosa cuneata*). Ground cover varies, with dense grass and herb cover in areas of open canopy, but sparse groundcover where shrub canopies are closed.

As was noted in the Revised Biodiversity Development Assessment Report, recorded vegetation communities within the construction footprint and surrounding the project provided suitable habitat for a range of fauna types including amphibians, reptiles, mammals (both terrestrial and arboreal) and birds. Local watercourses supported a diverse range of aquatic fauna (Sydney Metro, 2020). Faunal resources that are known or are likely to have been exploited by Aboriginal people occupying the southern extent of the Cumberland Plain, which incorporates the current construction footprint, include freshwater fish, eels, shellfish, molluscs, crustacea, snakes, fruit bats, lizards, bandicoots, possums, gliders, kangaroos, wallabies, birds, insects and grubs (Attenbrow, 2010: 69-76).

2.8 Historical land use

An understanding of historic land use and disturbance patterns can indicate the likely survivability and integrity of areas of Potential Archaeological Deposit (PAD) within a region. The following section contains a brief outline of the historical development within the construction footprint, set within the broader context of the region.

The Hawkesbury-Nepean area was known to Europeans from early in colonial history, when, in 1789, Governor Philip led a party of woodcutters to mark out a line of road between Sydney and Parramatta (Walker, 1906:43 - 48). With the road open and the soil surrounding the Nepean and its tributaries identified as especially fertile, settlers soon established large rural estates across the region with a focus around major waterways (Thorp, 1986:76). During this time, the landscape was modified by regimes of vegetation clearance prior to its use in agricultural and pastoral activities (Thorp, 1986:104).

From 1812, Governor Macquarie granted large tracts of land to notable figures within the colony. Robert Dixon's 1837 Map of the Colony of NSW (see Figure 2-1) shows the extent of major land holdings within the region by this time, with large portions of land designated along the Nepean River to the southeast of the construction footprint. While the nature of land holdings within the construction footprint at this time is unclear, the far northern portions appear to have been taken up by the estates of Governor King and Colonel O'Connell. These holdings, fronting the fertile South Creek and located close to the main road between Emu Plains and Parramatta, would have been ideal farming positions.

Figure 2-1 Excerpt from Dixon's Map of the Colony of NSW, 1837 (source: SLNSW/IE3742276). Approximate location of the project shown in red. Labels indicating holdings of Governor King and Colonel O'Connell are shown to the north of the project

Additional land was subsequently granted to independent farmers, and early parish maps demonstrate that the construction footprint was divided into multiple holdings by the mid-1800s, with portions varying from small, 20-acre properties, to large, thousand-acre estates. With the introduction of the *Robertson Land Acts* in 1861 and the rail line from Sydney to Penrith officially opened on 7 July 1862, greater numbers of settlers established small farms in the region and additional roads were constructed to accommodate the traffic (Cultural Resources Management, 2019; Walker, 1906:47).

The 1894 Map of the County of Cumberland illustrates the portion numbers and placement of the holdings located within the construction footprint and includes the names of the larger estates, many of which can be identified as farms (see Figure 2-2 to Figure 2-4).The majority of agriculture industries were confined to fruit growing and farming, especially dairying, which was well suited to the landscape (Walker, 1906:48). As such, the construction footprint would have been subject to land disturbance associated with farming activities, with key impacts including native vegetation clearance, grazing, construction of vehicle tracks and roads, altered waterways, and erosion – particularly along creek lines.

More intensive development was soon observed surrounding growing settlements, such as St Marys and Luddenham. As these towns flourished, further subdivisions, roads, public buildings and utilities were established to support their budding communities. A breakdown of the developments seen across the land holdings within the construction footprint is presented in Table 2-1.

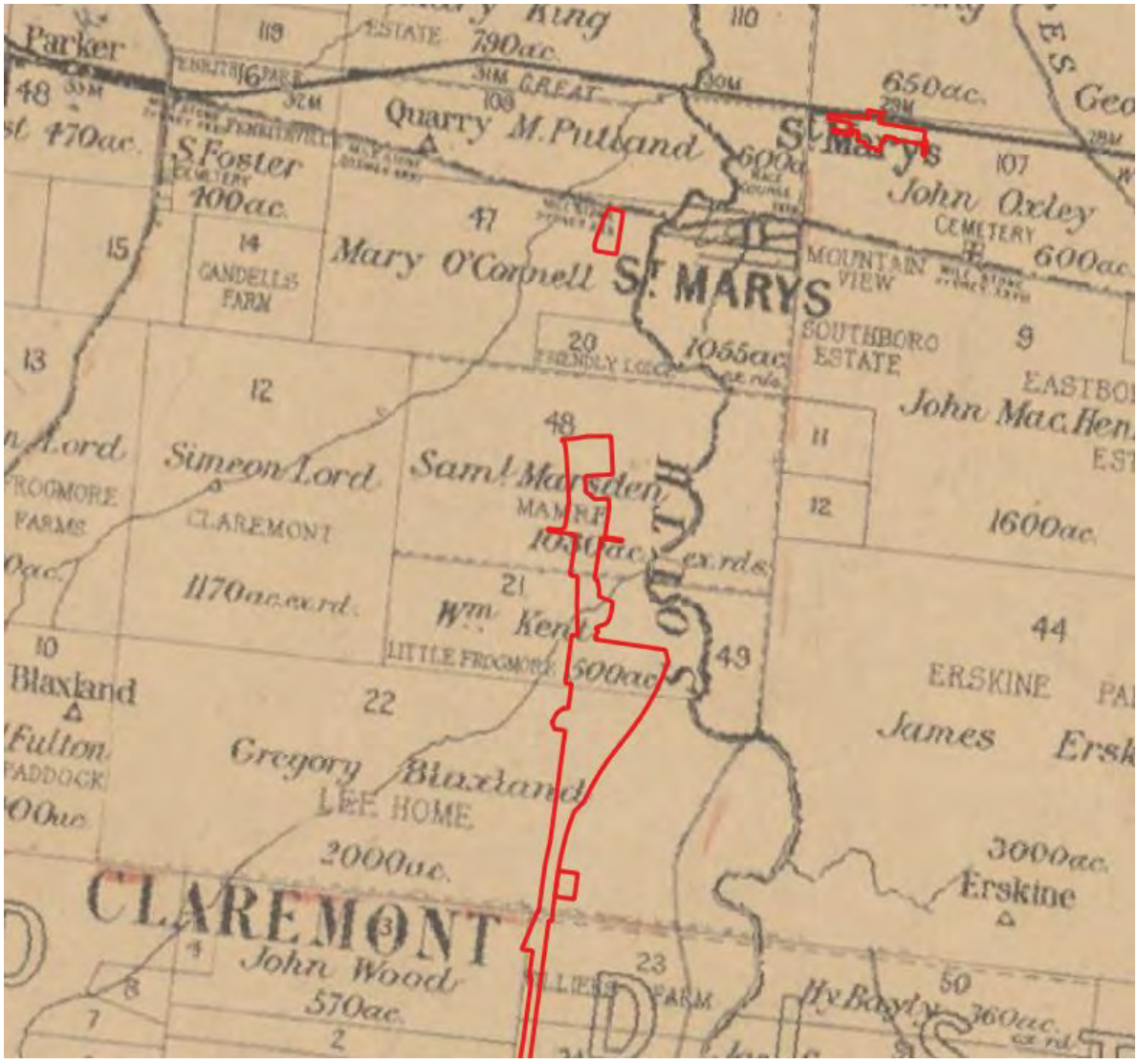


Figure 2-2 Excerpt from Map of the County of Cumberland, NSW 1894 (HLRV/1562201.jp2). Approximate location of the St Marys Station and northern portions of the construction footprint shown in red

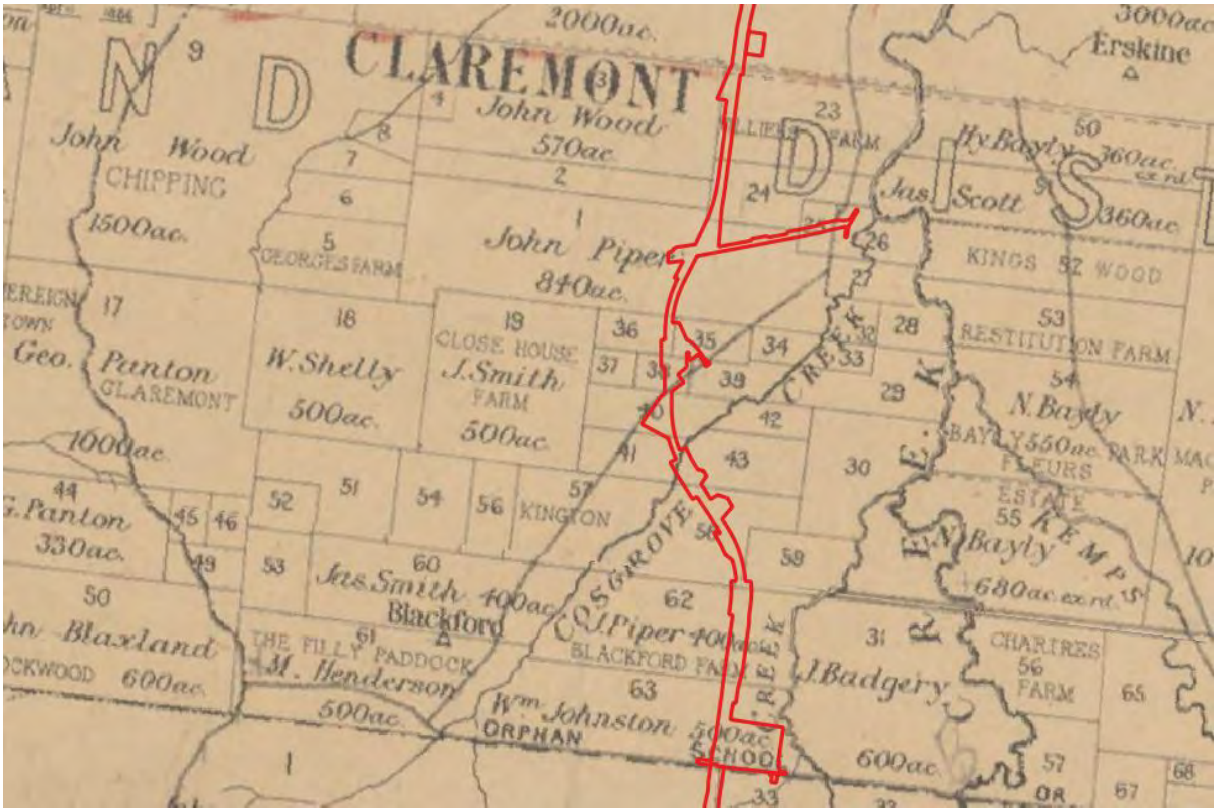


Figure 2-3 Excerpt from Map of the County of Cumberland, NSW 1894 (HLRV/1562201.jp2). Approximate location of the middle portion of the construction footprint shown in red

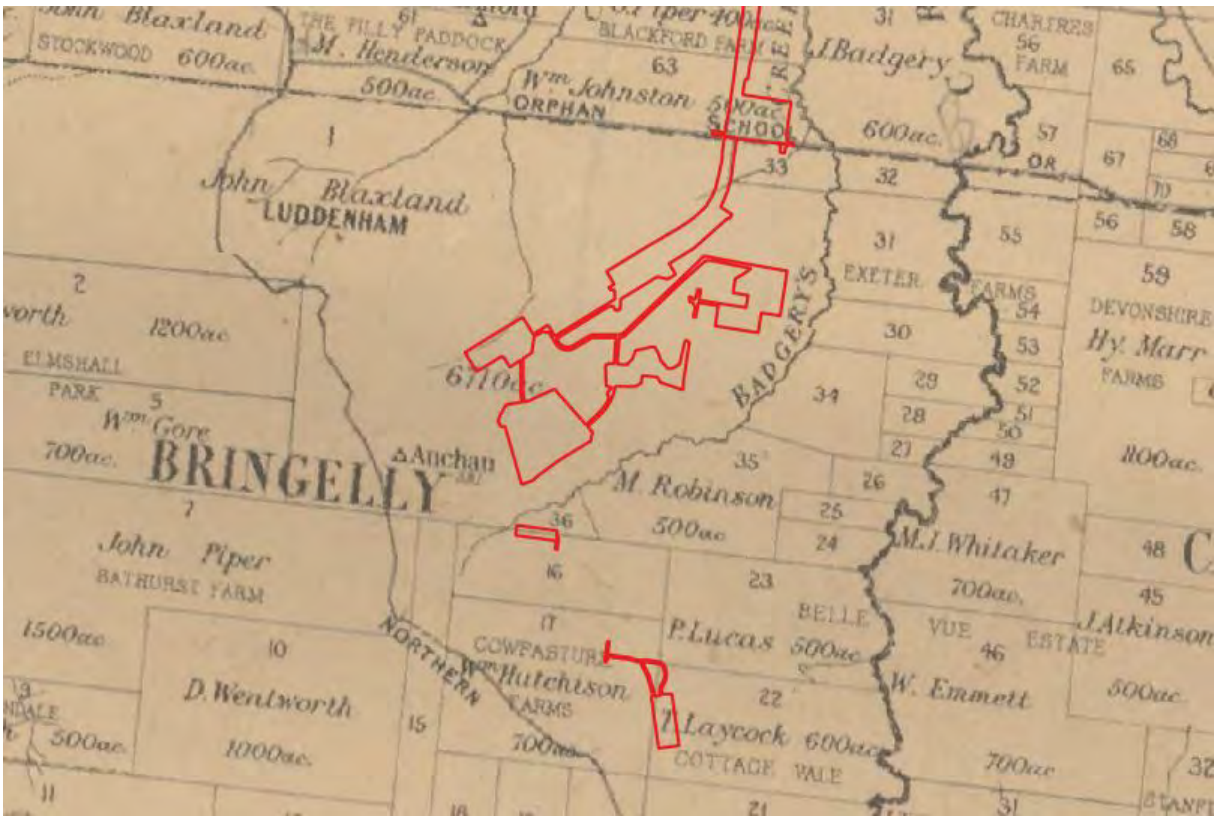


Figure 2-4 Excerpt from Map of the County of Cumberland, NSW 1894 (HLRV/1562201.jp2). Approximate location of the southern portion of the construction footprint shown in red

Table 2-1 Development of land holdings within the construction footprint as depicted in parish maps

Parish	Portion	Initial land holder	Acres	Development
Rooty Hill	111	Parker Philip King	650	1835 – Portion surveyed, fronting Ropes Creek N.D. – Labelled 'Triangle Farm' 1894 – Further subdivisions to the north, addition of the 'Great Western Railway' to the south 1972 – St Marys Railway Station located to south, much more developed with roads and residential/commercial subdivisions
	107	John Oxley (Explorer and surveyor)	600	1835 – Portion surveyed, fronting Ropes Creek and along the 'Great Western Road' from Emu Plains to Parramatta N.D. – Labelled 'Bathurst' 1894 – Cemetery located to the south, addition of the 'Great Western Railway' to the north, town of St Marys shown to the west 1972 – St Marys Railway Station located to west, much more developed with roads and residential/commercial subdivisions
	110; 118	Maria King	280	1835 – Portion surveyed, fronting South Creek N.D. – Labelled 'Marie Farm' 1894 – Labelled 'Parkesville' and 'Werrington Estate', addition of the 'Great Western Railway' to the south. 1941 – Acquired for Commonwealth purposes 1952 – Fauna corridor designated along South Creek 1972 – St Marys Railway Station located to east, much more developed with roads and residential/commercial subdivisions
	109	Mary Putland	600	1835 – Portion surveyed, fronting South Creek and along the 'Great Western Road' from Emu Plains to Parramatta N.D. – Designated as 'Town of St Marys' 1894 – Race course to the east of South Creek, additions of a quarry to the south and the 'Great Western Railway' to the north. 1972 – Labelled as 'Frogmore Farm' (Claremont Parish), St Marys High School to the north, much more developed with roads and residential/commercial subdivisions
Claremont	47	Mary O'Connell	1055	Mid-1800s – Portion surveyed, fronting South Creek, with South Creek Bridge in the north eastern corner and 'The Western Road' along northern boundary N.D. – Labelled as 'Town of St Marys', plan with regular, rectangular streets shown along the Western Road (labelled Victoria Road) to the west of South Creek 1894 – Subdivisions and roadways for the Town of St Marys now shown in north eastern corner, much more irregular plan 1916 – Subdivision of the entire property into multiple portions, with roads along

Parish	Portion	Initial land holder	Acres	Development
				boundaries, much more development along Victoria Road to east and west. Land labelled 'Coalree' 1972 – Residential subdivision labelled 'The Cedars'
	20	Lieutenant Menzies	100	Mid-1800s – Portion surveyed fronting South Creek, within the portion granted to Mary O'Connell 1894 – Labelled 'Friendly Lodge' 1916 – Land holder shown as Charles AFN Menzies
	18	Samuel Marsden	1030	Mid-1800 – Portion surveyed 1894 – Labelled 'Mamre' 1972 – Western Expressway running through centre, and 'Fauna protection district proclaimed 6th March 1959'
	21	William Kent	500	Mid-1800 – Portion surveyed 1894 – Labelled 'Little Frogmore' 1916 – Labelled 'Landsdown Place"
	22	Gregory Blaxland	2000	Mid-1800 – Portion surveyed 1894 – Labelled 'Lee Home' 1916 – Line of road through eastern portion 1972 – Easement for Sydney West Substation and Yass-Sydney West Transmission Lines through centre
	23	Gregory Blaxland	280	Mid-1800 – Portion surveyed 1894 – Labelled 'Villiers Farm' 1916 – Line of road through eastern portion 1972 – Easement for Yass-Sydney West Transmission Line through centre
	3	John Wood	570	Mid-1800 – Portion surveyed 1972 – Easement for Sydney West Substation Transmission Line, large portion 'Acquired by Commonwealth 13 Sep 1962'
	2	John Wood	150	Mid-1800 – Portion surveyed 1972 – Easement for Sydney West Substation Transmission Line small portion 'Acquired by Commonwealth 13 Sep 1962'
	24	Henry Bayly	140	Mid-1800 – Portion surveyed 1916 – Line of road through eastern portion
	1	John Piper	840	Mid-1800 – Portion surveyed 1916 – Line of road through eastern portion 1972 – Easement for Yass - Sydney West Substation Transmission Line
	25	Mary Crooke	30	Mid-1800 – Portion surveyed 1916 – Line of road along eastern boundary

Parish	Portion	Initial land holder	Acres	Development
	26	William Cosgrove	60	Mid-1800 – Portion surveyed, likely owned land earlier as Cosgroves Creek likely named after the family 1916 – Labelled 'Cosgrove Farm', many other holdings in district, line of road though western boundary
	36	James Beckett	60	Mid-1800 – Portion surveyed
	35	Daniel Wellings	50	Mid-1800 – Portion surveyed 1916 – Line of road through eastern portion
	38	William Sherries	70	Mid-1800 – Portion surveyed 1916 – Line of road through eastern portion
	39	Corn Regan	60	Mid-1800 – Portion surveyed 1916 – Land holder Cornelius Regan, line of road through north western corner
	40	Peter Workman	100	Mid-1800 – Portion surveyed 1916 – Line of road through central portion
	41	Andrew Nash	80	Mid-1800 – Portion surveyed 1916 – Line of road through central portion
	43	Philip Hogan	120	Mid-1800 – Portion surveyed
	58	Thomas Nicholls	200	Mid-1800 – Portion surveyed 1916 – Labelled 'Ham Farm" 1972 – Southern portion "vested in the commonwealth council for scientific and industrial research 1936"
	59	Samuel Laycock	100	Mid-1800 – Portion surveyed 1972 – Labelled "vested in the commonwealth council for scientific and industrial research 1936"
	62	John Piper	400	Mid-1800 – Portion surveyed 1894 – Labelled 'Blackford Farm' 1972 – Labelled "vested in the commonwealth council for scientific and industrial research 1936"
	63	William Johnson	500	Mid-1800 – Portion surveyed 1894 – Road shown south labelled 'Orphan School or Mulgoa Road' 1972 – Western portion "vested in the commonwealth council for scientific and industrial research 1936", Elizabeth Drive to south

Parish	Portion	Initial land holder	Acres	Development
Bringelly	1	John Blaxland	6710	Mid-1800 – Portion surveyed, (possibly granted 1813) 1894 – Labelled 'Luddenham' N.D. – Subdivision plans for "Luddenham Estate" – Eastern Division, small portion in west resumed for water supply for the Village of Luddenham, line of road 'Northern Road from Camden to Richmond' along western boundary 1953 – Multiple streets and regular shaped lots, Badgerys Creek Public School, road to north Elizabeth Drive (previously Orphan School Road and Mulgoa Road). Divisions to the south much larger than along Elizabeth Drive
	39	Hugh Derline	100	Mid-1800 – Portion surveyed within John Blaxland's property
	35	William White	20	Mid-1800 – Portion surveyed N.D. – Portion size changed to 40 acres
	7	John Piper	1500	Mid-1800 – Portion surveyed 1894 – Labelled 'Bathurst Farm'
	16	Edward Wright	350	Mid-1800 – Portion surveyed N.D. – Changed to Edmund Wright 1953 – Subdivided into regular lots with roads
	17	William Hutchinson	700	Mid-1800 – Portion surveyed N.D. – Labelled 'Cowpasture Farms', line of road 'Northern Road from Camden to Richmond' through southwest corner and post office to south 1953 – Subdivided into regular farm lots with roads
	23	Penelope Lucas	500	Mid-1800 – Portion surveyed N.D. – Portion boundary redrawn as smaller to the south 1953 – "Acquired for Commonwealth purposes 20.10.49'
	22	Thomas Laycock	600	Mid-1800 – Portion surveyed N.D. – Portion boundary redrawn as larger to the north, labelled 'Cottage Vale'

2.9 Land disturbance

The implications of this land use history include the disturbance of any pre-existing Aboriginal sites and deposits through both direct and indirect means, resulting in a loss of archaeological integrity. The construction footprint was extensively cleared of vegetation during the early pastoral settlement, with widespread ground disturbance likely associated with the cultivation of crops and smaller areas of impact associated with the construction of residential buildings. However, overall disturbance is minimal in the central and southern portions of the construction footprint in comparison with the existing St Marys Station and northern portions of the construction footprint, which have been subject to higher impact activities through large scale residential, commercial, road and rail development. The possibility for subsurface archaeological material, below the 'plough zone', therefore remains moderate in the portions of paddock to the south of the M4 Western Motorway (i.e. areas of low to moderate disturbance), but is nil to low in highly disturbed areas, such as within the St Marys area within the broader construction footprint.

2.10 Key observations

The presence of previously recorded Aboriginal sites across the region attest to the long-term use of this area by Aboriginal people. Although there have been past impacts of varying levels of intensity across the study area, there are numerous areas where this disturbance has predominantly been limited to vegetation clearance and pastoral use, such as stock grazing (ranging from low to moderate). The study area is likely to have been well-resourced in the past, particularly in areas located in proximity to permanent water sources. Consideration of known sites, low to moderate past disturbance and the presence of well-resourced areas suggests that unidentified Aboriginal sites may be present in both surface and subsurface contexts.

3. Archaeological context

3.1 Regional archaeological context

3.1.1 The Sydney region

Available archaeological data indicate that Aboriginal people have occupied the Sydney region[1] for at least 36,000 years (Williams *et al.*, 2014). Late Pleistocene/early Holocene occupation of the region is evidenced by radiometric dates from both coastal and hinterland sites (see Attenbrow, 2010:18, Table 3.1). Excavated material culture assemblages from these periods have been interpreted as evidence of relatively small populations of Aboriginal people employing settlement patterns of high residential and low logistical mobility (Attenbrow 2010:152-154; McDonald, 2008: 39; Williams *et al.*, 2014). Late Pleistocene/early Holocene chipped stone assemblages attest to a preference for silicified tuff sourced from secondary geological sources such as the Hawkesbury-Nepean River gravels (McDonald, 2008; Williams *et al.*, 2014). However, they also indicate the exploitation of other raw material types such as silcrete, quartzite, petrified wood and quartz. Direct freehand percussion appears to have been the dominant reduction technique employed by Late Pleistocene/early Holocene Aboriginals knappers, with bipolar flaking comparatively poorly represented in available assemblages. Retouched 'tools' include unifacially-flaked pebble implements, dentated saws, burins and a variety of scrapers, with unmodified utilised flakes also well represented (Kohen *et al.*, 1984; Williams *et al.*, 2014). Stone tools such as these will have been complemented by a range of organic implements such as wooden digging sticks, spears and boomerangs. However, these do not survive archaeologically (Attenbrow, 2010:154).

Compared with the late Pleistocene/early Holocene, archaeological evidence for mid-to-late Holocene Aboriginal occupation of the Sydney Region abounds (for recent syntheses see Attenbrow 2010; McDonald 2008). In keeping with broader Australian developments (e.g. Allen and O'Connell, 1995; Beaton, 1985; Brumm and Moore, 2005; Attenbrow *et al.*, 2009; Lourandos, 1983, 1997; Lourandos and Ross, 1994), the social and economic systems of Aboriginal groups living in the region during this period appear to have become increasingly complex. Available archaeological data, for example, suggest a significant increase in site establishment and population densities over time, as well as a concomitant growth in the size and complexity of social aggregation (but see Attenbrow (2012) and Hiscock (2008) for cautionary notes on the interpretive significance of radiometric date graphs). Growing economic specialisation is indicated by the emergence and/or proliferation of complex fishing and stoneworking technologies, with the latter linked variously to increased foraging risk associated with greater climatic variability as well as other variables such as redefinition of social space, reduction of resources and increased logistical pre-equipping (Attenbrow *et al.* 2009; McDonald, 2008: 40). Complex, long-distance exchange networks are also attested archaeologically (e.g. Attenbrow *et al.*, 2012; Grave *et al.,* 2012) as are important developments in artistic activities (McDonald, 2008). Higher levels of stylistic heterogeneity in pigment and engraved art across the region, for example, have been linked to increasing territoriality (McDonald, 2008: 42).

With some modification, McCarthy's (1967) *Eastern Regional Sequence* (ERS) of stone artefact assemblages remains the dominant chronological framework for Aboriginal occupation of the region. Based on appreciable changes in the composition of chipped stone artefact assemblages over time, the ERS hypothesises a three phase sequence of 'Capertian' (earliest), 'Bondaian' and 'Eloueran' (most recent) assemblages and was developed on the basis of McCarthy's (1948, 1964) pioneering analyses of stratified flaked stone assemblages from Lapstone Creek rockshelter, on the lower slopes of the Blue Mountains eastern escarpment, and Capertee 3 rockshelter in the Capertee Valley north of Lithgow (see Table 3-1). At present, the most widely cited characterisation of the ERS in the Sydney region is that of a four-phase sequence beginning with the *Pre-Bondaian* (McCarthy's *Capertian*) and moving successively through the Early, Middle and Late phases of the *Bondaian*, the last of which equates to McCarthy's (1967) *Eloueran* phase. The tripartite division of the Bondaian is based principally on the presence/absence and relative abundance of backed artefacts (Attenbrow, 2010: 101). However, other factors, such as changes in the abundance of bipolar artefacts and different stone materials, as well as the presence/absence of edge-ground hatchet-heads are also relevant.

[1] Following Attenbrow (2012a), the land bounded by the coast on the east, by the Hawkesbury-Nepean River in the north and west, and by a line running east-west through Picton and Stanwell Park in the south.

Table 3-1 McCarthy's (1967) Eastern Regional Sequence (ESR) of stone artefact assemblages

Current phasing	McCarthy's (1967) phasing	Approximate date range	Backed artefact frequency	Bipolar artefacts	Edge-ground hatchet heads
Pre-Bondaian	Capertian	36,000-8,000 BP	Absent	Rare	Absent
Early Bondaian	Bondaian	8,000-4,000 BP	Very low	Rare	Absent
Middle Bondaian		4,000-1,000 BP	Very high	Increasingly common	Present
Late Bondaian	Eloueran	1,000 BP to European contact	Low	Very common	Present

McDonald's (2008) Behavioural Land Use Model

Drawing, in particular, on the results of several large-scale archaeological salvage projects across the northern Cumberland Plain, including those undertaken for the various stages of the Rouse Hill Infrastructure Project (e.g. Jo McDonald CHM, 2001, 2005a), McDonald (2008) has proposed a behavioural model for prehistoric Aboriginal land use in the Sydney region. Developed in partnership with lithic analyst Beth White over several years, McDonald's (2008) model remains the most comprehensive model of its type for the region. The model, which differs from existing land use models for the region (i.e. Kohen, 1986, 1988; Kohen & Lampert, 1987; Ross, 1976, 1988) in its explicit, dual emphasis on stone artefact technology and rock art, is summarised below.

According to McDonald's (2008) model, Aboriginal groups occupying the Sydney region during the late Pleistocene/early Holocene were highly mobile. Groups travelled considerable distances between base camps and camped proximate to exploited resources (McDonald, 2008:39). Group territories at this time were large and the preferred raw material for flaked stone tool manufacture was silicified tuff. This raw material was sourced principally from the Hawkesbury-Nepean River gravels (McDonald, 2008:40). Transported lithics were used in woodworking and animal butchery and comprised large cores and simple flake-based implements. Though large, transported cores and implements served as portable raw material supplies and were curated. Backed artefacts were rarely produced during these periods (McDonald, 2008:40). In the late Pleistocene, rock art served as a communicative medium for emphasising broad-scale group cohesion. Social networks at this time were more open and extensive than those recorded at contact (McDonald, 2008:41).

Rising seas associated with the Post-Glacial Marine Transgression (c.21-6.5ka) forced groups previously occupying the region's coastal plain inland. Former low lying valleys and flats were converted into bays and estuaries. Initially, population densities remained relatively low. However, over time, these increased dramatically, necessitating social mechanisms to mediate uncontrolled and potentially hostile interactions between groups (McDonald, 2008:349). Pigment and engraved art was one of several such mechanisms and was now used to assert both local group distinctiveness and larger-scale (i.e. cultural bloc) cohesion. By 4,000 BP, groups were occupying smaller territories on a more permanent basis. Groups occupying the Cumberland Plain and surrounding sandstone country now did so on a full time-basis though movement between biogeographic zones still occurred (McDonald, 2008:40). Rockshelters in the latter zone were increasingly used for artefact manufacture and discard. Mobility strategies became increasingly logistically-organised, with groups exploiting the resources of well-defined foraging ranges out of base camps located in environmentally strategic locations (i.e. in terms of resource availability) (McDonald, 2008:40).

The stone artefact technology being employed by Aboriginal people occupying the Sydney region underwent substantial change as a result of these broader changes in demography and settlement organisation. Locally available lithic raw materials were increasingly utilised and there was an overall diminution in the size of utilised toolkits (McDonald, 2008:40). On the Cumberland Plain, silcrete was the preferred raw material and was frequently heated to improve flaking quality. Stone packages were most commonly prepared at exploited stone sources before being transported to residential and other task-specific sites for further use. Blanks selected for reduction were typically reduced via freehand percussion, with bipolar reduction sometimes also utilised. Various core reduction methods were

employed, with asymmetric alternating flaking frequently used. During the Middle Bondaian period (c.4,000 to 1,000 years Before Present (BP)), backed artefacts were manufactured in large numbers across numerous sites, with 'industrial' scale production occurring at some sites. These tools were utilised in range of craft and subsistence activities including bone-working, wood-working, plant processing and animal butchery.

During the Late Bondaian period (c.1,000 years to European contact), there was a reduced emphasis on the occupation of rockshelters, with open camp site locations now foci for habitation. This shift away from rockshelters was a response to the increased spatial requirements of larger social groups associated with a dual social system (McDonald, 2008:349). During times of seasonal abundance, groups lived in large, semi-permanent open 'villages'. However, in times of resource stress, these larger groups dispersed into smaller family or gender-based hunting/fishing groups who reverted to exploiting their traditional foraging ranges. An increased emphasis on bipolar flaking during this period was linked to an even more intensive use of locally available stone. In coastal areas, backed artefacts all but ceased to be produced. Edge-ground hatchets were widely made and used across the region. As in earlier periods, rock art during the Late Bondaian continued to function as an important communicative medium for the assertion of both local group identity and broader culture area cohesion (McDonald 2008:350).

3.1.2 The Cumberland Plain

Concentrated archaeological investigation of the Aboriginal archaeological record of Sydney's Cumberland Plain can be traced to the early-to-mid 1980s, a period marked by a rapid growth in residential and other forms of development across the Plain. Intensive development activities since this time have secured the Cumberland Plain's place as one of the most intensively investigated archaeological regions in Australia, with potentially thousands of Aboriginal archaeological investigations involving survey and/or excavation having now been undertaken (the exact number difficult to calculate due to the limited circulation of many reports). The majority of these investigations were undertaken as part of larger environmental impact assessments associated with residential development and affiliated infrastructure projects. Unsurprisingly, these investigations have varied significantly in scale and scope, ranging from targeted small-scale surveys to complex, multi-phase survey and excavation projects over large areas. Nonetheless, together they have revealed a rich and diverse record of past Aboriginal occupation, with thousands of Aboriginal archaeological sites now registered in the AHIMS database.

3.1.3 Open artefact sites: distribution, contents and definition

Surface and subsurface distributions of stone artefacts, variously referred to as open artefact sites, open sites and open camp sites are the most common and widely distributed form of Aboriginal archaeological site on the Cumberland Plain (see Attenbrow, 2010: Plate 12; Przywolnik, 2007: 46, Table 4.2). Other site types, such as modified trees, quarries, grinding grooves and rockshelters with deposit and/or art or PAD, have also been identified but are comparatively rare. Accordingly, open artefact sites remain the most intensively investigated component of the Aboriginal archaeological record of the Cumberland Plain, with site distribution and the technology of associated flaked stone artefact assemblages, in particular, comprising key research topics (e.g. AMBS, 2000; Craib et al., 1999; Jo McDonald CHM, 2001, 2003, 2005a, 2006a, 2006b, 2006c, 2007, 2009a, 2009b; Kohen, 1986; White & McDonald, 2010).

Existing archaeological survey data for the Cumberland Plain indicate a strong trend for the presence of open artefact sites along watercourses, specifically, on creek banks and 'flats' (i.e. flood/drainage plains), terraces and bordering lower slopes. Although this distribution pattern can be attributed in part to geomorphic dynamics and archaeological sampling bias, with extensive fluvial erosion activity along watercourses resulting in higher levels of surface visibility and, by extension, concentrated survey effort, an occupational emphasis on watercourses is supported by the results of numerous subsurface investigations (e.g. AMBS, 2000; Craib et al., 1999; GML, 2012, 2016; Jo McDonald CHM, 2001, 2003, 2005a, 2006a, 2006b, 2007, 2009a, 2009b). Collectively, these investigations have demonstrated that assemblage size and complexity tend to vary significantly in relation to stream order and landform, with larger, more complex[2] assemblages concentrated on elevated, low gradient

[2] Those containing a wider variety of raw materials and technological types and/or higher mean artefact densities and features such as knapping floors.

landform elements adjacent to higher order watercourses. Artefact distributions associated with major creek lines and confluences tend to consist of localised high density artefact concentrations set within lower density artefact scatters across the broader landscape. Outside of these contexts, surface and subsurface artefact distributions have typically been found to be sparse and discontinuous and are often referred to as 'background scatter', being "artefactual material which is insufficient in number or in association with other material to suggest focussed activity in a particular location" (Douglas and McDonald, 1993).

Flaked stone artefacts dominate archaeological assemblages from recorded open artefact sites on the Cumberland Plain, with heat shattered rock also well represented. Items such as complete and broken grindstones, hammerstones and edge-ground hatchet heads have also been recorded though comparatively infrequently. With the notable exception of 'knapping floors'[3], a relatively common component of the Aboriginal archaeological record of the Cumberland Plain, associated archaeological features (e.g. hearths, ground ovens and heat treatment pits) have proven elusive (but see AHMS, 2013; GML, 2016; McDonald and Rich, 1994; Jo McDonald CHM, 2009a for examples). Investigated knapping floors across the Plain have varied considerably in size and complexity, with the largest and most complex examples identified through excavation as opposed to surface survey (e.g. Jo McDonald CHM, 2001, 2005a, 2006b, 2007). Backed artefacts (i.e. Bondi points, geometric microliths and elouera) are a common feature of knapping floors and most of these features were likely specifically associated with their production. In common with regions such as the Hunter Valley (e.g. Hiscock, 1993; Moore, 2000), available evidence supports the suggestion that backed artefact manufacture on the Cumberland Plain was a highly structured or systematic activity.

Although relevant to a variety of site types, geomorphic processes such as soil erosion and colluvial/fluvial aggradation are of particular relevance to the identification and definition of open artefact sites. As in other archaeological contexts (e.g. Dean-Jones & Mitchell, 1993), the visibility of open artefact sites across Sydney's Cumberland Plain can, for the most part, be attributed to such processes, which have variously exposed or obscured them. Critically, surface artefacts invariably represent only a fraction of the total number of artefacts present within recorded surface open artefact sites across the Plain, with a typical surface to subsurface artefact ratio of 1:25 proposed (Jo McDonald CHM, 2005b: 35). Artefact exposure, unsurprisingly, is highest on erosional surfaces and lowest on depositional ones. At the same time, in many areas, surface artefacts have been shown through dispersed testing programs to form part of more-or-less continuous subsurface distributions of artefacts, albeit with highly variable artefact densities linked to environmental variables such as distance to water, stream order and landform (e.g. White & McDonald, 2010). The presence or absence of surface artefacts on the Cumberland Plain, therefore, is not a reliable indicator of Aboriginal archaeological sensitivity.

3.1.4 Flaked stone artefact technology

Virtually indestructible, flaked stone artefacts are a ubiquitous element of the Aboriginal archaeological record of the Cumberland Plain and have assumed a prominent position in archaeological reconstructions of past Aboriginal land use across the region. To date thousands of surface-collected and excavated flaked stone assemblages from across the Cumberland Plain have been analysed, with individual assemblage sizes, research questions, aims, analytical methodologies and terminological schemes varying significantly between researchers and projects. Studies to date have ranged from basic descriptive accounts of assemblage composition in typological terms to detailed reconstructions of past stone reduction and quarrying behaviours through rigorous technological analyses. Particularly informative analyses in the context of the Cumberland Plain include those conducted by Jo McDonald CHM (2001, 2003, 2005a, 2006a, 2006b, 2006c, 2007, 2009a, 2009b) as part of archaeological salvage projects associated with development activities within the Rouse Hill Development Area (RHDA), the former Australian Defence Industries site at St Marys and the Colebee Release Area. Technological analyses of stone artefact assemblages recovered from fluvial sand bodies adjacent to the Parramatta (Jo McDonald CHM, 2005b, 2005c, 2006b) and Hawkesbury Rivers (AHMS 2013; Williams et al. 2012) have likewise proven highly informative, particularly with respect to the documentation of diachronic changes in raw material use and stone artefact technologies.

[3] Following White (1997:8), knapping floors can be defined as activity areas "where primacy was given the systematic reduction of stone, with or without additional activities being carried out".

Available technological and typological data for surface collected and excavated flaked stone artefact assemblages from the Cumberland Plain suggest that the majority of these assemblages belong to what is known as the 'Australian small-tool tradition', a term coined by Gould (1969) to describe what was then thought to be the first appearance, in the mid-Holocene[4], of a new suite of flaked stone tool forms in the Aboriginal archaeological record of Australia, including backed artefacts, adzes and points (both unifacially and bifacially flaked). Complex, hierarchically-organised reduction sequences associated with the production of these tools contrast markedly with the simple sequences of earlier periods (Moore, 2011). Tools of the Australian small-tool tradition, it has been suggested, formed part of a portable, standardised and multifunctional tool kit aimed specifically at risk reduction (Hiscock, 1994, 2002, 2006). Stone artefact assemblages from late Pleistocene and early Holocene contexts, in contrast, are described by archaeologists as belonging to the 'Australian core tool and scraper tradition', a term first used by Bowler *et al.* (1970) to describe the Pleistocene assemblages recovered from Lake Mungo in western NSW. Bowler *et al.* (1970) saw the main components of these assemblages - core tools, steep-edged scrapers and flat scrapers - as characteristic of early Australian Aboriginal assemblages and as being of a distinctly different character to those associated with the proceeding small-tool tradition. In southeastern Australia, including the Cumberland Plain, the Australian 'small-tool' and 'core tool and scraper' traditions are most commonly described in terms of McCarthy's (1967) ERS, with 'Capertian' assemblages assigned to the latter tradition and 'Bondaian' assemblages to the former.

Flaked stone artefact assemblages from excavated and surface collected/recorded open artefact sites on the Cumberland Plain attest to the exploitation of a diverse range of lithic raw materials (Corkill, 1999, 2005). However, two rock types - silcrete and silicified tuff (also known as indurated mudstone) - dominate the region's existing stone artefact record. Other, less commonly exploited raw materials represented in excavated and surface collected/recorded assemblages include quartz, quartzite, petrified wood, chert and various fine-grained volcanics. Alongside silcrete and silicified tuff, these materials occur variously in a number of geological formations and units across the Cumberland Plain (for a detailed review see Corkill 1999). Oft-cited sources include the Tertiary St Marys (Ts) and Rickabys Creek Gravel (Tr) formations, as well as the various unconsolidated Pleistocene units that line as terraces the present day and abandoned channels of the Nepean-Hawkesbury River (e.g. the Cranebrook Formation (Qpc)). Holocene gravel banks along the same river system have likewise been identified as a potentially significant raw material source.

In common with the Sydney region as a whole (Attenbrow, 2010:120-121), various excavated assemblages from the body and peripheries of the Cumberland Plain (e.g. Jo McDonald CHM, 2001a, 2005a; Williams *et al.,* 2012, 2014) attest to a shift, over time, in the relative significance of particular raw materials for flaked stone artefact manufacture, principally silcrete and silicified tuff but also quartz. An 'early' (i.e. Pre-Bondaian) emphasis on the procurement and reduction of silicified tuff, for example, appears to have given way to a 'later' (i.e. Bondaian) emphasis on silcrete. Quartz use, meanwhile, appears to have peaked in the late Holocene. For the Cumberland Plain, these changes have been linked, in particular, to broader changes in settlement organisation, with a decline in levels of residential mobility over time prompting more intensive use of locally available stone (Jo McDonald CHM, 2005a).

In the northwestern portion of the Cumberland Plain, the Tertiary St Marys Formation has been singled out as a particularly important source of silcrete for flaked stone artefact manufacture. Mapped at various localities across the Mulgoa Creek, South Creek and Eastern Creek catchments, the best known and most intensively investigated outcrops of this formation occur on Plumpton Ridge, a low but locally prominent ridgeline separating the floodplains of Eastern Creek and Bells Creek between the suburbs of Plumpton and Riverstone. The subject of numerous archaeological investigations since the early 1980s (e.g. Australian Museum Business Services, 2002; Baker, 1996; Barry, 2005; McDonald, 1986), Jo McDonald CHM's (2006c) large-scale archaeological salvage works across what is now Stonecutters Ridge Golf Club unequivocally identified Plumpton Ridge as a major Aboriginal quarry site. At the same time, they highlighted a number of important trends in relation to the procurement and reduction of silcrete obtained from this source. Trends in the relative frequencies of

[4] More recent research into the chronology of backed artefacts and points in Australia (e.g. Hiscock & Attenbrow 1998, 2004; Hiscock 1993b) has demonstrated a long history of production and use for these implement types, with both types now known to have been produced, albeit in small numbers, in the early Holocene and likely in the late Pleistocene as well.

raw material types, artefact types and the size of silcrete artefacts in local excavated assemblages, for example, were attributed to a process of 'distance-decay' (Jo McDonald CHM's 2006c: 61).

Procurement evidence at documented Aboriginal quarry sites across the Cumberland Plain, including Plumpton Ridge, has to date consisted of varying surface and/or subsurface densities of flaked stone artefacts in direct spatial association with naturally occurring Tertiary gravel deposits (silcrete dominant). Topographic indicators of 'open cut' mining activities, such as localised circular/semi-circular depressions or trenches (cf. Binns & McBryde, 1972; Jones & White, 1988; McBryde, 1973, 1984), have yet to be identified, though this is unsurprising given the nature of the lithic deposits being quarried. Alongside those from the ADI:EPI and ADI-FF2 quarry sites within the former Australian Defence Industries site (Jo McDonald CHM, 2006a, 2008a), excavated flaked stone artefact assemblages from the SA25 and SA26 sample areas on the upper eastern flank of Plumpton Ridge, detailed in Jo McDonald CHM, 2006c, have provided a robust technological 'signature' for Aboriginal quarry sites on the Cumberland Plain. Amongst other activities, such as limited tool production/discard and later stage core reduction, stone procurement/reduction activities at exploited stone sources appear to have included 'primary' or early stage clast reduction as well as deliberate heat treatment and fracturing (Jo McDonald CHM, 2006c).

Backed artefacts dominate the retouched components of the majority of dated and undated Bondaian assemblages from the Plain and, as such, the technology of their manufacture has received considerable analytical and interpretive attention. Studies by Jo McDonald CHM (2001, 2003, 2005a, 2006a, 2006b, 2007, 2009a, 2009b), in particular, have demonstrated that backed artefact manufacture on the Cumberland Plain was a highly structured or systematic activity involving a complex system of raw material procurement, transportation, preparation and reduction. Differences in the technological character of recovered cores across the region attest to a significant degree of variability in the methods used by Aboriginal knappers to produce flakes for backed artefact manufacture. However, certain techniques (e.g. asymmetric alternating flaking and Hiscock's (1993) 'tranchet technique') are particularly well represented. Evidence for the deliberate heat treatment of silcrete blanks, both as part of systematic backed artefact manufacture activities and other reduction activities, is abundant and widespread, with excavated and surface collected assemblages attesting to the use of heat at various points in the reduction process. As in other contexts (e.g. Hiscock 1993), the thermal alteration of Cumberland Plain silcrete appears to have significantly improved the flaking quality of the stone, increasing the lustre and smoothness of fracture surfaces.

3.1.5 Chronology of occupation

In common with the Sydney region as a whole, evidence for late Pleistocene/early Holocene (i.e. Pre-Bondaian/Early Bondaian) Aboriginal occupation of the Cumberland Plain is sparse, with confirmed or potential evidence from these periods obtained from only a limited (<20) number of sites/landscapes. Well documented examples include Rouse Hill sites RH/CC2 (Jo McDonald CHM, 2001), RH/SC5 (Jo McDonald CHM, 2002b), RH/CD12 (Jo McDonald CHM, 2002a) and RHCD7 (Jo McDonald CHM, 2007); Richmond site RMI (Jo McDonald CHM, 1997a); PT12 near Pitt Town (Williams *et al.*, 2012, 2014); Jamisons Creek, Emu Plains (Kohen *et al.*, 1984); Power Street Bridge 2, Doonside (McDonald, 1993), Regentville RS1, Regentville (Koettig & Hughes, 1995; McDonald *et al.,* 1996), the Parramatta CBD (AHMS 2013; Austral Archaeology, 2007; Jo McDonald CHM, 2005b, 2005c, 2006b) and the Windsor Museum site (Austral Archaeology, 2011; Williams *et al.* 2012; Williams *et al.* 2014). Claims of a *c*.40 ka year old date for five 'flaked pebbles' recovered from a gravel pit associated with the Cranebrook Terrace near Penrith (Nanson *et al.* 1987) have been widely questioned, (P. Mitchell, 2010; Mulvaney & Kamminga, 1999; Williams et al., 2012) with legitimate concerns raised over the artefactual status of these pebbles, their provenance and association with available dates (but see Williams *et al*. 2017 for the results of more recent work at Cranebrook Terrace). For most sites, late Pleistocene/early Holocene occupation has been inferred on the basis of the technological and typological characteristics of recovered flaked stone artefact assemblages as opposed to radiometric dates.

At present, the oldest securely dated archaeological site on the Cumberland Plain is the PT12 site at Pitt Town, with compliance-based archaeological excavations across a source-bordering dune at this site, which overlooks the Hawkesbury River, producing a suite of Optically-Stimulated Luminescence (OSL) dates suggestive of Aboriginal occupation from at least 36,000 years ago (and potentially earlier) (Williams *et al.* 2012, 2014). Closer to the coast, Late Pleistocene/early Holocene occupation of a sandy fluvial terrace adjacent to the Parramatta River (i.e. the Parramatta Sand Sheet) has been

by proposed by Jo McDonald CHM (2005b, 2005c, 2006b) and seems likely on the basis of available radiometric dates and assemblage characteristics.

In stark contrast to the late Pleistocene/early Holocene, evidence for mid-to-late Holocene (i.e. Middle to Late Bondaian) Aboriginal occupation of the Cumberland Plain abounds, with numerous excavated sites producing assemblages that can be confidently assigned to these periods on the basis of radiometric dates and/or their typological/technological profiles. Available radiometric dates indicate a steady increase in the number of sites occupied over the course of the Holocene, with a peak in the 2nd millennium BP (see, for example, Przywolnik 2007: 53, Fig. 4.6). Taken at face value, this data suggests a progressive increase in the Aboriginal population of the Cumberland Plain over the course of the Holocene. However, following Hiscock (2008: 230-233), it seems likely that the directional population growth suggested by such data is, to a certain extent at least, a product of differential site preservation, with younger sites better preserved than older ones. Other factors, such as the burial of older sites through sediment deposition and bias in the location of archaeological surveys and excavations, may also be relevant.

Critical to any discussion concerning the antiquity of Aboriginal occupation across the Cumberland Plain are the well-documented difficulties surrounding the dating of open artefact sites with active 'biomantles' (*sensu* Paton et al. 1995; see Dean-Jones & Mitchell, 1993; Balek 2002; Hofman 1986; Johnson et al. 2005; Johnson 1989; Paton et al. 1995; Peacock & Fant 2002; Stein 1983). On the Cumberland Plain, the term biomantle is typically used as a collective descriptor for the 'A' soil horizons of the Plain's dominant texture contrast or duplex soil profiles[5], which tend to be relatively thin (<30 cm) and exhibit extensive evidence of bioturbation in the form of roots, open/infilled burrows, live insects and/or earthworms and stone lines[6]. However, it is noted that the uppermost portions of underlying 'B' soil horizons can also exhibit such evidence and form part of the biomantle (e.g. AECOM, 2015a). As highlighted by Dean-Jones & Mitchell (1993) and others (e.g. Balek, 2002; Johnson, 1989), excavated finds assemblages from archaeological sites with active biomantles are subject to a range of interpretive constraints, with intact depositional stratigraphy unlikely to be preserved and inset archaeological features (e.g. hearths and heat treatment pits) representing the only reliable means of dating (with any specificity) intercepted archaeological events (Mitchell, 2009: 4). Any stone artefacts discarded at the surface in landscapes with active biomantles are likely, over time, to have been incorporated into the soil profile through bioturbation, with depth of artefact burial ultimately corresponding to the base of major biological activity (i.e. the base of the biomantle). Where biomantles remain relatively undisturbed, horizontal patterns of artefact discard may be preserved. However, in heavily disturbed contexts, the preservation of such patterning is unlikely (Mitchell 2009: 4).

For archaeologists working on the Cumberland Plain, the analytical and interpretive constraints posed by intensive bioturbation have, in combination with a real paucity of dateable features, led to a reliance on the dating of excavated archaeological finds through relative means, specifically, through consideration of the typological and technological composition of associated flaked stone artefact assemblages and reference to a modified version of McCarthy's (1967) ESR, the broad temporal parameters of which are now well established. While offering a useful chronological framework within which to assess diachronic changes in stone artefact technologies and raw material use, the largely undated and palimpsest character of the Cumberland Plain's lithic record represents a significant analytical and interpretive obstacle for period-specific reconstructions of Aboriginal mobility regimes (cf. Cowan, 1999). Well dated assemblages from sites retaining stratified deposit(s) are rare, with the most comprehensively dated sequences to date coming from deep fluvial sand bodies adjacent to the Hawkesbury and Parramatta Rivers (i.e. AHMS, 2013; Jo McDonald CHM, 2005c; Williams et al., 2012, 2014). While the preservation and dating potential offered by such bodies has been amply demonstrated, the same cannot be said of alluvial valley fill sequences outside of these major river valley contexts, with comparatively little research directed towards investigating the age, genesis or evolution of alluvial valley fill sequences within the Cumberland Plain's numerous creek valleys, nor their potential for preserving at depth (i.e. within buried paleosols) Aboriginal archaeological materials

[5] These profiles are characterised by loamy topsoils and silty clay to clay subsoils, with boundaries between these two units typically clear to abrupt. Clayey subsoils have formed by *in situ* weathering of the parent material, while topsoils are derived from a combination of *in situ* weathering and the deposition of colluvially and/or fluvially transported materials.

[6] Stone lines, where present, typically occur at the interface between the A and B horizons.

of varying ages, including those of Late Pleistocene/Early Holocene antiquity (but see AHMS, 2015; Barham, 2005, 2007; Jo McDonald CHM, 2005a for notable exceptions). Nonetheless, the limited work that has been conducted in this regard suggests considerable research potential, particularly with respect with the development of chronological frameworks for contextualising and interpreting the flaked stone artefact assemblages recovered from such sequences.

3.1.6 Site distribution and occupation models

A number of Aboriginal site distribution and occupations models have been proposed for the Cumberland Plain over the past four decades, with early models (e.g. Kohen, 1986; Smith, 1989) based principally, or exclusively, on surface evidence and more recent models (e.g. AMBS, 2000; Jo McDonald CHM, 1997b) taking into account both surface and excavated evidence. As indicated in Table 3-2, Aboriginal site distribution on the Cumberland Plain has been linked to a variety of environmental factors, with proximity to water, stream order, landform and geology (including proximity to known stone sources) variously highlighted as key determinants.

Table 3-2 Aboriginal site distribution and occupation models for the Cumberland Plain

Researcher(s)	Year	Summary of model
Dallas and Witter	1983	Sites closer to silcrete and other raw material sources will tend to contain more cores and waste chips and less utilised material than sites which are located further away. They will also contain more block fractured pieces, a higher frequency of cortex, and the artefacts will generally be larger than those at sites not associated with raw material sources. In areas of raw material abundance, artefacts will be discarded earlier in the reduction sequence and will generally be larger and occur in a variety of forms. Raw material abundance, quality and size will influence assemblage variability. Sites located away from raw material sources will exhibit a wider variety of activities and a higher number of utilized pieces than those closer to them.
Kohen	1986	Proximity to water and geological context are key determinants for site location. Sites can be categorized as one of three types according to their function: camping sites, which have a wide range of activities represented in the archaeological record; woodworking sites, where there is a high proportion of implements to debitage present; and hunting sites, which contain a relatively small number of unworked flakes and are sometimes associated with backed blades. The greatest proportion of sites are located on Wianamatta Shale substrates. The number of artefacts found at a site and site size are more closely correlated to the nature and degree of disturbance at a site than any behavioural factors. The more disturbed the site, the greater the visibility and hence the greater quantity of artefacts recorded. Sites with high artefact densities tend to be found within 100 m of permanent water sources.

Researcher(s)	Year	Summary of model
Smith	1989	Sites are most likely to occur in association with water sources. Permanency of the water source, however, is not a determining factor for site location, with a significant quantity of sites found along temporary creek lines. Sites on the Londonderry Clay/Rickabys Creek Formation are likely to be found in association with gravel exposures. Sites dominated by silcrete are less likely to be found west of Marsden Park and South Creek than east of those areas. Isolated finds in these areas are also less likely to be made from silcrete. Sites east of South Creek are likely to be principally stone tool and silcrete manufacturing and processing sites. Sites in the northern Cumberland Plain are expected to have a lower frequency of implements than those in the south. Woodland areas will typically contain sites at lower densities than open forest areas. Surface sites appear to be more common than subsurface sites, and undisturbed stratified sites are rare due to the degree of disturbance. Sites with over 50 artefacts are rare, although very large sites (500+ artefacts) do occur. There is no apparent patterning to the occurrence of these large sites. The pattern of distribution of site size appears to be determined predominantly by visibility. Sites cannot be divided neatly into ‘single use’ categories, as most sites were the location of numerous activities.
Jo McDonald CHM	1997b	The size (density and complexity) of archaeological features will vary according to permanence of water (i.e. stream order), landscape unit and proximity to lithic resources. In the headwaters of upper tributaries (i.e. first order creeks) archaeological evidence will be sparse and represent little more than a background scatter; In the middle reaches of minor tributaries (second order creeks) will be archaeological evidence for sparse but focussed activity (e.g. one-off camp locations, single episode knapping floors). In the lower reaches of tributary creeks (third order creeks) will be archaeological evidence for more frequent occupation. This will include repeated occupation by small groups, knapping floors (perhaps used and re-used), and evidence of more concentrated activities. On major creeklines will be archaeological evidence for more permanent or repeated occupation. Sites will be complex and may even be stratified. Creek conjunctions may provide foci for site activity and the size of the confluence (in terms of stream ranking nodes) could be expected to influence the size of the site. Ridgetop locations between drainage lines will usually contain limited archaeological evidence although isolated knapping floors or other forms of one-off occupation may be in evidence in such a location. Naturally occurring silcrete will have been exploited and evidence for extraction activities (decortication, testing and limited knapping) would be found in such locations.

Researcher(s)	Year	Summary of model
		Sites in close proximity to an identified stone source would cover a range of size and cortex characteristics. As one moves away from the resource, the general size of artefacts in the assemblage should decrease, as should the percentage of cortex.
AMBS	2000	Spatial patterning in chipped stone artefact distributions adjacent to major creek lines can - in certain instances - be accommodated under a three-tiered model of 'Activity Overprint Zones' incorporating 'complex', 'dispersed' and 'sparse' zones. Complex zones will exhibit overlapping knapping floors and high density concentrations of artefacts indicative of repeated, long-term occupation events. Dispersed zones may include knapping floors. However, these are typically spatially discrete due to less frequent occupation. Sparse zones will exhibit consistently low frequencies/densities of artefacts. Artefact discard in these zones is likely to have resulted from discard in the context of use or loss rather than manufacture. Flaked stone artefact production and maintenance will leave a more obtrusive archaeological signature than resource extraction (e.g. food collection and processing). These activities will also occur closer to the residential core while resource extraction will typically occur away from it.
Jo McDonald CHM	2005a	Most areas - even those with sparse or no surface manifestations - contain sub-surface archaeological deposits. Where lithic concentrations are found in stable and aggrading landscapes, they are largely intact and have the potential for internal structural integrity. Sites in alluvium (shallow and deep) possess potential for stratification. While ploughing occurs in many parts of the Plain, this only affects the deposit up to c.30 cm depth, and even then ploughed knapping floors have been located which are still relatively intact. Contrary to earlier models for the region, many areas contain extremely high artefact densities, with variability appearing to depend on the range of lithic activities present. Densities in excess of 400-600 artefacts per m^2 are not uncommon. The complexity of the Cumberland Plain's archaeological record is far greater than was previously identified on the basis of surface recording and more limited test excavation. The time span of Aboriginal occupation has been demonstrated to be far greater than was originally thought. Gross patterning is identifiable on the basis of environmental factors: archaeological landscapes on permanent water are more complex than sites on ephemeral or temporary water lines.

White and McDonald's (2010) analysis of lithic artefact distribution in the RHDA provides a suitably robust dataset for assessing the validity of some of the key predictions of the models outlined above. Based on the results of over a decade of intensive test excavation in the RHDA, this study remains the most comprehensive of its type currently available for the Cumberland Plain. As indicated, Aboriginal site distribution on the Cumberland Plain has been linked to a variety of environmental factors, with distance to water, stream order, landform and geology (including proximity to known stone sources) variously highlighted as important influences. White and McDonald's (2010) analysis both supports

and negates various aspects of the postulated relationships between these factors and Aboriginal site patterning on the Cumberland Plain. Key findings can be summarised as follows:

- artefact distributions do not, as implied by the models of Kohen (1986) and Smith (1989), form bounded 'sites' but rather 'landscapes'
- artefact distribution does, as variably expressed by AMBS (2000), Kohen (1986), Jo McDonald CHM (1997b, 2005) and Smith (1989), appear to vary with proximity to water, albeit to different extents based on stream order
- artefact density does, as suggested by Jo McDonald CHM (1997b, 2005), appear to vary significantly with stream order
- artefact density does, as suggested by Jo McDonald CHM (1997b, 2005), appear to vary significantly with landform
- Aboriginal archaeological sites on the Cumberland Plain cannot, as proposed by Jo McDonald CHM (2005), be adequately characterized on the basis of surface evidence alone. Most areas, regardless of surface indications, contain subsurface archaeological deposit(s)
- the orientation of open land surfaces appears to have influenced the selection of artefact discard locations in the lower portions of valleys, with generally higher densities on lower slopes facing north and north-east
- distance from known silcrete sources does not, on present evidence at least, appear to have influenced intensity of artefact discard (cf. Dallas & Witter 1983)
- trends in artefact density and distribution indicate long-term, large scale patterns. Short term models of settlement organization are insufficient to account for these artefact distributions
- social and/or symbolic factors may have influenced site selection along with the distributions of economic and other resources.

More recently, AHMS (2015), employing a comparable analytical methodology to White and McDonald (2010), undertook an analysis of lithic artefact distribution across sixteen northwestern Cumberland Plain landscapes subject to dispersed testing and/or targeted open area salvage excavations. The dataset for this analysis, which sought, in common with White and McDonald's (2010) study, to identify patterns in artefact discard[7] comprised 2,988 artefacts from 345 dispersed test pits (1 m^2) along multiple pipeline corridors. In common with White and McDonald (2010: 32-33), AHMS found that artefact distribution within their sampled landscapes varied significantly in relation to both stream order and landform, with mean artefact densities highest in 3rd order landscapes (16.7 artefacts/m^2) and on terraces (16.9 artefacts/m^2). Interestingly, however, the mean artefact density for 3rd order landscapes in AHMS's (2015) dataset (i.e. 16.7 artefacts/m^2) was found to exceed that for 4th order landscapes in the RHDA dataset (13.9 artefacts/m^2). The mean artefact density for creek flats in AHMS's dataset (7.8 artefacts/m^2) was likewise found to exceed its counterpart in the RHDA dataset (3.8 artefacts/m^2), suggesting that creek flats in AHMS's sampled landscapes may have been more favoured for occupation than those in the RHDA or, alternatively, that creek flats in the RHDA had been subject to more intensive flood-erosion activity (resulting in a greater loss of artefacts).

In keeping with White and McDonald's (2010:34) results, AHMS found that in 2nd order landscapes, artefact density was highest within 50 m of water. Distance to water in 4th order landscapes was not assessed by AHMS. However, in a comparable finding to White and McDonald's (2010:34, Table 9) 4th order dataset, AHMS found that in 3rd order landscapes, artefact density was highest between 51 and 100 m from water. Consideration of 1st and 3rd order landscapes in combination likewise showed that mean artefact density was highest between 51 and 100 m of water, suggesting, in combination with the above, that landform elements located at a slightly greater distance to creeks (and particularly larger creeks) were favoured for sustained/repeated occupation[8]. While limited to lower slopes, AHMS's analysis of artefact distribution in relation to slope aspect revealed both similarities and differences with the RHDA dataset, with southeast-facing lower slopes in AHMS's sampled

[7] And, by extension, past Aboriginal land use preferences.
[8] For the RHDA, White and McDonald (2010:33) attributed a comparable finding to factors such as allowing animals to drink and catching a cool breeze.

landscapes exhibiting the highest mean artefact density (as opposed to north/northeast-facing slopes in the RHDA dataset), followed by northeast-facing lower slopes. Finally, AHMS's analysis of artefact distribution in relation to distance to known silcrete sources produced an entirely different result to White and McDonald's (2010:35, Table 12) analysis of the same relationship, with the latter revealing a pattern of increasing artefact density with increasing distance from known sources. In AHMS's dataset, artefact density was highest within two to three kilometres of known silcrete sources. However, outside of this finding, no clear patterning was evident, suggesting, in line with White and McDonald's (2010) findings, that distance to known silcrete sources likely had little influence over artefact discard rates.

3.2 Local archaeological context

3.2.1 Off-airport local context

AHIMS database

The AHIMS database, administered by Heritage NSW, contains records of all reported Aboriginal objects in accordance with Section 89A of the *National Parks and Wildlife Act 1974* (NPW Act). It also contains information about Aboriginal places, which have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are known as 'Aboriginal sites'.

Searches of the AHIMS database were undertaken on 1 April 2019 (Search IDs 411399, 411404 and 411419). This was undertaken over three separate search areas as the AHIMS register only provides search results for areas with fewer than 120 sites contained within them. Each of these searches was updated on 13 March 2020, 6 May 2020 and on 22 May 2020 (Search ID 507243). These searches covered an approximate area of 58 kilometres by nine kilometres, centred on the project, as well as sites in the immediate surrounding region.

A total of 360 sites were identified in these search results, comprising the study area for this assessment. Of these, a total of 12 sites were found to have centroids registered within the bounds of the construction footprint, with 10 in the on-airport area and two in the off-airport area. A further two sites were found to have PAD curtilages that extended partially into the off-airport construction corridor. The full search results are included in Appendix B (note: AHIMS Search Results are not shown in the public version of this report).

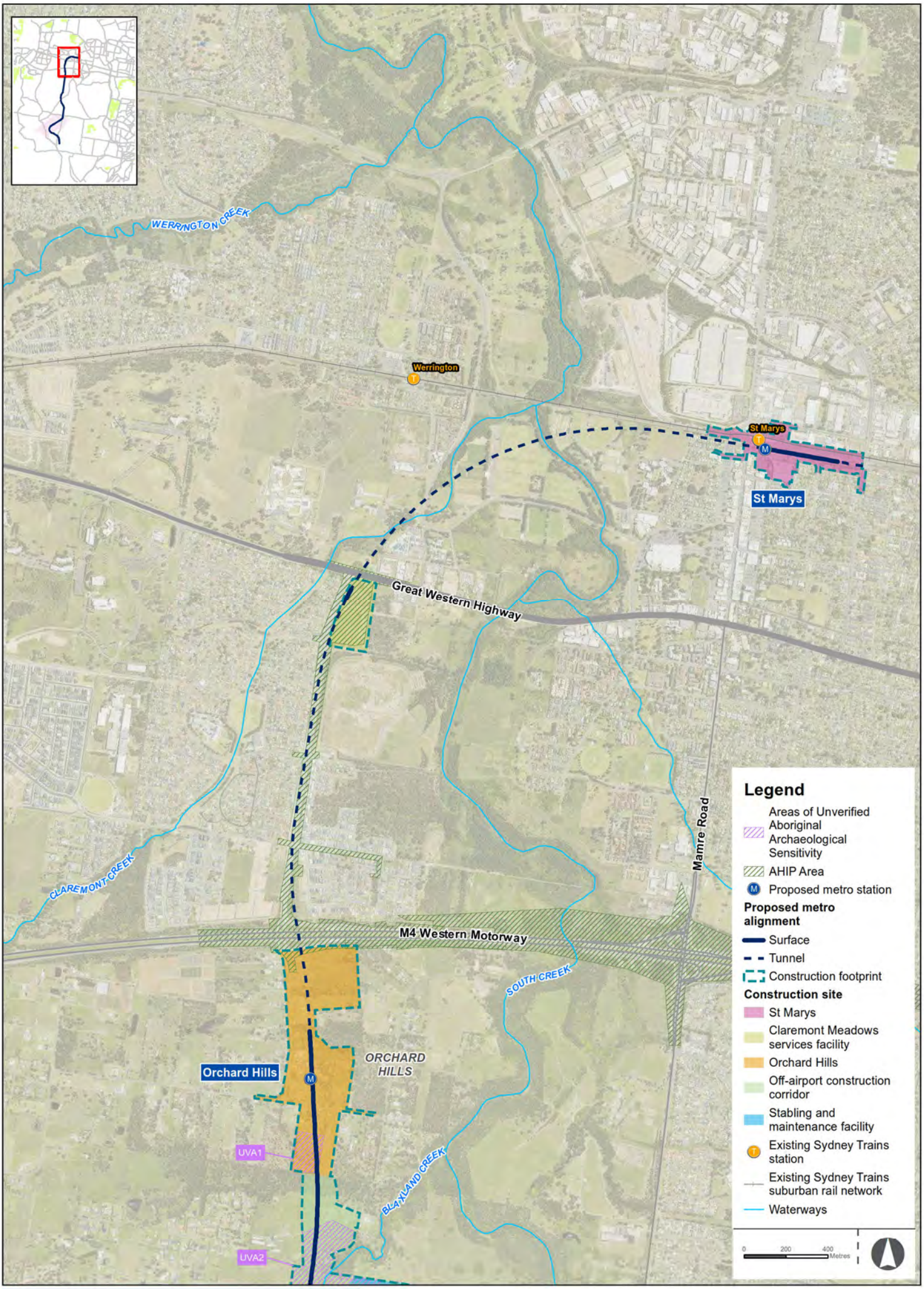
As is typical for the Cumberland Plain, artefact scatters and isolated artefact sites with and without other forms of archaeological evidence were the most common site type represented within the AHIMS search area (n=309 combined). Other, comparatively poorly represented types included nine PADs, six culturally modified trees, three art sites and one grinding groove site. It should be noted that a PAD is not a site, rather it is an area of potential awaiting verification of site status following further investigation to determine the presence or absence of subsurface artefact bearing cultural deposits.

There were 30 destroyed sites listed in the search results as well, referring to sites that have been destroyed under the conditions of a permit, usually issued for development works. The destroyed sites were predominantly located in the northern portion of the construction footprint, generally falling between St Marys and Claremont Creek. They were destroyed under permits 3762, 3752, 4001, 4096 and 4228. They were destroyed as a part of developing a regional depot at Plumpton and M4 Motorway upgrade road works between Church Street, Parramatta and Coleman Street, St Marys, as well as between Prospect and Emu Plains. These works included impacts in the suburbs of Riverstone, Schofields and Quakers Hill. Further details on AHIPs that intersect with the study area are included below.

There were also two registrations listed as Not a Site. The category Not a Site refers to a registration which, on further investigation, has been verified as not being of Aboriginal origin (i.e. verified as not having been created by Aboriginal people).

It should also be noted that the AHIMS search result data contains multiple inaccuracies. It is possible that some of the artefact scatter sites may be isolated artefacts, as information on the number of artefacts located in site areas is not present for all of those identified in the search results. Coordinate inaccuracy for AHIMS data is also known from past assessments to be an issue. The given

coordinates only represent a centroid, not the full extent of a site's area. As summarised in Table 3-3, there are 360 registered Aboriginal sites within the total study area.

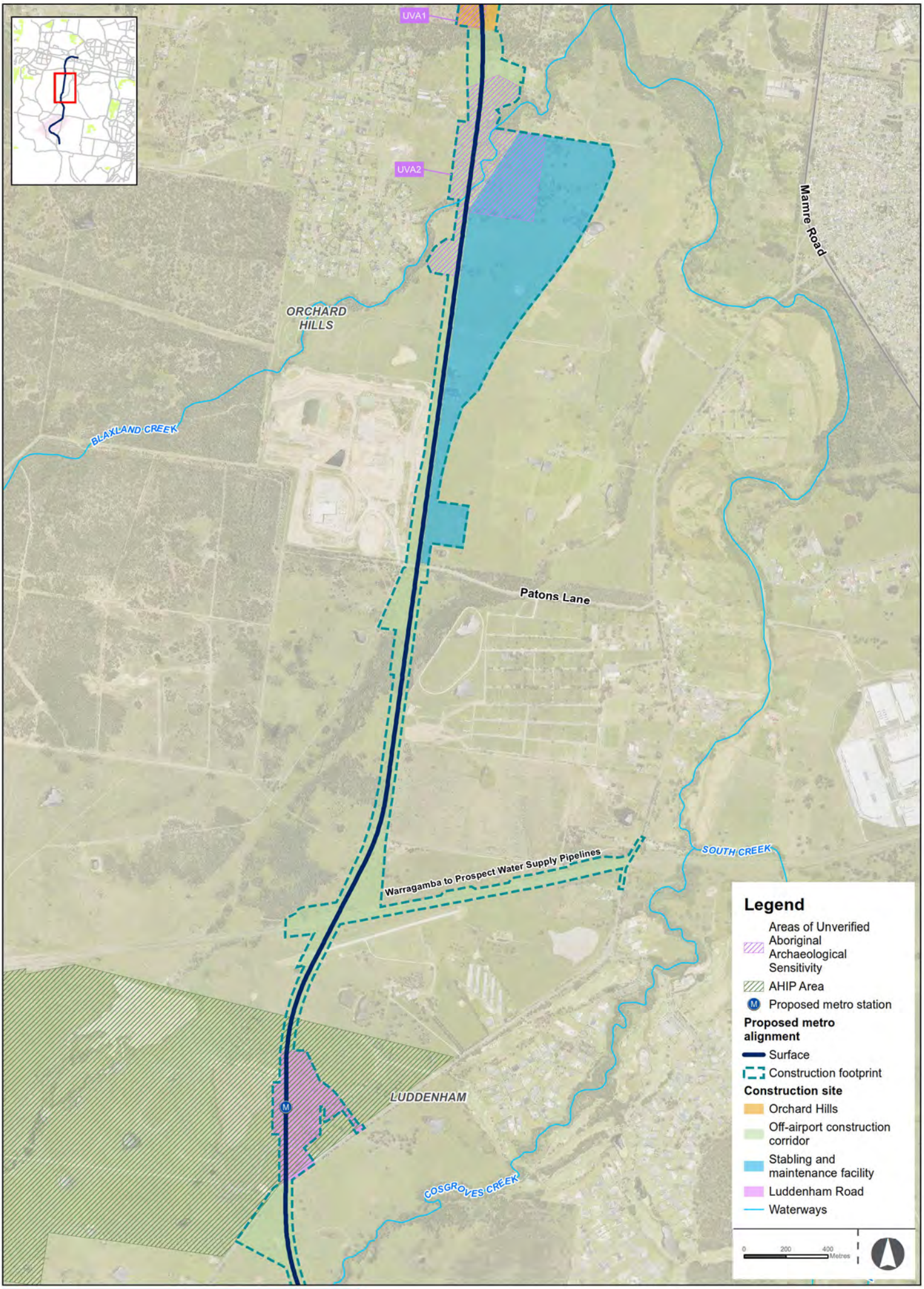


Sydney Metro – Western Sydney Airport

Verified archaeology and archaeological sensitivity

Indicative only, subject to design development

Figure 3-1a

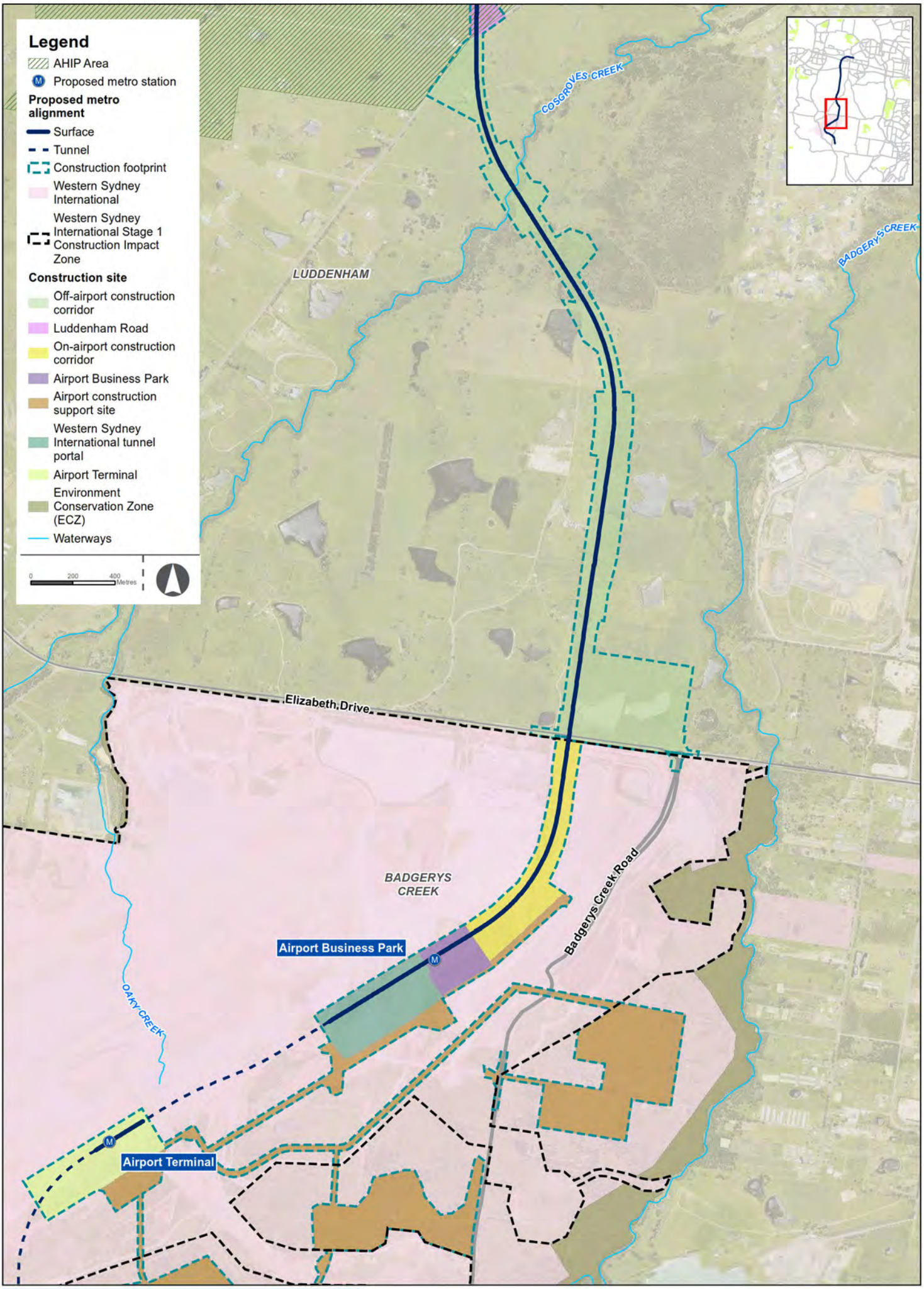


Sydney Metro – Western Sydney Airport

Verified archaeology and archaeological sensitivity

Figure 3-1b

Indicative only, subject to design development

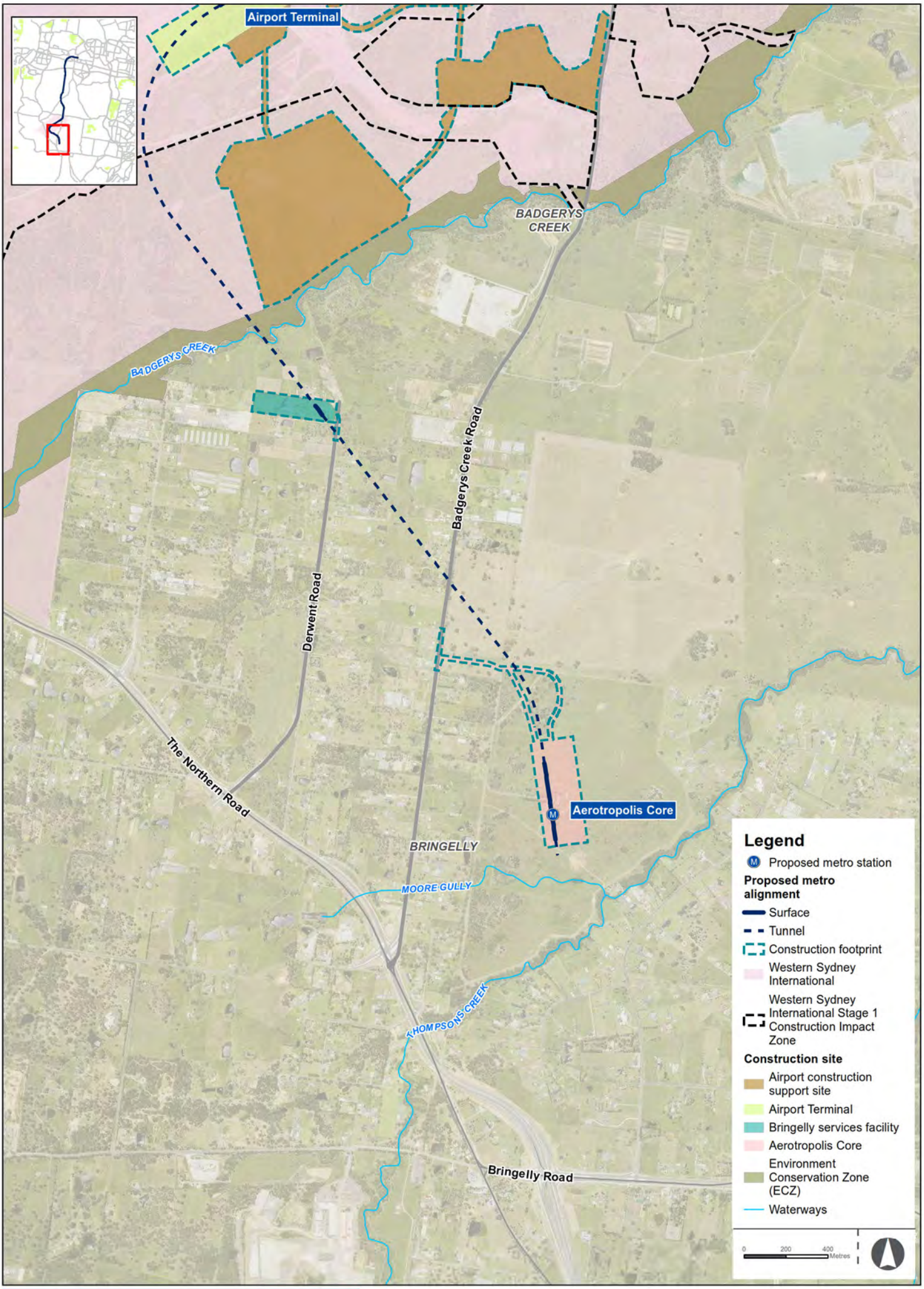


Sydney Metro – Western Sydney Airport

Verified archaeology and archaeological sensitivity

Figure 3-1c

Indicative only, subject to design development



Sydney Metro – Western Sydney Airport

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Indicative only, subject to design development

Figure 3-1d

Table 3-3 AHIMS search results

Site type	Number	%
Artefact Scatter	254	70.6
Isolated Artefact	55	15.3
Destroyed	30	8.3
Potential Archaeological Deposit (PAD)	9	2.5
Modified Tree	6	1.7
Art Site	3	0.8
Not a Site	2	0.56
Grinding Groove	1	0.24
Total	360	100

Of the 360 sites within the larger search area, a total of two sites were found to have centroids registered within the bounds of the off-airport construction footprint, one of which has been destroyed. A further two sites were identified as having PAD curtilages that extended partially into the construction footprint. These four sites are summarised in Table 3-4 and in Appendix C. Information on AHIP permits pertinent to destroyed sites in the off-airport area is included later in this section as well as in Appendix D.

Table 3-4 AHIMS sites within the off-airport construction footprint

Site ID	Site name	Site type/status	Within off-airport construction footprint
45-5-2640	B22	Artefact scatter	Aerotropolis Core
45-5-4420	GS3	Destroyed	Claremont Meadows services facility
45-5-5297	CCE T3	Artefact scatter with PAD	PAD extends partially into off-airport construction corridor (southern)
45-5-5298	BWB	Artefact scatter with PAD	PAD extends partially into off-airport construction corridor (southern)

There are errors and omissions with the AHIMS data, with common centroid discrepancy of up to 200 metre due to datum inaccuracy. Further to this, sites frequently extend to an area larger than the centroid coordinate used to represent them. To account for this and to consider that some sites registered outside the construction footprint according to the centroid coordinate, may in reality extend into its bounds, all sites within a buffer of 200 metres around the construction footprint were considered. The 22 sites within the 200 metre buffer of the off-airport construction footprint are summarised in Table 3-5. Due to access restrictions it was not possible to ground-truth all of these sites during fieldwork, but site card data was assessed to determine the veracity of the site locations and PAD curtilages in relation to the construction footprint. Only one of these previously recorded sites was able to be inspected during fieldwork (45-5-2784) as it was located in a road corridor. Although the area was inspected, this isolated artefact was not able to be located. Further to this, although the location of site 45-5-3773 was not able to be inspected as access to the property where it was located had not been granted, it was able to be viewed through the fence from within DEOH. The site location as seen through the fence was verified by a DLALC representative, who was the Knowledge Holder listed for the site on the corresponding AHIMS site card. In this way, it was confirmed as being outside the construction footprint in a disturbed area, but as access to the parcel of land containing the site had not been granted it was not possible to relocate any of the individual surface artefacts, only to generally view the site area from the adjoining property.

The three sections of Commonwealth land that the construction footprint crosses are managed by an existing Heritage Management Plan (HMP), Construction Management Plan (CMP) and Construction

Environmental Management Plan (CEMP). Defence Establishment Orchard Hills (DEOH) is managed through the Defence Establishment Orchard Hills, NSW: HMP (GML Heritage Pty Ltd, 2013). The HMP did not contain details of any previously recorded Aboriginal sites in the section of DEOH crossed by the off-airport construction footprint. The Royal Australian Air Force Telecommunications Unit, Bringelly is managed by a CMP. Western Sydney International is managed by a CEMP. Where available those documents were searched for any further sites not recorded in the AHIMS database. No further sites were identified intersecting with the study area.

Table 3-5 AHIMS sites within 200 metres of the off-airport construction footprint

Site ID	Site name	Site type/ status	Closest off-airport or on-airport construction footprint areas	Distance to construction footprint (m)
45-5-0356	Claremont Creek	Destroyed	Claremont Meadows services facility	170
45-5-2628	B 38	Artefact scatter	Aerotropolis Core	125
45-5-2641	B 23	Artefact scatter	Aerotropolis Core	80
45-5-2697	B49	Modified tree	Bringelly services facility	105
45-5-2702	B10	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	80
45-5-2703	B12	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	40
45-5-2706	B57	Artefact scatter	Bringelly services facility	55
45-5-2784	B 106	Isolated artefact	Bringelly services facility	10
45-5-2791	B 11	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	25
45-5-3190	Roughwood Park 1	Artefact scatter	Off-airport construction corridor	2
45-5-3191	Roughwood Park 2	Artefact scatter	Off-airport construction corridor	50
45-5-3773	Luddenham Road 1	Isolated artefact	Off-airport construction corridor	20
45-5-3776	Orchard Hills ISO2	Isolated artefact	Off-airport construction corridor	10
45-5-4390	Luddenham Road 3	Artefact scatter	Off-airport construction corridor	195
45-5-4418	GS1	Destroyed	Claremont Meadows services facility	5
45-5-4419	GS2	Destroyed	Claremont Meadows services facility	15
45-5-4424	Kent Road North 13	Destroyed	Orchard Hills	135
45-5-4429	M4 North 1	Destroyed	Orchard Hills	130
45-5-4430	Kent Road South 12A	Destroyed	Orchard Hills	80
45-5-4431	Kent Road South 12B	Destroyed	Orchard Hills	20

Site ID	Site name	Site type/ status	Closest off-airport or on-airport construction footprint areas	Distance to construction footprint (m)
45-5-4477	South Creek 4	Destroyed	Orchard Hills	180
45-5-5240	Elizabeth Drive Artefact (AFT) 2	Artefact scatter	Off-airport construction corridor	95

Of the sites that were identified as having registered centroids within 200 metres of the construction footprint, seven sites were assessed based on site card recordings as being wholly outside the construction footprint, but within close enough proximity to warrant protective fencing. These sites are summarised below in Table 3-6.

Table 3-6 AHIMS sites requiring protective fencing

Site name	AHIMS	Site type	Closest construction site	AHIMS Feature(s)	Surface or subsurface site	Management measure(s)
Roughwood Park 2	45-5-3191	Artefact scatter	Stabling & maintenance facility	Artefact (AFT)	Surface	Temporary protective fencing
Roughwood Park 2	45-5-3190	Artefact scatter	Stabling & maintenance facility	AFT	Surface	Temporary protective fencing
Orchard Hills ISO2	45-5-3776	Isolated artefact	Off-airport construction footprint	AFT	Surface	Temporary protective fencing
Luddenham Road 1	45-5-3773	Isolated artefact	Off-airport construction footprint	AFT	Surface	Temporary protective fencing
B106	45-5-2784	Isolated artefact	Bringelly services facility	AFT	Surface	Temporary protective fencing
B23	45-5-2641	Open artefact site	Aerotropolis Core	AFT	Surface	Temporary protective fencing
B57	45-5-2706	Open artefact site	Bringelly services facility	AFT	Surface	Temporary protective fencing

Previous archaeological investigations

Numerous Aboriginal archaeological investigations have been carried out across the off-airport study area over the last four decades. As in other parts of the Cumberland Plain, the majority of these investigations have been limited to survey. However, a number of investigations involving test and/or salvage excavation programs have also been undertaken. For contextual purposes, the results of a selection of these investigations, as relevant to the study area, are summarised in Table 3-7.

Intensive development activities since this time have secured the Cumberland Plain's place as one of the most intensively investigated archaeological regions in Australia, with potentially thousands of Aboriginal archaeological investigations involving survey and/or excavation having now been undertaken (the exact number difficult to calculate due to the limited circulation of many reports). This has led to ongoing cumulative impacts both to select Aboriginal sites and to the wider cultural landscape they are situated within. At the same time, the scientific knowledge gained through these numerous investigations has been significant. Currently much of the scientific knowledge is communicated through technical papers and reports; any opportunity proffered by the project to further the spread of this knowledge would be of benefit to the communities of this area.

The results of previous surface and subsurface investigations show that past Aboriginal occupation and land use in the study area was consistent with that of the Cumberland Plain as a whole. Collectively this does attest to an occupational emphasis on elevated low gradient landforms adjacent to higher order watercourses, as well as an emphasis on the procurement, transport, pre-processing and reduction of silcrete as a primary raw material for artefact manufacture.

Table 3-7 Previous Aboriginal archaeological investigations

Author	Project	Investigation type	Summary of results
Hanrahan, 1981	Proposed Housing Commission Subdivision at South Werrington, near Penrith	Survey	Archaeological survey was undertaken across land proposed for subdivision, incorporating the construction footprint to the north of the (M4) Western Motorway. A single artefact scatter was identified along the banks of Claremont Creek north of Caddens Road.
M. Dallas, 1982	An archaeological survey at Riverstone, Schofields and Quakers Hill, NSW	Survey	Seven artefact scatters and four isolated artefacts were identified during the survey. Identified impacts included erosion and ploughing. Eastern Creek was the main water source in proximity to these sites. Site density ranged from two to 50. Silcrete was the most common raw material, with others including chert, quartz, chalcedony and petrified wood. Artefact types included cores and flakes. Two of the sites were noted as having abundant stone resources on the ridges adjacent to them.
Rhoads, J.W.; Dunnett, 1985	Aboriginal Resources Planning Study: City of Penrith	Desktop and Survey	Desktop assessment and survey were undertaken across the region of Penrith for an Aboriginal resources planning study. 11 new and 82 known sites were identified and examined in four analytical study units. The current construction footprint is located within the regions of the Wianamatta Hill Country and South Creek Flood Plains units. Sites in the Wianamatta Hill Country (n=24) were found across all landforms, although correlations were noted with seasonal streams and confluences and gullied rises and stream banks. Raw materials were predominately silcrete and chert, with quartz additionally represented in half of the sites. Artefact densities varied with one artefact located every 2-25 m^2, and suggested activities of manufacture, use and repair. Low ground surface visibility inhibited detailed survey of this area. Sites in the South Creek Flood Plains (n=10) were mainly located on landforms adjacent to permanent waterways. Artefact densities were mostly 1/m^2 to 1/5m^2 and silcrete and

Author	Project	Investigation type	Summary of results
			chert were the predominate raw materials. Overall, site ages were poorly indicated by soil horizons.
J. McDonald, 1986	Archaeological reconnaissance of the proposed Schofield regional depot at Plumpton, NSW	Survey and test excavation	Surface artefact scatters were identified across the entire area, but density was found to reduce away from the ridgelines (being the source of raw materials). Sites were found to cluster around water courses and low ridges. Four out of five excavated test pits (50 cm by 50 cm) contained artefacts. Silcrete was the most common material.
Dallas, 1988	Preliminary archaeological study of the Luddenham Equestrian Centre, Luddenham Road, Erskine Park, NSW	Survey	An archaeological survey was undertaken for a proposed development located outside the construction footprint to the west of Cosgroves Creek. 12 artefact scatters (LEC 1-12) were identified and an area of PAD was defined.
Dallas & Smith, 1988	Site Investigations at the Luddenham Equestrian Centre, Erskine Park	Test excavation	Following the preliminary study, test excavation was undertaken in areas in proximity to artefact scatters LEC 9 and LEC 12 and also across landforms within similar topographic features to these sites. A total of 13 test trenches were excavated. Within 10 pits 104 stone artefacts and one piece of ochre were recovered. One trench demonstrated modern artefacts suggestive of site disturbance. Silcrete was the dominant raw material (99%), with minor additions of mudstone, quartz and chert. Significant quantities of stone artefacts were limited to at depth subsurface deposits on relatively flat ground.
Dean-Jones, 1991	Proposed clay/shale extraction Lot 3 DP623799 Adams Road, Luddenham	Survey	A single artefact scatter comprising 22 stone artefacts was identified at the edge of the Oaky Creek floodplain.
Brayshaw McDonald Pty Ltd, 1992	Proposed 33kV transmission line between Bringelly and Rossmore, NSW	Survey	A single artefact scatter comprising 11 stone artefacts was identified on a low spur less than 150 m from South Creek.
Brayshaw, 1995	Elizabeth Drive Upgrade Environmental Impact Statement Archaeological Survey for Aboriginal Sites	Survey	Pedestrian surveys were undertaken in an easement along Elizabeth Drive. Surveys noted high levels of disturbance from previous road works in areas that may originally have been archaeologically sensitive. Two open artefact scatters (one disturbed) and six

Author	Project	Investigation type	Summary of results
			areas of PAD were identified. The artefact scatters contained a total of 13 stone artefacts of varied materials (silcrete, chert, FGS, mudstone and quartzite), with one possible and two definite cores identified. A program of subsurface testing was recommended for the undisturbed site and five of the PADs.
Helen Brayshaw Heritage Consultants, 1996	M4 Upgrade: Archaeological Survey for Aboriginal Sites for Proposal to Upgrade the M4 Motorway from Church Street Parramatta to Coleman Street Marys Hill and Prospect to Emu Plains	Survey	Pedestrian survey undertaken prior to upgrade works on the M4, including an area of the construction footprint where the M4 intersects with Kent Road. 20 open artefact sites comprising isolated artefacts or artefact scatters were identified, including four located within or in proximity to the construction footprint (Locations 11, 12A, 12B and 13). Most sites were located in disturbed contexts.
Steele, 1999 Steele, 2001 Steele, 2004 Steele, 2007	Twin Creeks Estate, Luddenham	Survey (1999); Test excavation (2001); Aboriginal Heritage Conservation Action Plan (2004); Excavation and monitoring (2007)	A program of archaeological assessment was undertaken following previous work undertaken at the Luddenham Equestrian Centre by Dallas in 1988. Surveys identified five previously unrecorded open campsites, an isolated artefact and a possible modified tree, in addition to relocating five of 12 previously recorded artefact scatters in the locality. Preliminary test excavations were undertaken for three of the previously recorded open campsites (AHIMS #45-6-1772, #45-6-1774 and #45-6-1777) which were indicated to contain moderate archaeological potential. Additional excavation was undertaken around a spur identified by the representatives from the Local Aboriginal Land Council (LALC) as potentially sensitive. Angular silcrete gravels and fragments assessed as naturally occurring were present throughout the site. Total worked stone (n=319) consisted of varied proportions of silcrete, tuff and quartz, with small numbers of volcanics, petrified wood and quartzite. The presence of backed artefacts led to the dating of the site to the Middle Bondaian, between 2,800 BP and 1,600 BP.

Author	Project	Investigation type	Summary of results
			An Aboriginal Heritage Conservation Action Plan (Steele, 2004) was prepared in conjunction with an application for a Section 90 Heritage Impact Permit Consent with Salvage and Collection for the Twin Creeks Estate development. The area was divided into 9 zones; consent with salvage was requested for Zones F and G, while consent with collection was requested for Zones B, C, D, E and H. Archaeological excavation and monitoring (Steele, 2007) were undertaken at the Twin Creeks Estate in accordance with the approved Conservation Action Plan and S90 Consent (#2056). Site LEC 12 (AHIMS #45-6-177) was assessed and stabilised; site LEC 10 (AHIMS #45-6-1779) was excavated for salvage; and site TCE 1 (AHIMS #45-5-2991) was collected following its identification during the period of development monitoring. Excavations for LEC 10 recovered 120 artefacts over 16 test trenches, with 57 complete flakes.
Jo McDonald Cultural Heritage Management Pty Ltd, 2000	Archaeological Survey for Aboriginal Sites: Proposed Light Industrial Subdivision, "Austral Site", Mamre Road, Erskine Park, NSW	Survey	Five artefact scatters and three isolated artefacts were identified. Salvage works were recommended prior to development proceeding.
Jo McDonald Cultural Heritage Management Pty Ltd, 2001	Survey for Aboriginal Sites 1503 Elizabeth Drive, Kemps Creek	Survey	Pedestrian surveys were undertaken for a 25.5 hectares section of Nolans Quarry proposed for redevelopment. One section of PAD was identified on a ridgeline in proximity to Kemps Creek and South Creek, with an associated quartz flake located on the surface. Clearing prior to the survey was suggested to have impacted the surface of the site, potentially having destroyed previous artefacts. Despite this, intact subsurface deposits were considered possible.

Author	Project	Investigation type	Summary of results
URS Australia Pty Ltd, 2001	Gipps Street Landfill Site, Claremont Meadows	Survey	An archaeological survey was undertaken of Gipps Street Lane, located within the construction footprint. No Aboriginal sites were identified. Observations concluded that the site had been subject to high levels of past disturbance.
Appleton, 2002	The Archaeological Investigation of Lot 2, DP 120673 The Site of a Proposed New Clay and Shale Extraction Area - Old Wallgrove Road Horsley Park, West of Sydney NSW	Survey	Two isolated artefacts and an area of PAD were identified during survey at this location.
Environmental Resources Management Australia Pty Ltd, 2003 Environmental Resources Management Australia Pty Ltd, 2006a	Land Solutions Development, Claremont Meadows	Survey; Test excavation and salvage	Archaeological survey was undertaken for a portion of land located outside the construction footprint, between the M4 and Fowler Street. Nine sites were identified, comprising four artefact scatters, four isolated artefacts and a possible scarred tree. A Section 90 consent to destroy was recommended for disturbed sites in the north of the study area, while testing followed by a Section 90 consent was recommended for site OAD1. Subsequent test excavations and salvage were undertaken for site OAD1 (AHIMS #45-5-3013), which was determined to form part of AHIMS #45-5-2898. Approximately 2,000 artefacts were recovered, with evidence of complex activity zones including knapping floors and potential associations with heat shatters and campsites. Site distribution within the area was correlated with the crest at the 30 m contour overlooking South Creek.
Environmental Resources Management Australia Pty Ltd, 2006b	Lots 8, 9, 10 DP27107 and Lot 19 DP239091 Claremont Meadows	Survey	Survey was undertaken for a proposed development located outside the construction footprint, to the north west of Kent Road. Six Aboriginal sites were identified in areas of exposure across the site and subsurface potential was predicted for the flat floodplain.
Jo McDonald Cultural Heritage Management Pty Ltd, 2008b	Austral Land Mamre Rd, Erskine Park: Archaeological	Salvage	Salvage excavations were undertaken with 298 m^2 excavated and 8,867 artefacts retrieved from subsurface deposits. Artefact density was found to be tied to stream order. Use of silcrete

Author	Project	Investigation type	Summary of results
	Salvage Excavations		as a raw material diminished as the distance from silcrete sources increased. Backed blades were present as was evidence of bipolar flaking.
Jo McDonald Cultural Heritage Management Pty Ltd, 2008a	Lot 2 DP771697, Claremont Meadows	Survey	Pedestrian survey undertaken for a development area located within the construction footprint to the immediate south of the (A44) Great Western Highway. One isolated find (GS01 consisting of a silcrete flake) was identified in the road corridor of Gipps Street at the edge of an eroding bank associated with a drainage line.
Biosis Research Pty Ltd, 2008	Rosehill Recycled Water Scheme Preliminary Cultural Heritage Assessment	Survey	No sites were identified during survey, although it was noted that one artefact scatter and one PAD were both located in close proximity. An area of sensitivity was demarcated.
Environmental Resources Management Australia Pty Ltd, 2010	Lots 8, 9, 10 DP27107 and Lot 19 DP239091 Claremont Meadows	Test excavation and salvage	Test excavations were undertaken for three sites identified in the 2006 assessment (CMSW3, CMSW4 and CMSW5), while test excavation and salvage were undertaken for site CMSW1. A total of 773 artefacts were recovered and included flaked stone and flaked glass, suggesting site occupation in the contact period.
Archaeological and Heritage Management Solutions Pty Ltd, 2012	Aboriginal Archaeological Survey Report: Werrington Arterial Road (M4 Motorway – Great Western Highway), Claremont Meadows, NSW	Survey	An assessment was undertaken for proposed upgrade works at Gipps Street and Kent Road from the M4 Motorway to the Great Western Highway, near Claremont Meadows. A total of seven Aboriginal sites were identified within the study area, with a further three in close proximity, outside the study area boundary. Five of the sites had been previously recorded; five sites were new recordings. The sites included seven isolated artefacts and three artefact scatters (one identified as having an associated area of PAD). Site #45-5-2898 was verified as being outside the study area, as the AHIMS coordinates had erroneously identified it as within. Site avoidance was recommended with an AHIP stated as needed if sites could not be avoided.

Author	Project	Investigation type	Summary of results
Kelleher Nightingale Consulting Pty Ltd, 2012	Werrington Arterial Road M4 Motorway to Great Western Highway Cultural Heritage Assessment Report	Desktop	A report was compiled to support the AHIP application for the proposed upgrades at Kent Road and Gipps Street between the M4 Motorway and the Great Western Highway, as part of the Werrington Arterial Road project near Claremont Meadows. Of the 10 sites identified (seven isolated artefacts and three artefact scatters), seven were to be destroyed, two were to be protected and preserved, and one was to be partially destroyed. An AHIP (C0000636) was subsequently issued for the impact.
Kelleher Nightingale Consulting Pty Ltd, 2013b	Sydney Science Park Development, Luddenham	Survey	Archaeological surveys were undertaken across a 448 hectares parcel of land proposed for rezoning and development. This included a section within the construction footprint to the north of Luddenham Road. Five archaeological sites (including one previously recorded site) and three areas of PAD were identified. An AHIP was recommended for the development.
Kelleher Nightingale Consulting Pty Ltd, 2013a Kelleher Nightingale Consulting Pty Ltd, 2016a	M4 Managed Motorway from Lapstone (Western End) to Strathfield (Eastern End)	Survey and cultural heritage assessment	33 Aboriginal sites were shown to be located within the M4MM corridor, including previously recorded sites (Brayshaw and Haglund 1996) and two new artefact scatters. High levels of disturbance were observed during surveys. AHIP C0002113, AHIMS Permit ID 4001 was subsequently issued for the recommended salvage excavation, community collection and destruction of Aboriginal objects throughout the development.
Biosis Research Pty Ltd, 2016	Mamre West Precinct, Orchard Hills	Survey and test excavation Salvage	Survey recorded a single artefact scatter comprising 11 stone artefacts. Test excavation across four areas of identified sensitivity identified a total of 78 artefacts. Subsequent salvage excavations recovered 43 artefacts from 39 excavation units, with an overall density of 1.1/m^2.

Author	Project	Investigation type	Summary of results
Kelleher Nightingale Consulting Pty Ltd, 2016b	The Northern Road Upgrade Stage 3 Jamison Road, Penrith to Glenmore Parkway	Survey	Pedestrian surveys were undertaken across a four kilometre stretch of land proposed for development. Four artefact scatters and two isolated artefacts were identified, most of these on the crests and slopes of a north-south running ridgeline. Five of the sites showed evidence of high disturbance from infrastructure and erosion, with low archaeological potential. One site (TNR AFT 32) exhibited evidence of in situ material and moderate archaeological potential. The assessment of site TNR ART 32 prompted the adjustment of RMS's concept design to ensure it was avoided. Two sites were assessed as potentially impacted by the proposed works and an AHIP was recommended. AHIP C0002492, AHIMS Permit ID 4078 was subsequently issued for these impacts. Three additional sites were identified as within the boundary of a separate AHIP application (KNC 2016a, AHIP C0002113) that was already in progress at the time of the assessment.
Kelleher Nightingale Consulting Pty Ltd, 2018	Sydney Science Park Development Luddenham, NSW Aboriginal Archaeological Assessment Test Excavation Report	Test excavation	The study area, located on Luddenham Road, Luddenham, was to be developed as Sydney Science Park, a place to install leading science-based businesses, tertiary institutions, research and development providers. A total of 15 artefacts were recovered from across 24 test pits at RPS LTPAS01. Materials were predominantly silcrete (n=11) whilst artefacts of silicified tuff (n=3) and quartzite (n=1) were also found. Further to this a total of two artefacts were recovered from the five test pits excavated at SSP 1, 29 artefacts were recovered from the 22 test pits excavated at SSP 2, a total of 36 artefacts were recovered from the 15 test pits excavated at SSP 3, 42 artefacts were recovered from the 26 test pits excavated at SSP PAD 1, six artefacts were recovered from the 12 test squares excavated at SSP PAD 2 and 76 artefacts were recovered from the 47 test squares excavated at SSP PAD 3 and 76 artefacts were recovered from the 47 test squares excavated at SSP PAD 3.

Author	Project	Investigation type	Summary of results
Kelleher Nightingale Consulting Pty Ltd, 2018b	Sydney Science Park Development, Luddenham, NSW Cultural Heritage Assessment Report	Desktop	Following test excavations this report was compiled to support an all of area AHIP application.
Streat & Pavinich, 2018	Aboriginal Test Excavation Report Lot 2 Section 4 DP 2954 111-1141 Elizabeth Drive, Cecil Park	Test excavation	30 test trenches were excavated across the study area of a proposed subdivision, located to the east of the construction footprint. Intact soil profiles were present in some areas; however, no Aboriginal archaeological material was identified.
Roads and Maritime Services, 2019	M12 Motorway concept design and Environmental Impact Statement ACHAR	Survey and test excavation	Field surveys and test excavations conducted along the proposed M12 Motorway identified nine stone artefact sites and 17 areas of PAD, all grouped around major creek lines. PADs were subsequently excavated in linear transects extending away from identified creek lines. A total of 1,509 Aboriginal artefacts were recovered from 16 of the 17 PADs, comprising 1,404 flaked artefacts, in addition to hammer stones, stone fragments and an ochre pencil. Across the sites, subsurface extents suggested that subsurface material was extensive across the site and continued into the surrounding landscape. The construction footprint crosses into PAD M12-BWB, defined as an area of creek flats immediately north of Elizabeth Drive and extending at least 520 m along an east-west axis from Badgerys Creek. M12-BWB contained a total of 72 artefacts across 13 test pits. Artefact densities were generally low; however, one pit recorded 24 artefacts. Artefact distributions demonstrated that artefacts were located throughout the soil profile but occurred consistently in topsoils up to 360 m from creek. The site was assessed to be of low-moderate significance, with the exception of high social significance. Overall, 19 sites were to be impacted by the project, including the partial impact (1.7 ha) of BWB. Mitigation measure such as salvage and protective fencing were recommended.

Author	Project	Investigation type	Summary of results
Baker Archaeology Pty Ltd, 2019	University of Sydney lands at Badgerys Creek ACHAR	Survey	Pedestrian field surveys were conducted to assess archaeological sensitivity across parcels of farmland, including the section of the construction footprint to the north of Elizabeth Drive. A total of 29 previously unrecorded sites were identified (UoS 1 – 29), all of which consisted of stone artefact sites ranging from densities of one to 100 artefacts. Two low density artefact sites, (UOS 06 and UOS 27) were located within the current construction footprint. There are also zoned areas for conservation value, with the construction footprint passing through areas zoned as low archaeological value, with the exception of the section within the vicinity of Badgerys Creek associated with site BWB, assessed as moderate

Based on the summary provided in the table above, past assessments undertaken across the wider region including the construction footprint have identified the presence of Aboriginal artefacts in both surface and subsurface contexts. Artefact sites have predominantly been identified in proximity to water sources, although other landforms may contain sites if they have not been subject to high levels of past disturbance. Although artefact sites are the most common across the area other site types have been identified in the region, including culturally modified trees. There are both known AHIMS sites and areas of archaeological sensitivity that are likely to contain intact subsurface deposits present within the bounds of the construction footprint.

Previous AHIPs

In land covered by NSW legislation, there are a number of existing AHIPs that have been previously granted to cover works and AHIMS site impacts in those areas. Known AHIPs that the construction footprint for the project crosses into include the following (the permits of which are included in full in Appendix D):

- AHIP C0000637 for upgrades to Kent Road and Gipps Street at Claremont Meadows, granted 5 November 2014. The permit authorised impacts to AHIMS sites 45-4-4418, 45-4-4419, 45-4-4420, 45-4-4423, 45-4-4424, 45-4-4428, 45-4-4430 and 45-4-4431. The entire AHIP area was approved for impacts
- AHIP C0002113 for M4 Western Motorway upgrades at Parramatta, granted 5 September 2016. The permit authorised impacts to AHIMS sites 45-5-1070, 45-5-1071 and 45-5-1074. The entire AHIP area was approved for impacts following the surface collection and salvage that had been proposed as mitigation measures for the destroyed sites
- AHIP C0003861 for Sydney Science Park, granted 23 July 2018. The permit authorised impacts to AHIMS sites 45-5-4189, 45-5-4707, 45-5-4709 and 45-5-4922. The entire AHIP area was approved for impacts following the completion of salvage works that had been proposed as a mitigation measure for the destroyed sites.

Surface sites above tunnels

Consideration has also been given to those previously recorded sites identified in surface contexts above the two tunnel alignments, as well as areas of archaeological potential along its extent. Currently artefact scatter site 45-5-4423 (GS5) is the only valid previously recorded AHIMS site directly over the tunnel alignment an**d** outside the bounds of the construction footprint (with sites 45-5-4418 (GS1), 45-5-4419 (GS2), 45-5-4420 (GS3) and 45-5-4428 (GS4) all listed as Destroyed). One

new artefact scatter site (SMWSA-AS1) was identified in the northern above tunnel area. Although not all areas in the southern portion of the above tunnel areas were able to be accessed during surveys undertaken to date, there was sufficient visibility to view along the alignment from accessible areas at intervals along its extent to determine whether rockshelters and grinding grooves (site types susceptible to cracking from vibration and subsidence) were present or likely to be present. The results of the research into known AHIMS sites and surveys to date were that no sites with a high risk of vibration or subsidence related impact were present in the above tunnel areas. It was assessed as unlikely that tunnelling at depth would impact directly or indirectly on Aboriginal sites as no site types with risk of collapse or cracking were found to be present during survey.

Key observations

The presence of surface sites within the study area suggests that further as yet undiscovered sites are likely to be present within this area. Areas of archaeological potential have been predicted to be most likely to occur in proximity to surface sites, or on elevated well drained landforms within 50 metres of a permanent water source. Aboriginal cultural values have been identified as present, attached to known sites and landscape features such as water courses. Feedback from the RAP representatives during the fieldwork indicated that the waterways that traverse the construction footprint, and the project alignment, have cultural significance as pathways and focal resource areas for Aboriginal people in the past. Known sites are culturally significant on the grounds that they are a tangible link to ancestors and a physical presence in the landscape denoting the long-term Aboriginal use and occupation of this area. Archaeological field investigation, including survey and test excavation, undertaken for the project to date are outlined in Chapter 4.

3.2.2 On-airport local context

AHIMS database

Details of the AHIMS searches undertaken for the project are outlined in Section 3.2.1. Of the 360 sites within the larger search area, a total of 10 sites were found to have centroids registered within the bounds of the on-airport section of the construction footprint. These sites are summarised in Table 3-8.

Table 3-8 AHIMS sites within the on-airport construction footprint

Site ID	Site name	Site type	On-airport construction site
45-5-2637	B5	Artefact scatter	Airport construction support site
45-5-2665	B88	Artefact scatter	On-airport construction corridor
45-5-2586	B3	Isolated artefact	Airport construction support site
45-5-2687	B71	Artefact scatter	Airport Terminal
45-5-5068	B131	Isolated artefact	On-airport construction corridor
45-5-5078	B136	Isolated artefact	Airport construction support site
45-5-5085	B162	Artefact scatter	Airport construction support site
45-5-5089	B163	Artefact scatter	On-airport construction corridor
45-5-5094	B154	Artefact scatter	On-airport construction corridor
45-5-5100	B147	Artefact scatter	Airport construction support site

Of the 10 sites listed above, three sites (listed as 45-5-5078, 45-5-2637 and 45-5-2586) are located outside of the Western Sydney International Stage 1 Construction Impact Zone. Only one of these sites was able to be found during archaeological field investigations (listed as 45-5-5078). Should site collection and salvage not have been undertaken for any of the on-airport direct impact sites prior to the project commencing in those areas, the conditions of the Western Sydney International Aboriginal Cultural Heritage CEMP and related methodologies for collection and salvage would need to be followed.

As was previously noted, there are errors and omissions with the AHIMS data, with common centroid discrepancy of up to 200 metres due to datum inaccuracy. Further to this, sites frequently extend to an area larger than the centroid coordinate used to represent them. To account for this and to consider that some sites registered outside the construction footprint according to the centroid coordinate, may in reality extend into its bounds, all sites within a buffer of 200 metres around the construction footprint were considered. These sites within the buffer for the on-airport area are summarised in Table 3-9.

Table 3-9 AHIMS sites within 200 metres of the on-airport construction footprint

Site ID	Site name	Site type	Closest off-airport or on-airport construction sites	Distance to construction footprint (m)
45-5-2586	B3	Isolated artefact	Airport construction support site (on-airport, outside Stage 1)	75
45-5-2623	B 68	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	40
45-5-2630	B 40	Modified tree	Airport construction support site (on-airport, outside Stage 1)	160
45-5-2632	B 44	Artefact scatter	On-airport construction corridor (Stage 1)	185
45-5-2658	B67	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	160
45-5-2659	B66	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	10
45-5-2673	B101	Artefact scatter	Airport construction support site (Stage 1)	185
45-5-2680	B78	Artefact scatter	Airport terminal (Stage 1)	95
45-5-2681	B77	Artefact scatter	Airport terminal (Stage 1)	120
45-5-2682	B75	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	55
45-5-2683	B76	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	105
45-5-2690	B59	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	150
45-5-2705	B15	Artefact scatter	Airport construction support site (Stage 1)	130
45-5-2763	B87	Artefact scatter	On-airport construction corridor (Stage 1)	120
45-5-2770	B70	Artefact scatter	Airport construction support site (Stage 1)	180
45-5-2788	B 112	Artefact scatter	Airport construction support site (Stage 1)	140
45-5-2813	B104	Artefact scatter	Airport construction support site (Stage 1)	120
45-5-2814	B103	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	80
45-5-5022	B113	Isolated artefact	Airport construction support site (Stage 1)	140
45-5-5055	B118	Isolated artefact	Airport construction support site (on-airport, outside Stage 1)	90

Site ID	Site name	Site type	Closest off-airport or on-airport construction sites	Distance to construction footprint (m)
45-5-5057	B120	Grinding groove	Airport construction support site (on-airport, outside Stage 1)	135
45-5-5067	B130	Isolated artefact	Airport construction support site (on-airport, outside Stage 1)	70
45-5-5082	B159	Artefact scatter	Airport terminal (Stage 1)	60
45-5-5083	B160	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	120
45-5-5085	B162	Artefact scatter	Airport construction support site (Stage 1)	155
45-5-5086	B164	Artefact scatter	On-airport construction corridor (Stage 1)	30
45-5-5087	B165	Artefact scatter	Off-airport construction corridor	70
45-5-5090	B158	Artefact scatter	Airport construction support site (on-airport, outside Stage 1)	70
45-5-5096	B152	Artefact scatter	Off-airport construction corridor	165
45-5-5097	B151	Artefact scatter	Off-airport construction corridor	40
45-5-5099	B146	Artefact scatter	Airport construction support site (Stage 1)	10
45-5-5102	B148	Artefact scatter	Airport construction support site (Stage 1)	125
45-5-5173	B169	Artefact scatter	On-airport construction corridor (Stage 1)	95
45-5-5175	B167	Artefact scatter	Airport construction support site (Stage 1)	95

Previous archaeological investigations

Extensive archaeological investigation has been undertaken and is currently ongoing within the bounds of Western Sydney International. Survey and test excavation were undertaken in 2015 and salvage works are currently underway as development works continue. The results of the 2015 investigation (see Table 3-10) identified sites and artefact assemblages consistent with those evident in the wider region (as discussed in the previous section in relation to the off-airport area).

Table 3-10 Previous Aboriginal archaeological investigations

Author	Project	Investigation type	Summary of results
Haglund, 1978	Major airport needs of Sydney study; survey of Aboriginal sites and relics, second Sydney airport site options	Survey	Pedestrian surveys were undertaken over multiple sites selected as potential locations of a second airport, with the aim of identifying Aboriginal archaeological constraints. A number of sites were identified, including three north of Elizabeth Drive (AHIMS sites #45-5-0213, 45-5-0214 and 45-5-0215). No sites were identified within the construction footprint.

Author	Project	Investigation type	Summary of results
Lance & Hughes, 1984	Second Sydney Airport Aboriginal Archaeological Study: Badgerys Creek/Wilton	Survey	Comprehensive survey undertaken over sample areas within Badgerys Creek to assess Aboriginal archaeological sensitivity. Results indicated poor surface visibility adjacent to creeks and on hillslopes due to vegetation growth. One artefact scatter (AHIMS site #45-5-0517) was identified in a ploughed field adjacent to Badgerys Creek.
Navin Officer Heritage Consultants Pty Ltd, 1997	Proposal for Second Sydney Airport at Badgerys Creek or Holsworthy Military Area	Survey	Archaeological surveys were undertaken for alternative airport locations at Badgerys Creek and Holsworthy Military Training Area. 111 Aboriginal sites were recorded across the Badgerys Creek study area, including one previously recorded site (#45-5-0517). These predominately consisted of stone artefact sites; however, 8 scarred trees and one area of PAD were also recorded. Sites were generally low density, with the exception of higher densities in valley floor and fluvial corridor landforms. Most sites were assessed to be in disturbed contexts. Badgerys Creek was assessed as a lesser impact due to the presence of highly sensitive rockshelters at the Holsworthy site. Recommendations included a more detailed survey of impacted areas, subsurface testing and salvage.
Artefact Heritage, 2012	The Northern Road Upgrade	Survey	A total of new 32 sites were recorded, including 11 stone artefact sites, two scarred trees and 1 PAD. Sites were located across varied landforms. Four previously recorded sites were assessed as destroyed.
AMBS, 2014	Environmental survey of Commonwealth Land at Badgerys Creek: Aboriginal Heritage	Desktop and survey	A desktop review and archaeological survey were undertaken for Commonwealth owned land at Badgerys Creek. 21 previously recorded sites were inspected to determine their condition. Only seven sites were relocated, consisting of five stone artefact sites and two possible scarred trees. Results concluded that the area contained greater subsurface potential than assessed within the 1997 report (Navin Officer 1997).

Author	Project	Investigation type	Summary of results
Navin Officer Heritage Consultants Pty Ltd, 2015	Western Sydney Airport Aboriginal Cultural Heritage Assessment	Field inspection and test excavation	An archaeological assessment was undertaken for Stage 1 of the proposed 1,700 hectares Western Sydney Airport at Badgerys Creek. Desktop review revealed a total of 51 previously recorded sites within the study area. 38 test pit locations were initially proposed for testing; however, only 11 of these were excavated following field inspection of the locations. Each location comprised a total of 10-14 x 5m^2 test pits. Following field inspections of excavation sites and test excavation, a total of 23 new Aboriginal sites were recorded, comprising of nine surface sites, 13 subsurface sites and one site with both surface and subsurface expressions of artefacts. Due to the nature of impact proposed for the construction of the airport, the sensitivity of the study area for Aboriginal sites, the cumulative impact of development across the Cumberland Plain and strong opposition from Aboriginal stakeholders, the preparation of a conservation management plan was recommended.
Department of Infrastructure and Regional Development, 2016	Western Sydney International - Environmental Impact Statement	Survey and test excavation	Survey and test excavation were carried out at both the Stage 1 area and areas outside of the Stage 1 area of Western Sydney International in May 2015. In addition to previously recorded sites, a total of 23 new sites were identified, comprising 14 subsurface artefact deposits (identified during test excavation), nine open artefact sites (determined by the surface expression of artefacts) and one grinding groove site. A total of 39 sites (all open artefact sites) were identified within impact areas for the development.

Author	Project	Investigation type	Summary of results
Navin Officer Heritage Consultants Pty Ltd, 2017	Western Sydney Airport - Enabling Activities, Aboriginal Cultural Heritage Management Plan	Desktop	An Aboriginal Cultural Heritage Management Plan (ACHMP) was prepared for Aboriginal archaeological survey and salvage works undertaken prior to the Western Sydney Airport initial enabling works. Upon completion of the ACHMP and subsequent survey and salvage works in 2018, an updated inventory was prepared of all surface and subsurface sites known across the site (n=127).
WSA Co, 2018	Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan	Desktop	An Aboriginal Cultural Heritage CEMP was prepared for further works required at the Western Sydney Airport. The CEMP undertook a risk assessment for potential impacts of the works on Aboriginal cultural heritage and detailed mitigation measures for reducing this impact. The CEMP indicated that the previous inventory of Aboriginal archaeological sites across the site would be updated with additional finds following targeted and selective survey and salvage programs.

Cultural values

The observations made on cultural values in relation to the off-airport area in Section 3.2.1 have the same validity for the on-airport area.

Key observations

The higher number of sites identified within the on-airport area is indicative of the high level of archaeological investigation that has occurred there, rather than that area necessarily having more sites than the off-airport area. Aboriginal cultural values have been identified as present, attached to known sites and landscape features.

Searches of the Aboriginal Heritage Information Management System (AHIMS) database found 10 sites registered within the on-airport construction footprint. Three of these sites are located outside of the Western Sydney International Stage 1 construction footprint. Based on the Western Sydney Airport Aboriginal Cultural Heritage CEMP (Western Sydney Airport, 2019), the seven sites within the Stage 1 construction impact zone should have been salvaged as part of the works undertaken to date within that area. The three sites that are located outside of the Stage 1 construction impact zone (45-5-2586, 45-5-2637 and 45-5-5078), are unlikely to have been salvaged as they were not within an area proposed for development as defined by the Western Sydney Airport Aboriginal Cultural Heritage CEMP (Western Sydney Airport, 2019).

For any of the 10 sites that are not removed as part of the Western Sydney International development, Sydney Metro would prepare an Aboriginal Cultural Heritage Construction Environmental Management Plan for the on-airport rail works which would include the related methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, and outlining nominated sites for protection.

3.3 Predictions

A review of the existing environment and archaeological data has been used to predict likely Aboriginal archaeology within the off-airport construction footprint. The predictions that have been made are as follows:

- the construction footprint contains a range of landforms, varying from alluvial flats and gently inclined slopes, to ridges and flat-topped terraces. The distribution and density of archaeological material associated with past Aboriginal peoples moving through this varied landscape are likely to have been influenced by the suitability of landforms for campsites. Areas considered to have the highest archaeological sensitivity are predominantly undisturbed terraces and flats, especially when elevated and well-drained
- prior to European occupation, the permanency of potable water sources is likely to have played an important role influencing the nature and duration of Aboriginal activity in their vicinity. More permanent watercourses (e.g. South Creek, Badgerys Creek and Blaxland Creek) are likely to have attracted more intensive or longer-term occupation activity; while lower order streams may have attracted short term or single activity occupation
- the availability of raw lithic material (e.g. silcrete boulders observed in South Creek) is also likely to have influenced the nature of activities at the site and may be correlated with higher artefact densities and evidence of tool manufacture
- archaeological deposits may have been preserved at depth in alluvial contexts
- original native vegetation has been cleared from the construction footprint as a result of European land use practices, including farming and grazing. As old growth trees with the potential for cultural modification have been removed during the past clearance activities, it is unlikely that scarred or carved trees will be present within the construction footprint, with the possible exception of the small sections of riparian corridors
- the construction footprint has been subject to a range of historic and recent land use impacts including: native vegetation clearance, pastoral activities (e.g. grazing, fencing and dam excavation), the construction of residential and commercial structures, as well as scientific and industrial facilities with their associated subsurface infrastructure services. Key archaeological implications of these activities include the destruction, in areas of grossly modified terrain, of pre-existing sites and deposit(s); the disturbance of pre-existing sites and deposit(s) through both direct and indirect (e.g. erosion) means, resulting in a loss of archaeological integrity, the removal of culturally modified trees and an increase, in areas affected by erosion, of archaeological site visibility.

4. Archaeological survey

4.1 Aims and objectives

Surveys undertaken for the project to date have sought to:

- identify and record any existing surface evidence of past Aboriginal occupation within the construction footprint
- ground truth all AHIMS registered Aboriginal sites within and immediately adjacent to the construction footprint
- sample all accessible landform elements within the study area
- identify areas that, irrespective of the presence or absence of surface artefacts, are likely to contain subsurface archaeological deposit (i.e. areas of PAD)
- provide data that will assist with the development of an appropriate management strategy for the known and potential Aboriginal archaeological values of the study area.

4.2 Survey strategy

Consideration was given to the following factors when developing the survey strategy for the project:

- property access and COVID-19 restrictions, with numerous land parcels initially unavailable for access
- the presence of areas of severely disturbed terrain within the study area, all of which were assessed pre-inspection as having negligible potential for the presence of Aboriginal archaeological materials
- generally poor ground surface visibility conditions due to vegetation cover
- a desire to sample all accessible landform elements within the construction footprint and to confirm the presence or absence of sites susceptible to damage from subsidence and vibration (such as rockshelters and grinding grooves) in the above tunnel areas.

Ultimately, in consideration of the above, it was decided that all accessible and non-severely disturbed portions of the construction footprint would be comprehensively sampled, with a particular focus on areas of enhanced archaeological visibility.

To inform the desktop predictions, aid in the effectiveness of the field investigations and inform the impact assessment, areas of archaeological sensitivity (i.e. areas considered likely to contain artefact bearing subsurface deposits) were mapped across the construction footprint.

These areas were informed by landform (low gradient areas in close proximity to water courses), previously identified sites (surface expression taken to be an indication of further artefacts below the ground surface where soil deposits were present) and low levels of past disturbance. Where all these attributes connected within the construction footprint it was considered and mapped to be an area of archaeological sensitivity. Some of these areas were further informed by ground-truthing during the preliminary field inspection before subsequent survey was undertaken for this assessment between October 2020 and February 2021.

Areas above the proposed tunnel alignment were assessed for known sites. Survey of these areas was required to determine if there were previously unrecorded sites in these areas that had the potential to be damaged by vibration and subsidence (e.g. rockshelters, art sites and grinding groove sites).

4.3 Field team and methods

The field team for the preliminary field inspections consisted of archaeologists Dr Darran Jordan and Dr Andrew McLaren. RAP representatives consisted of a representative from Gandangara LALC and Deerubbin LALC. Inspections of accessible sections of the construction footprint were undertaken over four days on Thursday 27 February, Wednesday 4 March, Tuesday 28 April and Friday 12 June 2020.

Once further access was granted to undertake survey between October 2020 and February 2021, the field team consisted of archaeologists Dr Darran Jordan, Dr Andrew McLaren, Geordie Oakes, Luke Wolfe and Julia Atkinson. RAP representatives were in attendance from A1 Indigenous Services, Arugung Aboriginal Cultural Heritage Site Assessments, Corroboree Aboriginal Corporation, Cubbitch Barta, Darug Custodian Aboriginal Corporation, Deerubbin Local Aboriginal Land Council, DNC, Gandangara Local Aboriginal Land Council, Gunyuu, Kamilaroi Yankuntjatjara Working Group, Murra Bidgee Mullangari Aboriginal Corporation, Tocomwall, Wailwan Aboriginal Group and Walbunja.

4.3.1 Site definition

The definition, in spatial terms, of Aboriginal archaeological sites is a topic of considerable importance to modern cultural heritage management and one that has generated significant discussion in Australian archaeology (e.g. Doelman 2008; Holdaway, 1993; Holdaway et al. 1998, 2000; MacDonald & Davidson 1998; McNiven 1992; Robins 1997; Shiner 2008). Aboriginal archaeological sites, of course, can be broadly defined as places in the landscape that retain physical evidence of past Aboriginal activity. Such evidence can assume a range of forms, depending on the nature of the activity or activities that produced it, and can vary dramatically in quantity and extent. Some Aboriginal archaeological sites are, by their very nature, easy to define in spatial terms. Scarred trees and rockshelters, for example, can be readily delineated from their surrounding landscapes. Difficulties arise, however, for sites whose present-day physical extent is, more often than not, a product of geomorphic processes, as opposed to the actions of Aboriginal people in the past.

Although relevant to a variety of site types, geomorphic processes such as soil erosion and deposition are of particular relevance to identification and definition of surface scatters of stone artefacts, commonly referred to as ‘open camp sites’ or ‘artefact scatters’. It is, for example, now widely accepted that the visibility and preservation of such sites are to a significant extent, products of such processes, both contemporary and historic (Dean-Jones & Mitchell 1993; Fanning et al. 2008, 2009; Shiner 2008). As demonstrated by countless large-scale excavations projects in south-eastern Australia, surface artefacts almost invariably represent only a fraction of the total number of artefacts present within these sites, with the majority occurring in subsurface contexts. Artefact exposure, unsurprisingly, is highest on erosional surfaces and lowest on depositional ones. At the same time, in many areas, surface artefacts have been shown to form part of more-or-less continuous subsurface distributions of artefacts, albeit with highly variable artefact densities linked to environmental variables such as stream order and landform (e.g. White & McDonald 2010).

Such evidence poses a significant analytical and interpretive dilemma. Defining sites on the basis of surface artefacts alone is clearly problematic, with modern site boundaries invariably reflecting the size and distribution of surface exposures as opposed to the actions of Aboriginal people in the past. Nonetheless, for pragmatic reasons, this is the most commonly used approach, with ‘distance’ and ‘density-based’ definitions dominating. In NSW, two of the most commonly employed distance-definitions are ‘*two artefacts within 50m of each other*’ and ‘*two artefacts within 100 m of each other*’. Neither definition is derived from a particular theoretical approach or body of empirical research - they are simply pragmatic devices for site definition. Definitions based on artefact density also vary in their particulars. However, one of most commonly used definitions is that which isolates, within an arbitrarily defined ‘background scatter’ of one artefact per 100 m², higher density clusters that are subsequently defined as ‘sites’.

Non-site or distributional archaeology offers an alternative approach to distance and density-based site definitions (Ebert 1992; Foley 1981), with individual artefacts, not sites, treated as the basic units of analysis (for published Australian examples see Doelman 2008; Holdaway et al. 2000; McNiven 1992; Robins 1997; Shiner 2008). While recognising the interpretive potential of non-site approaches with respect to data analysis and discussion, their implementation in the context of cultural heritage management studies is difficult. Here, the identification of ‘sites’ is required for reasons of recording (i.e. their entry into site databases such as AHIMS) as well as ease of relocation, protection, and ongoing management. The identification of spatially-discrete ‘sites’, therefore, offers the most pragmatic approach to Aboriginal heritage management in impact assessment contexts (but see McDonald (1996) for a different view).

The definition for sites identified during the surveys has been based on the 50 metres distance convention cited above.

4.3.2 Silcrete artefact identification

Existing ambiguities and debate surrounding the positive identification of silcrete artefacts in the northwestern portion of the Cumberland Plain necessitate a brief note on the artefact identification criteria employed for the current assessment. As highlighted by Jo McDonald CHM (2006b) and others (e.g. AMBS 2002b; Baker 1996), silcrete artefact identification in this area is complicated by the near-ubiquitous presence of technologically non-diagnostic silcrete fragments in assessed surface and subsurface contexts, many of which exhibit evidence of thermal alteration (Corkill 1997). A review of existing archaeological assessment reports for the greater Box Hill/Riverstone/Schofields area indicates that such fragments are widely and abundantly distributed across this area, with the greatest known concentrations occurring on the upper slopes of Plumpton Ridge to the southwest of the project area. Despite a long history of archaeological and geological research, significant ambiguities remain concerning both the extent of the silcrete-bearing St Marys formation across the northern Cumberland Plain and the nature of the silcrete clasts associated with it (i.e. intra-formation variability in clast shape and size) (see, for example, Mitchell, 2002, 2005). Together with available distribution evidence, such issues necessitate a precautionary approach to the identification of silcrete artefacts. Accordingly, following Hiscock (2005), silcrete fragments identified during the survey and recovered from test pits were only accepted as artefacts if they possessed one or more of the following diagnostic features of controlled conchoidal fracture:

- a striking platform
- signs of an external initiation to the fracture surface, namely a ring crack or cone of force
- a bulb of force on the ventral surface of a flake
- a termination to the conchoidal fracture plane
- one or more negative flake scars.

4.3.3 Stone artefact recording

Stone artefact recording for the current investigation involved recording a maximum of 19 attributes for individual stone artefacts identified during survey or recovered from test pits. The number of attributes recorded per specimen differed by type and identification method (i.e. survey versus test excavation). Attributes used in the current investigation are defined in Table 4-1 below. Type definitions can be found in Hiscock (1986) and Holdaway and Stern (2004).

Table 4-1 Stone artefact attributes

Attribute	Definition	Recorded for
Type	Primary artefact type: flake, flake shatter (*sensu* Andrefsky (2005), core, retouched flake, flaked piece, hammerstone, edge-ground hatchet head, grindstone and muller.	All artefacts
Raw material	Lithic raw material on which the artefact was made (e.g. silcrete, silicified tuff, chert, quartz, FGS)	All artefacts
Colour	Generic description of rock colour following Jo McDonald CHM (2001: 39) (e.g. red, pink, yellow-red, yellow, grey).	All artefacts recovered from test pits
Weight	Weight to nearest 0.1 g, measured using an electronic scale.	All artefacts recovered from test pits
Maximum linear dimension (MLD)	Maximum linear dimension of artefact in millimetres.	All artefacts
Cortex	Presence/absence of cortex	All artefacts
Heating	Presence/absence of evidence for thermal alteration.	All artefacts & non-diagnostic lithic items recovered from test pits

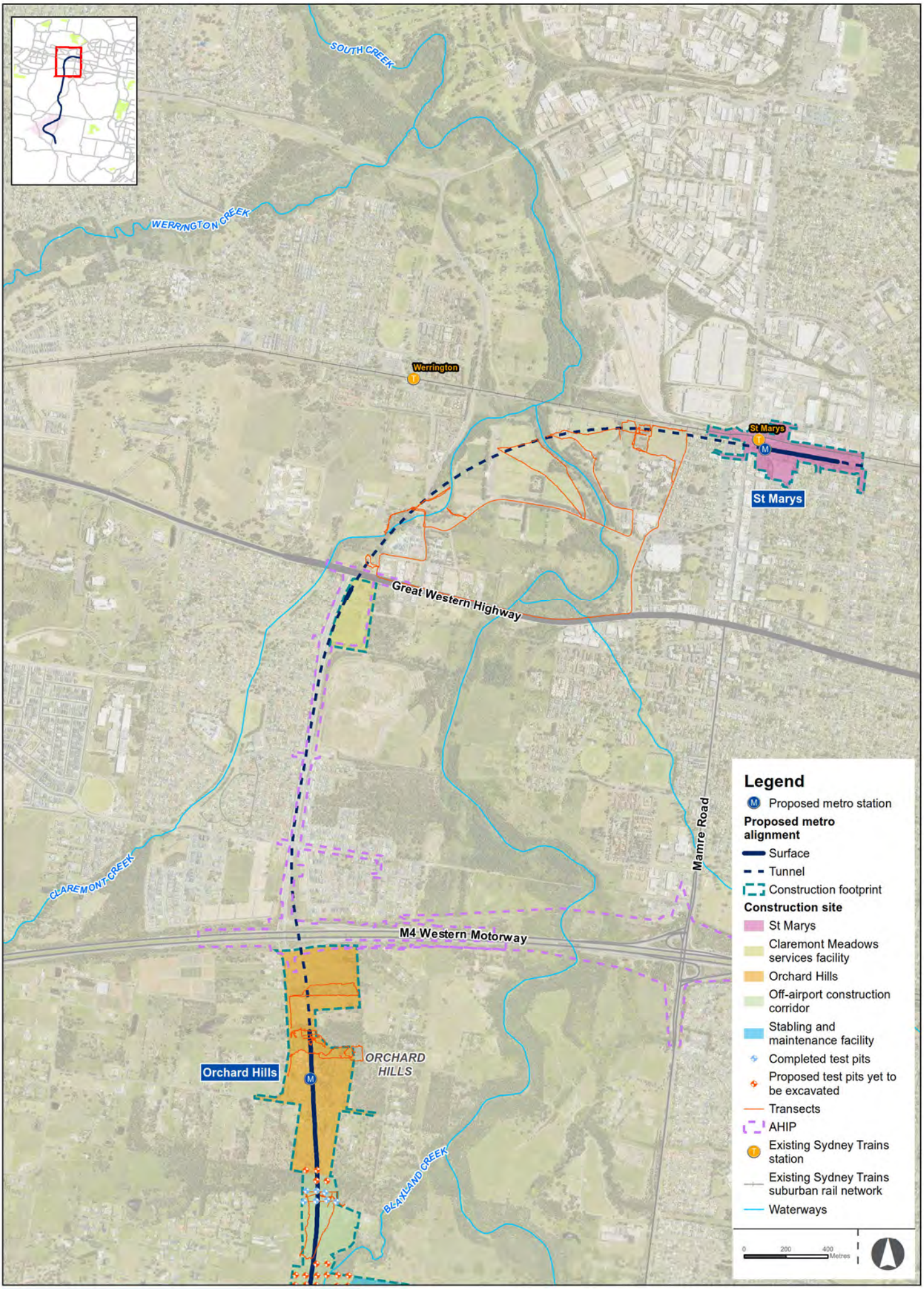
Attribute	Definition	Recorded for
Flake type	Flake sub-type: complete flake, proximal flake and split flake.	All flakes
Tool type	Formal implement type, as defined by Holdaway and Stern (2004).	All retouched flakes and edge-ground implements
Flake length (mm)	Distance between the point of percussion and the furthest distal point of the flake (i.e. length to the most distal point) (after Holdaway and Stern 2004: 138).	All complete flakes
Flake width (mm)	Longest line that can be drawn at right angles to the length dimension (i.e. maximum width) (after Holdaway and Stern 2004: 139).	All complete flakes
Flake thickness (mm)	Maximum distance from dorsal to ventral face (i.e. maximum thickness) (after Holdaway and Stern 2004: 140).	All complete flakes
Platform surface	Nature of the platform surface on complete and proximal flakes: single scar, multiple scar, flaw/crenated, faceted, cortical and crushed/collapsed.	All complete and proximal flakes recovered from test pits
Platform width (mm)	Maximum distance between the two lateral margins of a flake, measured across the platform surface.	All complete and proximal flakes recovered from test pits
Platform thickness (mm)	Maximum distance between the ventral and dorsal surfaces of a flake.	All complete and proximal flakes recovered from test pits
Dorsal cortex	Amount of cortex on dorsal surface of flake: none, 1-50%, 51-99% and 100%.	All complete flakes
Flake termination	Shape of the distal end of complete flakes and distal flake fragments: feather, hinge, step and plunging.	All complete and distal flakes recovered from test pits
Core type	Core type: unidirectional, multidirectional, bidirectional, bifacial, bipolar and tranchet.	All complete cores
Core blank	Stone package on which the core was made: cobble/pebble, flake, heat shatter fragment and indeterminate.	All complete cores
Cortex (core)	Amount of cortex remaining on core at discard: none, 1-50%, 51-99% and 100%.	All complete cores
Longest flake scar	Length of longest complete flake scar preserved on core.	All complete cores
Number of striking platforms	Number of striking platforms preserved on core at discard	All complete cores
Number of removals	Number of complete and partial flake scars (>15 mm) preserved on core.	All complete cores
Core length (mm)	Maximum linear dimension of core.	All complete cores
Core width (mm)	Width at mid-point of maximum dimension	All complete cores
Core thickness (mm)	Thickness at mid-point of maximum dimension	All complete cores
Tool state	Complete or broken	All tools

Attribute	Definition	Recorded for
Tool length (mm)	Maximum linear dimension of tool.	All complete tools
Tool width (mm)	Width at mid-point of maximum dimension	All complete tools
Tool thickness (mm)	Thickness at mid-point of maximum dimension	All complete tools

4.3.4 Survey methodology

The strategy of the surveys was to space participants at regular intervals across the construction footprint and to walk transects across the area. The overarching aim of this survey was to identify and record any existing surface evidence of past Aboriginal occupation within the study area. All surveys were conducted on foot. As per the field inspection and survey strategy, all accessible and non-severely disturbed portions of the construction footprint were sampled, with particular attention paid to ground surfaces with higher visibility. All mature trees encountered during the inspection were inspected for cultural scarring. Outcropping sandstone bedrock exposures, where intercepted, were inspected for grinding grooves. The location of each transect completed during the inspection, including start and end points, was recorded using a handheld differential GPS unit. The transects walked for these surveys are shown on Figure 4-1 to Figure 4-1d.

When any Aboriginal archaeological sites were identified they were recorded to the standard required by the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*. All sites were comprehensively photographed following artefact recording.

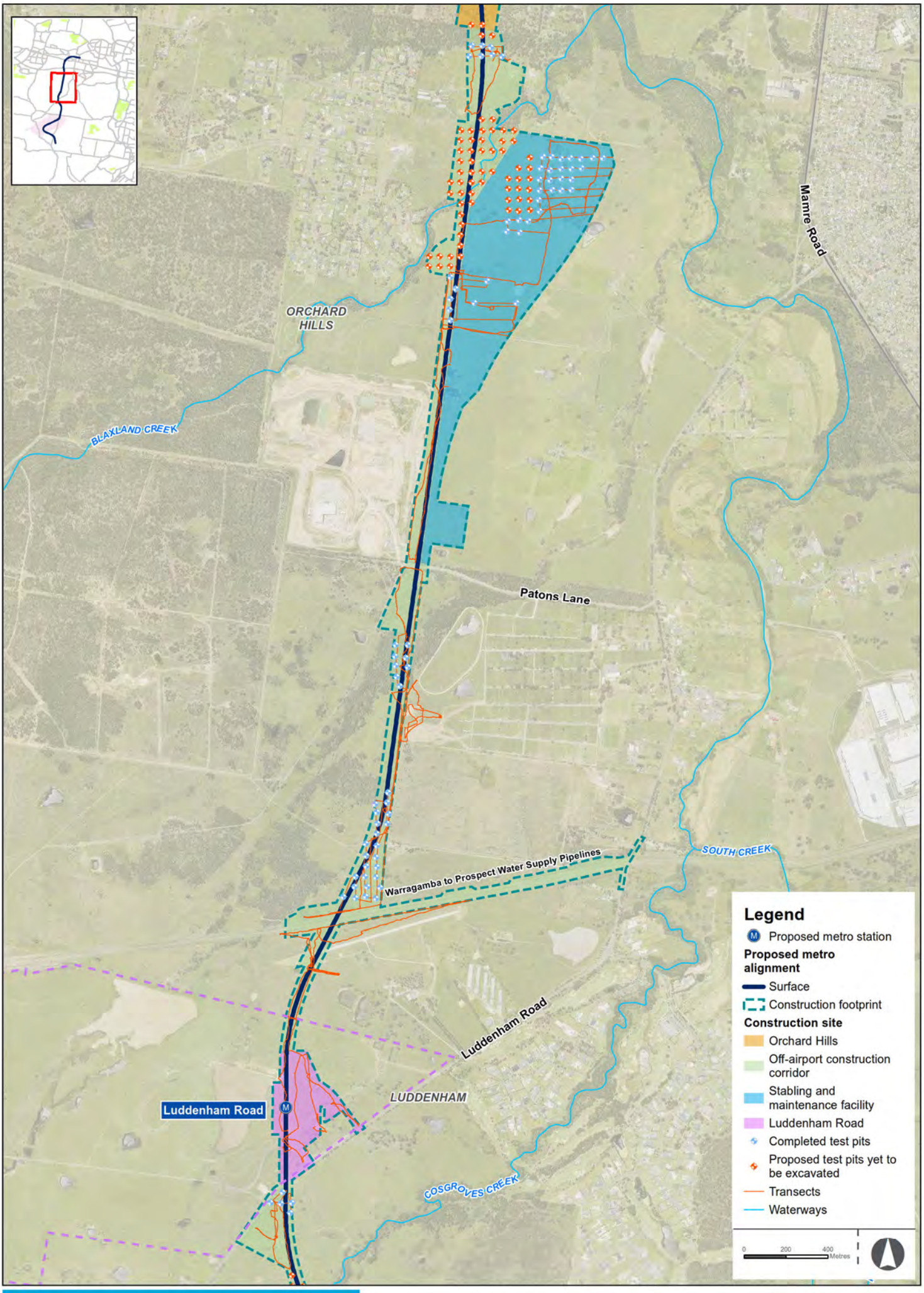


Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Aboriginal fieldwork

Figure 4-1a

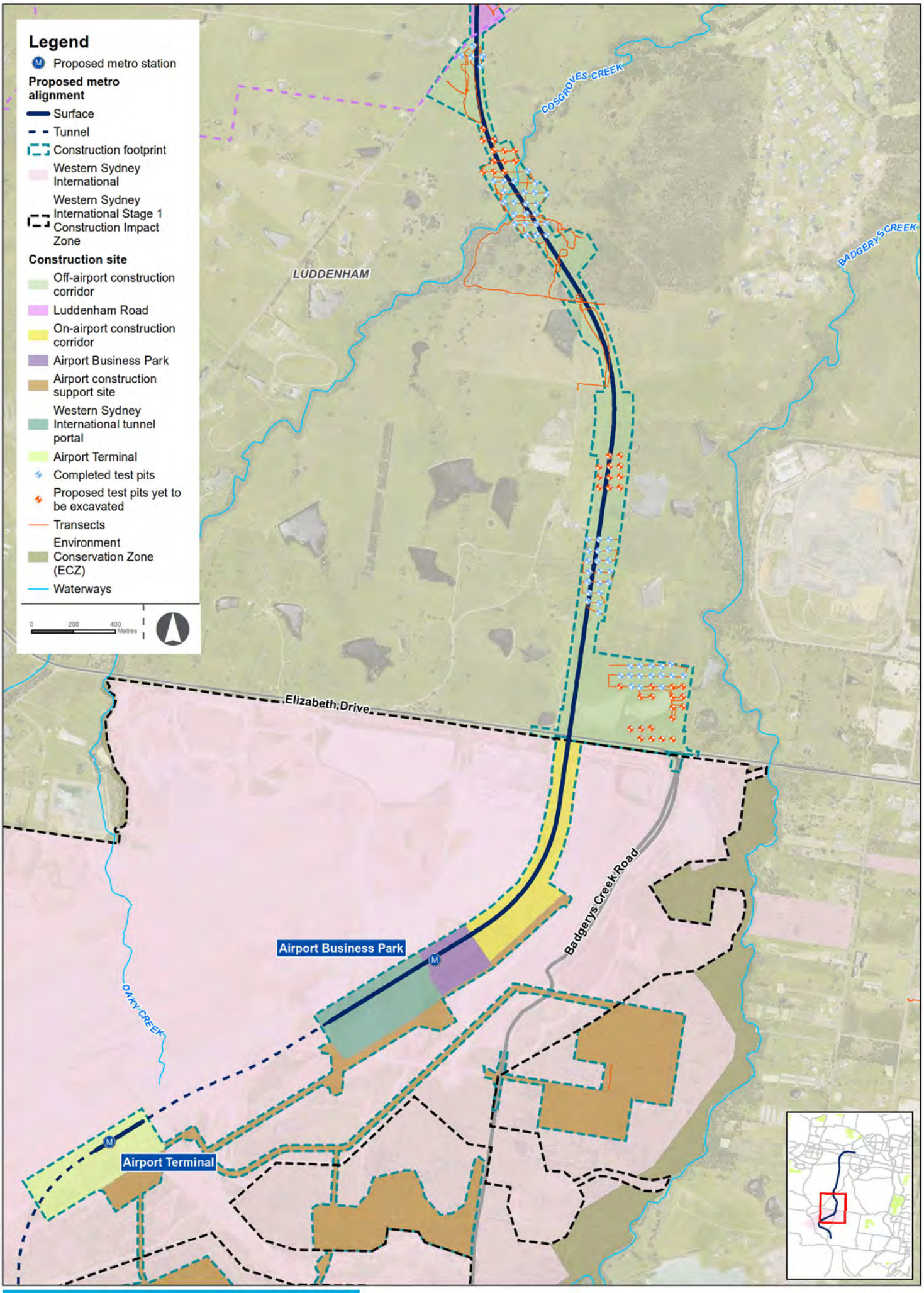


Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Aboriginal fieldwork

Figure 4-1b

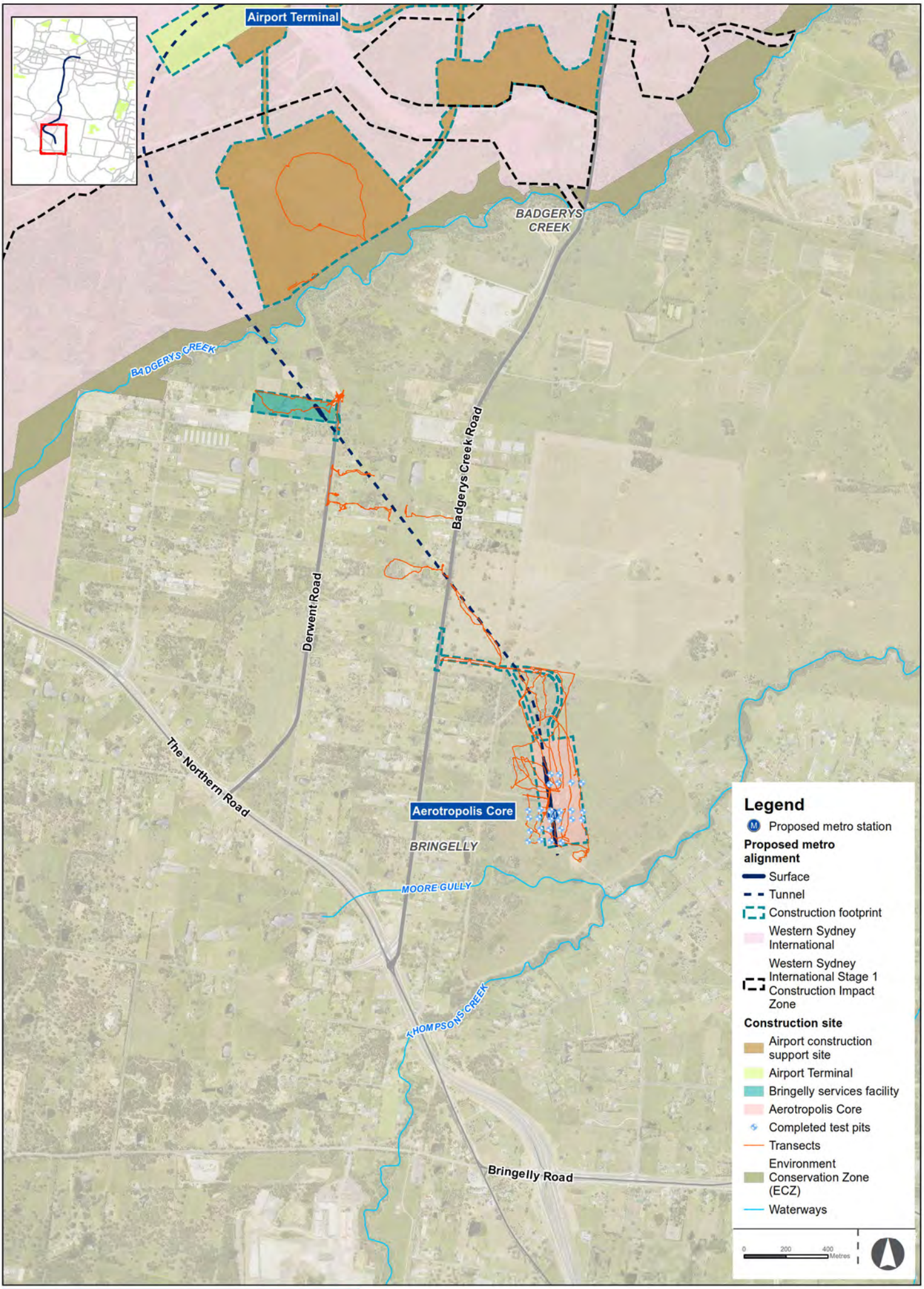


Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Aboriginal fieldwork

Figure 4-1c



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Aboriginal fieldwork

Figure 4-1d

4.4 Survey results

4.4.1 Preliminary investigation results

Off-airport

Above tunnel areas

Areas above the proposed tunnelling between St Marys and the Great Western Highway were subject to survey on 13 October and 17 November 2020. On average the ground surface visibility (GSV) was fair during the survey, ranging from between 11% and 30%. The ground integrity was assessed as low, having been subject to significant disturbance in the past. This included earthworks associated with roads and the railway line at St Marys, landscaping for the school grounds at St Marys Senior High School and Wollemi College, as well across The Kingsway park. Developments within The Kingsway park area included playing fields, a skateboard park, BMX areas and picnic facilities. The banks on the eastern side of South Creek had been subject to rubbish dumping, but the western banks were in a better maintained condition at the time of inspection. Due to the past disturbance no areas of PAD were identified, but one surface scatter of artefacts was recorded within the bounds of St Marys Senior High School.

The artefact scatter site (SMWSA-AS1) consisted of six surface artefacts in a disturbed context. The area was adjacent to the rail line and had been subject to past earthworks. Since then it had been used by St Marys Senior High School as a farm area for student studies, with goats housed in various enclosures at this location at the time of inspection. These artefacts were in the northern-most enclosure, closest to the rail line, which did not have any animals being housed in it at the time of inspection. Details on the six identified artefacts are included in the table below (Table 4-2).

Table 4-2 SMWSA-AS1 artefacts

Raw material	Type	Flake type	Scar count	Length (cm)	Width (cm)	Thickness (cm)
Silcrete	Flake	Complete	N/A	1	0.7	0.2
Silcrete	Flake	Complete	N/A	0.5	0.5	0.2
Chert	Flake	Complete	N/A	0.6	0.5	0.1
Silcrete	Core	N/A	3	2	1.7	1.5
Silcrete	Flake	Complete	N/A	1.2	1	0.7
Silcrete	Core	N/A	1	0	0	0

Accessible sections of the above tunnel areas between Western Sydney International and the Aerotropolis Core were surveyed on 12 and 13 October, 5, 6, 12 and 14 November 2020. On average the ground surface visibility (GSV) was fair during the survey, ranging from between 11% and 30%. The ground integrity was assessed as low due past disturbances including residential development, road development, dam construction, vegetation clearance and pastoral activities including ploughing and grazing. Sections of the area located in proximity to unnamed drainage lines and multiple dams were also found to be swampy and waterlogged. No surface sites or areas of PAD were identified during the surveys.

No previously recorded AHIMS sites were found to be in the area above the proposed tunnels in the section between St Marys and the Great Western Freeway, and only artefact scatter site SMWSA-AS1 was identified during survey. One previously recorded site, artefact scatter 45-5-4423, was located in the above tunnel area between the Great Western Freeway and the Western Motorway. Two previously recorded AHIMS sites were located in the area above the proposed tunnels between Western Sydney International and the Aerotropolis Core, being artefact scatter 45-5-2666 (consisting of two artefacts on a dam wall) and isolated artefact 45-5-2784 (on the disturbed verge adjacent to a road).

The purpose of undertaking survey in the above tunnel areas was to identify the presence or absence of any site types with a risk of vibration or subsidence impact, including such site types as rockshelters, art sites and grinding groove sites. The AHIMS data identified that none of these site types had previously been recorded in these areas. Survey undertaken of the accessible sections of

the above tunnel areas did not identify any site types but confirmed high levels of past disturbance, with the only known surface sites consisting of two low density artefact scatters and an isolated artefact all located in disturbed areas. This data suggests it is unlikely that Aboriginal archaeological or cultural sites or values will be directly or indirectly impacted by the proposed works in the above tunnel areas.

St Marys

Access was not provided to the St Marys area, but background research identified there were no previously recorded sites within its bounds and the high levels of past impact at this location for rail, road and commercial development, made it highly unlikely that sites would be present within its bounds.

Claremont Meadows services facility

The Claremont Meadows services facility has been subject to gross levels of past disturbance and site destruction under the conditions of AHIP C0000637, granted 5 November 2014 for upgrades to Kent Road and Gipps Street at Claremont Meadows. Due to the removal of known sites and areas of archaeological potential under the existing AHIP, no further survey was undertaken in this area.

Orchard Hills

Survey was undertaken within the Orchard Hills area on 11, 16 and 20 November. There were no previously recorded AHIMS sites in this area. On average the ground surface visibility (GSV) was fair during the survey, ranging from between 11% and 30%. The ground integrity was assessed as low, having been subject to significant disturbance in the past. Past disturbance included residential development, vegetation clearance, road construction and use, dams, animal grazing, earthworks and erosion. No surface sites were identified during the surveys in this area and no areas of PAD were identified.

Stabling and maintenance facility

Surveys were undertaken of the stabling and maintenance facility construction footprint on 4 March, 12 and 18 June 2020 and 3 and 30 November 2020. Thick ground vegetation was present across the area obscuring ground surface visibility. No new sites were identified in surface expressions during this inspection. The area was predominantly cleared with little mature vegetation extant in the area. Where trees were present, they were checked for signs of cultural modification, but none were identified. It was noted that much of the north eastern portion of the area was low lying floodplain likely to be waterlogged at times if inundated. Although the landform was predominantly flat there were some slightly elevated areas which were more likely to have been used for habitation and activity by Aboriginal people in the past. The presence of spring filled dams in the area attests to the availability of resources likely to have been present in the past. Further testing was deemed appropriate to occur in this area to determine the presence or absence of subsurface archaeological deposits.

Off-airport construction corridor (northern) (between the Orchard Hills and Luddenham Road)

On 28 April, 4 March, 28 October, 13 and 30 November and 16, 17 and 18 December 2020, surveys were undertaken within the Off-airport construction corridor (northern) area. The majority of surveyed area fell within the bounds of the Defence Establishment Orchard Hills, as well as the area to the immediate north of Patons Lane and to the south of the Warragamba to Prospect water supply pipelines, within the St Marys/Kennetts Airfield area. No previously recorded AHIMS sites were present within the area being investigated. The centroid for one site (45-5-3773) was located immediately adjacent to the transect, but it was outside the construction footprint on the opposite side of an impassable fence. It was noted that an unnamed creek that is a tributary of South Creek bisected this investigation area, with areas either side of it appearing to retain intact deposits. These areas have archaeological potential and require test excavation to be able to discern if any artefact bearing deposits were present in this area, an approach that was also recommended by the attending Deerubbin LALC representative (see ACHAR).

One new surface site was identified during survey, being SMWSA-AS5. This artefact scatter site consisted of 18 artefacts on a vehicle track located to the immediate south of the Warragamba to Prospect Water Supply pipelines and to the immediate north of the St Marys/Kennetts Airfield runway. The site was located outside the construction footprint, but its close proximity meant that it could be

accidentally damaged during works if protection measures were not in place. The artefacts are shown in Table 4-3.

Table 4-3 SMWSA-AS2 artefacts

Raw material	Type	Length (cm)	Width (cm)	Thickness (cm)
Silcrete	Flake	1.5	1.29	0.39
Silcrete	Flake	1.02	0.82	0.16
Silcrete	Flake	1.5	1.66	0.86
Chert	Flake	1.75	1.28	0.76
Silcrete	Flake	0.51	2.34	1.52
Silcrete	Flake	1.92	2.18	0.82
Silcrete	Flake	1.64	2.45	0.48
Silcrete	Flake	2.57	2.06	0.62
Silcrete	Flake	1.96	1.64	0.57
Silcrete	Flake	1.7	1.62	0.6
Silcrete	Flake	2.12	1.25	0.7
Silcrete	Flake	2.3	1.06	0.57
Silcrete	Flake	1.96	0.62	0.39
Silcrete	Flake	0.86	0.95	0.27
Silcrete	Flake	1.39	2.15	0.48
Silcrete	Flake	1.78	1.21	0.33
Silcrete	Flake	1.88	0.86	0.48
Silcrete	Flake	0.8	0.79	0.23

Luddenham Road

Survey was undertaken within the Luddenham Road area on 28 October 2020. No surface expressions of artefacts were located and no areas of archaeological sensitivity were identified. The area was noted as having been subject to past disturbance caused by vegetation clearance, stock trampling, dam construction, residential development, earthworks associated with roads and embankments and erosion. It was also noted that this area was covered by existing AHIP C0003861 for Sydney Science Park, granted 23 July 2018. The permit authorised impacts to previously recorded AHIMS sites 45-5-4189, 45-5-4707, 45-5-4709 and 45-5-4922 (all outside the construction footprint) and the entire AHIP area was approved for impacts following the completion of salvage works that had been proposed as a mitigation measure for the destroyed sites. As a result, no further investigations were deemed necessary for this area.

Off-airport construction corridor (southern) (between the Luddenham Road and the 'on-airport corridor' construction site)

On Wednesday 4 March 2020, survey was undertaken to the immediate south of the Luddenham Road construction footprint within the off-airport construction corridor. No previously recorded AHIMS sites were present within the three areas subject to investigation. The centroids for existing sites closest to the transects for these inspections were between 70 metres and 100 metres away. No new sites were identified during the investigations of these areas and no areas of archaeological sensitivity were identified.

Further surveys were undertaken on 30 October, 9 and 12 November, 4, 21 and 22 December 2020, and 10 February 2021. One surface artefact scatter was identified during these surveys within the

bounds of the construction footprint, consisting of three artefacts in a disturbed area (SMWSA-AS6) (see Table 4-4). Due to vegetation cover reducing ground surface visibility during the surveys, further investigation through test excavation was deemed appropriate in areas of archaeological sensitivity identified within this area.

Table 4-4 SMWSA-AS3 artefacts

Raw material	Type	Flake type	Length (mm)	Width (mm)	Thickness (mm)
Silcrete	Flake	Complete Flake	18.8	13.8	6.3
Silcrete	Flake	Broken Flake (Proximal)	14.4	12.2	3.8
Petrified Wood	Flake Shatter	Shatter	29	18.3	6.6

Bringelly services facility

A survey undertaken in this area on 12 November 2020. It confirmed that this area had been subject to high levels of past disturbance (dam construction and other development). No surface expressions of artefacts were identified within this area during survey and no areas of archaeological sensitivity were identified due to the high levels of past disturbance.

Aerotropolis Core

On Thursday 27 February 2020, an inspection was undertaken of the Aerotropolis Core construction footprint in the off-airport area. The one valid site that was identified in the desktop assessment as being present within the bounds of the construction footprint (artefact scatter site 45-5-2640 (B22)) was targeted for inspection. Although the coordinate was located and the location identified, no surface expression of artefacts was visible at this site during the inspection. It was concluded that this was likely the result of low ground surface visibility due to high levels of grass and weeds currently established at this location.

Further survey was undertaken on 13 and 14 October 2020, targeting areas of exposure throughout this area. No surface artefacts were identified within the area, including at the location for previously recorded artefact scatter site 45-5-2640. Another artefact scatter site that had previously been recorded (45-5-2641) was located and confirmed to be outside the bounds of the construction footprint (approximately 80 metres to the south at its closest point). It was assessed as likely given the presence of previously recorded sites that subsurface deposits could be present, with further investigation through subsurface testing deemed appropriate.

Permanent power supply route

No access was provided to undertake survey in this area. The permanent power supply route crosses in proximity to a number of previously recorded AHIMS sites, including 45-5-3182, 45-5-3184, 45-5-4811, 45-5-4812, 45-5-4813, 45-5-4136, 45-5-4137 and 45-5-4138. As part of further design development, the permanent power supply route would seek to avoid and/or minimise potential impacts to these sites. Ground-truthing would be required for the route to confirm the proximity of these sites. The banks of South Creek have archaeological sensitivity. Further investigation would be required prior to ground disturbance works at this location to determine both archaeological and cultural heritage values.

Temporary power supply route (Kemps Creek)

The section between Martin Road and South Creek was surveyed on 11 November 2020. The developed area directly to the east of Martin Road was found to be highly disturbed and unlikely to contain surface or subsurface artefacts. The area closer to South Creek however was found to have had less disturbance, limited predominantly to past clearance. No surface artefacts were identified, although vegetation cover limited visibility. The banks of Badgerys Creek and South Creek have

archaeological sensitivity. Further investigation would be required prior to ground disturbance works at this location to determine both archaeological and cultural heritage values.

Temporary power supply route (Claremont Meadows to Orchard Hills)

No access was provided to undertake survey in this area. Trenching is proposed to be undertaken within road reserves where possible. As road reserves have been subject to high levels of past disturbance, no archaeological sensitivity has been identified within their bounds. Two destroyed sites were located immediately adjacent to this area and one destroyed site was within its bounds. Although the archaeological values have been removed through site destruction these areas may retain cultural values for the Aboriginal community. One valid artefact scatter site (45-5-4423) is present along the proposed temporary power supply route at its southern end. Ground-truthing would be required for the route to confirm the proximity of AHIMS sites. The intention is for further design development for the route to be informed both by known sites and areas of past disturbance.

Discussion

Only one new surface site was identified within the bounds of the construction footprint during surveys of the accessible areas (see also Section 6.3). Feedback from the RAP representatives during the investigations stated that the waterways that crossed the construction footprint have cultural significance as pathways and resource areas for Aboriginal people in the past. The archaeological findings were also that there were likely to be intact deposits associated with either side of the creeks within the construction footprint, including Blaxland Creek, Cosgroves Creek and Badgerys Creek as well as their tributaries. The presence of known sites, areas of potential and waterways linking a connected cultural landscape all attest to the cultural values of the area, elements that may be appropriate to feed into the design and interpretation opportunities for the project. Ground surface visibility was found to be reduced due to vegetation cover. Further investigation through test excavation was deemed appropriate for areas of identified archaeological sensitivity that had been verified through survey as retaining integrity. Sensitivity was determined based on landform, including low gradient and elevated, well-drained areas, proximity to existing sites, proximity to water sources and low to moderate levels of past disturbance. Other areas that were determined to have been subject to high levels of past disturbance were excluded from the testing program.

On-airport

On Thursday 27 February 2020, an inspection was undertaken on Western Sydney International outside the Stage 1 construction impact zone. The inspection covered areas both within and outside of the project's construction footprint. The on-airport areas investigated were all within the airport construction support site. The coordinates of 11 previously recorded AHIMS sites located in accessible land parcels were inspected for ground-truthing, but only two of these previously recorded sites were able to be found, being:

- 45-5-5078, this site is listed as an isolated artefact, but three surface artefacts were identified during the inspection. This site is within the construction footprint in the airport construction support site and outside the Western Sydney International Stage 1 construction impact zone
- 45-5-2699, this site is listed as an artefact scatter, but only a single artefact was able to be identified during the inspection, located on the lower flank of the dam wall. This site is outside the project's construction footprint and outside the Western Sydney International Stage 1 construction impact zone.

In addition to this, two new sites were identified during the inspection, being one isolated artefact and one artefact scatter. These sites were recorded as WSI-IA1-20 and WSI-AS1-20 (see Plate 1 to Plate 4). Both sites were identified outside the project's construction footprint and outside the Western Sydney International Stage 1 construction impact zone.

WSI-AS1-20 consists of a scatter of three artefacts in an area of rabbit/fox burrowing within Western Sydney International, outside of the Stage 1 area. The artefacts, consisting of a complete silicified tuff flake, a proximal silcrete flake and a silicified tuff angular shatter fragment, have been exposed through burrowing. Topographically, the site is located on a gently inclined spur crest approximately 85 metres southwest of an unnamed second order drainage line which feeds into a farm dam around 200 metres to the east. A large ant nest is also present. Surrounding vegetation consists of woodland regrowth.

WSI-IA1-20 comprises a complete silicified tuff flake. The flake was located on a vehicle track, outside of the Stage 1 construction impact zone, Western Sydney International. The site is located at the eastern end of a partially vegetated spur crest bordered to the north and south by unnamed first order drainage depressions. The flake measures 26.6 (l) x 34.4 (w) x 14.1 (th) mm, exhibits 1-50% dorsal cortex and has a single conchoidal striking platform. Ground surface visibility on the track itself is good but very poor outside of it due to grass growth.

As the existing Aboriginal Cultural Heritage CEMP for Western Sydney International contained protocols for the removal and protection of all known sites within Western Sydney International, no further survey was undertaken within the bounds of Western Sydney International.

Plate 1 Artefact at site WSI-AS1-20

Plate 2 Artefact at site WSI-IA1-20

Plate 3 View across site WSI-AS1-20

Plate 4 View across site WSI-IA1-20

4.4.2 Survey coverage and effective coverage

A breakdown of survey coverage by area is shown in Table 4-5 below. A full representation of landform investigation across the entire construction footprint is not possible at this time as sections of the construction footprint have not yet been made accessible to survey. Impact rating schemes are defined in the tables below and discussed in Section 4.4.3.

Table 4-5 Ground Surface Visibility (GSV) Rating Scheme

GSV rating	% GSV
Poor	0-10%
Fair	11-30%
Good	31-50%
Very good	51-70%
Excellent	71-90%
Complete	91-100%

Table 4-6 Ground Integrity (GI) Rating Scheme

GI rating	Definition
Low	Area has been subject to significant disturbance through natural and/or anthropogenic processes (e.g. heavy earthworks).
Moderate	Area has been subject to moderate disturbance (e.g. native vegetation clearance) but retains a reasonable degree of integrity.
High	Area remains in a natural or near-natural state.

Table 4-7 Archaeological Sensitivity Rating Scheme

Rating	Definition
Nil	Land with no potential for subsurface archaeological deposit(s) due to past ground disturbance(s).
Low	Subsurface archaeological deposit(s) may be present. Relative to areas of high sensitivity, lower artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.
High	Subsurface archaeological deposit(s) likely to be present. Relative to areas of low sensitivity, higher artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.

Effective coverage estimates for transects across each of the areas investigated during survey, were uniformly low, with none exceeding 30%. Ground Surface Visibility (GSV) across the construction footprint was, for the most part, fair (11-30%) due to dense vegetation cover. Areas of higher GSV, where encountered, were limited to exposures associated with vehicle tracks, cleared areas and areas of erosion. Low GSV means that artefacts could be present that are unable to be seen due to vegetation cover. To test presence or absence in areas of low GSV, test excavation was undertaken.

4.4.3 Discussion

The generally low ground surface visibility means that surface expressions of artefacts may be present but obscured by vegetation. The survey allowed for confirmation of landforms likely to contain sites and checked these against visible evidence of past disturbance.

Sensitivity was determined based on landform, including:

- low gradient areas
- elevated, well-drained areas

- proximity to existing sites
- proximity to water sources
- low to moderate levels of past disturbance.

Areas with a nil rating for archaeological sensitivity were confirmed as being within the bounds of three existing AHIP areas. This was due to the high levels of disturbance in those areas. In other sections of the off-airport construction footprint the differentiation between low and high potential for subsurface archaeology was problematic. This was due to the low GSV encountered during survey, meaning there was limited information on which to base a hierarchy of potential.

The survey results did enable the mapping of areas of Aboriginal archaeological sensitivity. This was due to identifiable evidence of disturbance in some locations. This had been caused by clearance, erosion, dams, houses, roads and other infrastructure. Such areas were removed from the mapped areas proposed for test excavation, with the remaining areas of sensitivity mapped and gridded for testing. Thus, areas proposed for test excavation did not have any further differentiation of low and high ratings.

It was predicted that areas considered to have the highest archaeological sensitivity were predominantly on undisturbed terraces and flats, especially when elevated and well-drained. The test pits were spaced across varying landforms (slopes, flats, floodplain, banks and terraces) within the identified areas of Aboriginal archaeological sensitivity, in order to test the veracity of the predictions that had been made based on desktop research. Further investigation through subsurface testing was deemed warranted to test for the presence or absence of artefacts in subsurface deposits within the construction footprint.

5. Archaeological test excavation

5.1 Purpose, sampling strategy and methods

A program of archaeological test excavation was undertaken concurrently with the subsequent archaeological surveys, conducted between October 2020 and February 2021. In accordance with Requirement 3.1 of the Code of Practice, the purpose of the test excavation program was to determine the presence or absence of subsurface archaeological deposits in areas of identified archaeological sensitivity at risk of direct impacts across the construction footprint. Together with the field survey results discussed above, the results of the test excavation program described below provide a robust dataset for assessing the impacts of the proposed development on the Aboriginal archaeological resource of the study area. In accordance with Requirement 15c of the Code of Practice, notification of M2A's intention to undertake the program of test excavation detailed in this report was provided, in writing, to Heritage NSW on 12 October 2020.

Archaeological test excavation within the construction footprint involved the excavation of a total 196 test pits measuring 0.25 m² (50 x 50 cm). Test pit locations were planned at 50 metre intervals in a grid across the construction footprint where proposed impacts intersected with areas of previously identified archaeological sensitivity. In the field, however, a call was made to exclude those pits that were found upon inspection to have been subject to gross levels of past disturbance. A total of 196 test pits were excavated over non-consecutive days between October 2020 and February 2021, as access to individual land parcels became available. Participants of the combined test excavation program included RAP representatives. Further participation details of individual RAP field representatives are outlined in the ACHAR. Clause 5(ii) of Requirement 16a of the Code of Practice stipulates that the maximum surface area of all test excavation units must be no greater than 0.5% of the area - either PAD or site - being investigated. The test excavation program undertaken for the current investigation was executed in compliance with this clause.

In accordance with the Code of Practice, all test pits were hand excavated as 50 x 50 cm units (0.25 m²), with 5 cm spits employed during the excavation of the first excavated test pit and 10 cm spits thereafter. All test pits were excavated to culturally sterile horizons, with excavation ceasing once clay was identified (at times requiring some excavation into the clay deposit). Excavated sediment was dry-sieved through a 3 millimetre wire-mesh sieve. Wet sieving was considered as an option to be employed if required, but soil was able to pass through the 3 millimetre mesh successfully to enable dry sieving to be undertaken. Where stone artefacts and non-diagnostic lithic items were recovered during sieving, they were bagged by square and spit. Representative profiles in each test pit were photographed. Test pit stratigraphy was recorded on pro forma test pit recording sheets using standard sedimentological terms and criteria (after McDonald & Isbell 2009). All pits were backfilled after excavation.

5.2 Testing results

A total of 196 test pits measuring 0.25 m^2 (50 x 50 cm) were hand excavated across the construction footprint over non-consecutive days between October 2020 and February 2021, as access to individual land parcels became available. Test pits were generally located at 50 metre intervals across previously identified areas of archaeological sensitivity at risk of direct impacts. Test pit locations are shown in Figure 4-1a to Figure 4-1d. The photographic recording of all test pits is included in Appendix A.

A total of 22 test pits (11.2 per cent) were found to contain Aboriginal objects, with densities ranging from one to five objects per 0.25 metres squared. Collectively, a total of 42 lithic items which satisfied technical criteria for identification as artefacts were recovered as a result of the test excavation program.

Test excavation identified five artefact scatters (SMWSA-AS2, SMWSA-AS3, SMWSA-AS4, SMWSA-AS7 and SMWSA-AS8) and three isolated artefact sites (SMWSA-IA1, SMWSA-IA2 and SMWSA-IA3) within the off-airport construction footprint.

The archaeological testing allowed for refined mapping of areas across the off-airport construction footprint in relation to Aboriginal archaeological sensitivity. Mapping has been classified into the following zones including:

- areas of unverified sensitivity (refer to Figure 3-1a to 3-1d) - this zone comprised of the areas that have been identified as having Aboriginal archaeological sensitivity based on desktop data, but which have not yet been subject to survey or test excavation due to access restrictions
- areas of verified Aboriginal archaeological sensitivity (refer to Figure 3-1a to 3-1d (note: Areas of verified archaeological sensitivity are not shown in the public version of this report)) – this zone contains areas that have sites that have been identified by the results of survey and test excavation, with curtilages capturing associated PAD as appropriate. PAD curtilages were informed by artefact distribution and landform, as per the predictions made in Section 3.3
- areas to be managed by unexpected finds procedures - these areas have been identified through survey and testing as not to have a high likelihood to contain sites based on disturbance, landform and a lack of result from the survey and test excavation. Although these areas cannot be said to have nil potential, the low potential for them to contain sites means that further investigation is unwarranted, and any unexpected finds encountered during works can be managed through the appropriate stop work procedures.

The management of these areas is further described in the ACHMP.

5.3 Lithics

The lithics identified by test excavation are presented in Table 5-1.

Table 5-1 Lithics identified during test excavation

Square	Spit	Tech. Type	Raw Mat.	Cortex	Colour	Lustre	Flaw	Ther. Dam.	Weight (g)	MLD (mm)	Flk. lngth (mm)	Flk. wdth (mm)	Flk. thk (mm)	Plat. Type	Over-hang	Plat. wdth (mm)	Plat. thk (mm)	Dorsal Cortex	DFSO	Termin-ation
30	2	Core fragment	Silcrete	Y	P/R	Y	Y	Y	6.2	27.4										
32	1	Core	Chert	Y	B	Y	N	N	9.45											
32	2	Core fragment	Silcrete	N	P	Y	N	Y	2.6											
43	1	Core fragment	Silcrete	N	P	Y	N	Y	13.8	30.6										
54	1	Flake shatter	Silcrete	N	Y	Y	N	N	3.73	27.4										
54	2	Complete flake	Silcrete	Y	Y	Y	N	N	6.4		31.2	36.8	7.4	Cortical	N	13.1	5.1	100	N/A	Feather
54	2	Complete flake	Silcrete	N	Y	N	N	N	0.53		15.9	13.4	2.7	Single	N	5.1	2	N	Indeterminate	Feather
54	2	Proximal flake	Silcrete	Y	Y	Y	N	N	0.11	9.2				Single	N	2.4	1.7			
73	2	Redirecting flake	S.tuff	N	Buff	N	N	N	5.6		56.3	15.2	8.1	Single	N	5.1	1.9	N	Irregular	Feather
73	1	Complete flake	S.tuff	N	Y/B	N	N	N	2.4		31.1	17.2	3.4	Single	N	6.2	2	N	Uni	Hinge
73	1	Proximal flake	S.tuff	N	Y/B	N	N	Y	0.62	14.2				Single	N	2.8	1.9			
73	1	Flake shatter	S.tuff	N	Y/B	N	N	N	1.38	25.8										
73	1	Flake shatter	S.tuff	N	Y/B	N	N	N	5.78	41.9										
77	2	Proximal flake	Silcrete	N	R	Y	N	N	1.65	25.2				Facetted	N	6.1	3			
81	2	Proximal flake	Silcrete	Y	P/R	Y	Y	Y	8.3	28.6				Cortical	N	13.2	4.1			
81	2	Angular shatter	Silcrete	N	R	Y	N	Y	0.6	14.6										
81	1	Split flake	Silcrete	N	Y	Y	N	Y	0.69	15.9										
85	2	Complete flake	Quartz	N	W	N	N	N	0.8		15.3	16.9	3.5	Single	N	11.7	2.6	N	Indeterminate	Feather
117	2	Angular shatter	Silcrete	N	R	Y	Y	Y	4.2	32.8										
136	3	Complete flake	Silcrete	N	P	N	N	N	1		17.1	19.8	4.4	Linear	N	3.4	0.3	N	Indeterminate	Plunge
136	2	Proximal flake	Silcrete	N	R	N	N	N	0.14	9.9				Single	N	6.7	2.1			
136	1	Flake shatter	Silcrete	N	G	N	N	N	1.52	22.5										
139	3	Angular shatter	Silcrete	N	R	Y	N	N	0.56	12.7										

Square	Spit	Tech. Type	Raw Mat.	Cortex	Colour	Lustre	Flaw	Ther. Dam.	Weight (g)	MLD (mm)	Flk. lngth (mm)	Flk. wdth (mm)	Flk. thk (mm)	Plat. Type	Over-hang	Plat. wdth (mm)	Plat. thk (mm)	Dorsal Cortex	DFSO	Termin-ation
139	3	Angular shatter	Silcrete	N	R	Y	N	N	0.51	12.8										
139	3	Angular shatter	Silcrete	N	R	Y	N	N	0.06	9.2										
139	3	Flake shatter	Silcrete	N	R	Y	N	N	0.05	8.9										
141	3	Flake shatter	Quartz	N	W	N	N	N	0.83	18.6										
143	1	Complete flake	Silcrete	N	R	Y	N	N	1.4		23.4	14.3	3.9	Multiple	N	10.4	4.1	N	Irregular	Feather
145	2	Angular shatter	Quartz	N	W	N	N	N	0.71	13.2										
162	2	Split flake	Silcrete	N	R/P	Y	N	Y	0.53	15										
165	2	Flake shatter	Silcrete	N	P	N	N	N	0.55	13.7										
166	2	Flake shatter	S.tuff	N	B	N	N	Y	0.66	15.8										
168	1	Angular shatter	Silcrete	N	R	Y	Y	Y	1.9	15.6										
168	1	Complete flake	Silcrete	N	R	Y	N	N	0.62		14.9	8.1	5.7	Crushed	N/A			N	Indeterminate	Plunge
168	2	Proximal flake	Silcrete	N	Y	Y	N	N	0.1	8.8				Single	N	4.8	1.3			
182	2	Backed artefact	Silcrete	N	R	Y	N	N	0.49											
177	1	Flake shatter	Silcrete	N	Y/R	Y	N	N	0.81	19.6										
189	1	Complete flake	Silcrete	N	Y	N	N	N	1		18.2	18.1	4.5	Crushed	N/A			N	Indeterminate	Feather
195	2	Angular shatter	Silcrete	N	P	Y	N	Y	0.22	12.3										
182	1	Angular shatter	Silcrete	N	P	N	N	N	3.99	31										
187	1	Angular shatter	Silcrete	N	R	Y	N	N	0.7	14.4										

5.3 Analysis and discussion of results

Background research identified one site being located wholly within the off-airport construction footprint (45-5-2640) and two with PAD curtilages extending partially into the construction footprint. The survey resulted in one artefact scatter site (SMWSA-AS6) being located within the off-airport construction footprint. Test excavation identified a total of 42 lithic items across 22 of the 196 test pits. The test excavation resulted in eight sites being defined, consisting of five artefact scatters (SMWSA-AS2, SMWSA-AS3, SMWSA-AS4, SMWSA-AS7 and SMWSA-AS8) and three isolated artefacts (SMWSA-IA1, SMWSA-IA2 and SMWSA-IA3).

Lithic analysis resulted in artefacts from raw material types including 31 silcrete, six silicified tuff, three quartz and one chert. Artefact types included 10 pieces of angular shatter, nine pieces of flake shatter, eight complete flakes, six proximal flakes, three core fragments, two split flakes, one redirecting flake, one core and one backed artefact. The presence of cores indicates that stone tool manufacturing was taking place within this area. Although no verified single incident production signature could be verified from the available data, test pit 73 contained a complete flake, a proximal flake, a redirecting flake and two pieces of flake shatter, all from the same raw material type (silicified tuff). The assemblage is at least suggestive of a knapping floor. Only one backed artefact was identified, located in test pit 182 along with a single piece of angular shatter.

The current finds are evidence of the use of the area by Aboriginal people in the past, and retain cultural heritage values to the contemporary Aboriginal community as a tangible link to their past. The identification of the majority of the material in elevated areas in proximity to water sources indicates the accuracy of predictions made based on known sites and landform. The paucity of data means that research questions cannot be accurately answered at this time, although further evidence may be gathered through future test excavation and salvage.

6. Scientific significance assessment

This section provides an assessment of the archaeological (or scientific) significance of identified Aboriginal archaeological sites within the study area. Scientific significance ratings are presented as a means of determining, in conjunction with assessed levels of social or cultural significance by RAPs, the most appropriate management / mitigation measures for these sites.

6.1 Assessing values and significance

Heritage sites hold value for different communities in a variety of different ways. All sites are not equally significant in terms of archaeological/scientific values and thus not equally worthy of conservation and management (Pearson & Sullivan, 1995: 17). One of the primary responsibilities of cultural heritage practitioners, therefore, is to determine which sites are worthy of preservation and management (and why) and, conversely, which are not (and why) (Smith & Burke, 2007: 227). This process is known as *the assessment of cultural significance* and, as highlighted by Pearson and Sullivan (1995: 127), incorporates two interrelated and interdependent components. The first involves identifying, through documentary, physical or oral evidence, the elements that make a heritage site significant, as well as the type(s) of significance it manifests. The second involves determining the degree of value that the site holds for society (i.e. its cultural significance) (Pearson & Sullivan, 1995: 126). As has previously been noted, cultural values are either present or not, and RAPs will not draw a hierarchical distinction between sites and features. All known sites have been identified as having cultural values. Other values associated with the scientific/archaeological components of a site are generally determined through assessment guidelines.

In Australia, the primary guide to the assessment of heritage significance is the *Australian ICOMOS Charter for Places of Cultural Significance* (1999), informally known as *The Burra Charter*, which defines cultural significance as the "aesthetic, historic, scientific, social or spiritual value for past, present or future generations" of a site or place (ICOMOS, 1999: 2). Under the Burra Charter model, the cultural significance of a heritage site or place is assessed in terms of its aesthetic, historic, scientific and social values, none of which are mutually exclusive (see Table 6-1). Establishing cultural significance under the Burra Charter model involves assessing all information relevant to an understanding of the site and its fabric (i.e. its *physical* make-up) (ICOMOS, 1999: 12). The assessment of cultural significance and the preparation of a statement of cultural significance are critical prerequisites to making decisions about the management of any heritage site or place (ICOMOS, 1999: 11).

With respect to Aboriginal sites and places, it is possible to identify two major streams in the overall significance assessment process: the assessment of *scientific value(s)* by archaeologists and the assessment of *social (or cultural) value(s)* by Aboriginal people. Scientific value refers to the importance of a place in terms of its rarity, representativeness and the extent to which it may contribute further information (i.e. its research potential) (OEH 2011: 9). Social or cultural value, meanwhile, refers to the spiritual, traditional, historic and contemporary associations and attachments a place or area has for Aboriginal people and can only be identified through consultation with Aboriginal people (OEH, 2011: 8). Social or cultural value therefore is not limited to specific sites or objects or physical expressions of place.

Table 6-1 Values relevant to determining cultural significance, as defined by The Burra Charter (1999)

Value	Definition
Aesthetic	"Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use" (ICOMOS, 1999: 12).
Historic	"Historic value encompasses the history of aesthetics, science and society...[a] place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may have historic value as the site of an important event" (ICOMOS, 1999: 12).

Value	Definition
Scientific	"The scientific or research value of a place will depend on the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information" (ICOMOS, 1999:12).
Social	"Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group" (ICOMOS, 1999: 12).

6.2 Scientific values (archaeological significance)

The scientific (or archaeological) significance of Aboriginal archaeological sites relates primarily to their potential for providing information about past Aboriginal culture and is commonly assessed on the basis of their research potential, representativeness and rarity. Other criteria, such as aesthetic value and education potential, may also be relevant.

Research potential

Research potential can be defined as the potential of an archaeological site to address what Bowdler (1981:129) has referred to as "timely and specific research questions". These questions may relate to any number of issues concerning past human lifeways and environments and, as suggested by Bowdler's quote, will inevitably reflect current trends or problems in academic research (Burke & Smith, 2004:249). For their part, Bowdler and Bickford (1984:23-4) suggest that the research potential of an archaeological site can be determined by answering the following series of questions:

1. Can the site contribute knowledge which no other resource can?
2. Can the site contribute knowledge which no other such site can?
3. Is this knowledge relevant to general questions about human history or other substantiative subjects?

Several criteria can be used to assess the research potential of an archaeological site. Particularly important in the context of Aboriginal archaeology are the intactness or integrity of the site in question, its complexity and its potential for archaeological deposit (NPWS, 1997: 7). The connectedness of the site to other sites or natural landscape features may also be relevant.

Integrity refers to the extent to which a site has been disturbed by natural and/or anthropogenic phenomena and includes both the state of preservation of particular remains (e.g. animal bones, plant remains) and, where applicable, stratigraphic integrity. Assessments of archaeological integrity are predicated on the notion that undisturbed or minimally disturbed sites are likely to yield higher quality archaeological and/or environmental data than those whose integrity has been significantly compromised by natural and/or anthropogenic phenomena. Establishing levels of preservation or integrity in the context of a surface survey is difficult. Nonetheless, useful rating schemes are available for 'open' sites (Coutts & Witter, 1977: 34) and scarred trees (Long, 2003).

The *complexity* of a site refers primarily to the nature or character of the artefactual materials or features that constitute it but also includes site structure (e.g. the physical size of the site, spatial patterning in observed cultural materials). In the case of open artefact sites, for example, the principal criteria used to assess complexity are the site's size (i.e. number of artefacts and/or spatial extent), the presence, range and frequency of artefact and raw material types, and the presence of features such as hearths.

Potential for archaeological deposit refers to the potential of a site to contain subsurface archaeological evidence which may, through controlled excavation and analysis, assist in answering questions that are of contemporary archaeological interest. Assessing subsurface potential in the absence of subsurface investigation is difficult. Nonetheless, consideration of a range of factors, including the integrity of the site, the complexity of extant surface evidence, the nature of the local geomorphology (as established through surface observations and documentary research) and the results of previous archaeological excavations in the area, will help inform assessment of this criterion.

Connectedness concerns the relationship between archaeological sites within a given area and may be expressed through a combination of factors such as site location, type and contents. It may, for example, be possible to establish a connection between a stone quarry and hatchet head found nearby. Demonstrating connectedness archaeologically, however, is far from straightforward, especially when dealing with surface evidence alone. Ultimately, this difficulty rests with the need to demonstrate contemporaneity between sites that may have been created hundreds, if not thousands, of years apart. As Shiner (2008: 13) has observed, "much of the surface archaeological record documents the accumulation of materials from multiple behavioural episodes occurring over long periods of discontinuous time". Contemporaneity, then, needs to be demonstrated not assumed.

Rarity and representativeness

Rarity and *representativeness* are related concepts. Rarity refers to the relative uniqueness of a site within its local and regional context. The scientific significance of a site is usually higher if it is unique or rare within either context; conversely, it is usually considered to be of lower scientific significance if it is common in a local or regional context. The concept of representativeness, meanwhile, refers to the question of whether or not a site is "a good example of its type, illustrating clearly the attributes of its significance" (Burke & Smith, 2004: 247). Representativeness is an important criterion as one of the primary goals of cultural heritage management is to preserve for future generations a representative sample of all archaeological site types in their full range of environmental contexts.

In common with rarity, assessments of representativeness within a region are dependent on the state of current knowledge concerning the number and type of archaeological sites present within that region[9]. This is a critical point, for as suggested by Kuskie (2000) and others (e.g. Bowdler, 1981; Godwin, 2011; Pearson & Sullivan, 1995), the absence across most of Australia of regional-scale quantitative data for Aboriginal sites and places represents a major constraint in assessments of representativeness and rarity. As Bowdler (1981) stressed almost 40 years ago, detailed regional-scale assessments of the Aboriginal archaeological record of Australia are required to address this issue.

6.3 Identified scientific values

The identified scientific values rest in the Aboriginal archaeological sites that have been recorded. Taking into account the results of all archaeological survey and test excavation works undertaken for the project up to and including February 2021, a total of 10 Aboriginal archaeological sites are recognised as being wholly within the off-airport section of the construction footprint, with an additional two sites that have PAD curtilages partially extending into it. Identified sites consist of three valid previously recorded artefact scatter sites, being B22 (45-5-2640) BWB (45-5-5298) and CCE T3 (45-5-5297). Survey identified another artefact scatter site (SMWSA-AS6), while test excavation has identified five artefact scatters (SMWSA-AS2, SMWSA-AS3, SMWSA-AS4, SMWSA-AS7 and SMWSA-AS8) and three isolated artefact sites (SMWSA-IA1, SMWSA-IA2 and SMWSA-IA3) within the off-airport construction footprint.

The artefact assemblages at surface sites 45-5-2640 (B22) and SMWSA-AS6 are low density in disturbed areas and are therefore limited in the research questions that can be answered. It is important to note, however, that these sites are part of a landscape of linked sites and it is its connection to the wider cultural landscape that allows for a larger suite of research questions to be applied.

An assessment of the scientific significance of the 12 Aboriginal sites (listed in Table 6-2) identified within the off-airport construction footprint is presented in Table 6-3. Significance ratings are offered on the basis of the assessed research potential, rarity and representativeness of each site on a local and regional scale. Rankings for the previously recorded artefact site 45-5-2640 (B22), which was not relocated during the survey component of the archaeological field investigation, has been based on site information provided in the associated site card (see Table 6-3).

[9] There is, of course, a temporal fluidity to this criterion (i.e. as knowledge of the Aboriginal archaeology of a region increases, assessed levels of representativeness may change, a point of equal relevance to rarity).

Table 6-2 Aboriginal archaeological sites within the off-airport construction footprint (CF)

Name	Site type	AHIMS Feat	Surface/ Subsurface	AHIMS	Location	Mapped landform	Artefact no.
B22	Artefact scatter	AFT	Surface	45-5-2640	Aerotropolis Core	Midslope	3
BWB	Artefact scatter with PAD	AFT;PAD	Subsurface	45-5-5298	Off-airport construction corridor (southern)	Floodplain	9
CCE T3	Artefact scatter with PAD	AFT;PAD	Subsurface	45-5-5297	Off-airport construction corridor (southern)	Slopes	N/A (PAD)
SMWSA-AS2	Artefact scatter with PAD	AFT;PAD	Subsurface	TBA	Stabling and Maintenance Facility	Flat	4
SMWSA-AS3	Artefact scatter with PAD	AFT;PAD	Subsurface	TBA	Off-airport construction corridor (northern)	Flat	3
SMWSA-AS4	Artefact Scatter	AFT	Subsurface	TBA	Off-airport construction corridor (northern)	Midslope	7
SMWSA-AS6	Artefact scatter	AFT	Surface	TBA	Off-airport construction corridor (southern)	Slopes	3
SMWSA-AS7	Artefact scatter with PAD	AFT;PAD	Subsurface	TBA	Off-airport construction corridor (southern)	Flat	13
SMWSA-AS8	Artefact scatter	AFT	Subsurface	TBA	Off-airport construction corridor (southern)	Slopes	2
SMWSA-IA1	Isolated artefact	AFT	Subsurface	TBA	Off-airport construction corridor (southern)	Ridge	1
SMWSA-IA2	Isolated artefact	AFT	Subsurface	TBA	Off-airport construction corridor (southern)	Hill top	1
SMWSA-IA3	Isolated artefact	AFT	Subsurface	TBA	Off-airport construction corridor (southern)	Ridge	1

Table 6-3 Scientific significance assessment for identified Aboriginal sites within the off-airport construction footprint

Site	Scientific significance ranking	Justification
B22	Low	***Complexity*** • The three surface artefacts recorded at this location in 1996 were not able to be located during survey. Surface observations identified that this area was highly disturbed. No other surface artefacts were identified in the immediate vicinity of this site. • Test pits excavated in the immediate vicinity were predominantly shallow (between 7 centimetres and 11 centimetres depth for three of the test pits within 60 metres of this site). The proximity to a drainage depression suggests water flow has caused increased soil erosion to the immediate north of this site, just as high levels of disturbance associated with buildings and roads have impacted deposits to its immediate south. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site is likely to have been subject to high levels of past disturbance, reducing its integrity to low. ***Potential for deposit*** • The results of adjacent test excavations and available geomorphological/geoarchaeological reference materials suggest that past disturbance has reduced the potential for the presence of buried soil horizons with the potential to contain archaeological deposits with research potential. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
BWB	Moderate	***Complexity*** • Taken at face value, the uniformly low subsurface artefact densities revealed by test excavation within the mapped boundaries of this site suggest non-intensive use by Aboriginal people. However, consideration of the landscape context of this site suggests that any such behavioural interpretation need not be valid, with observed densities potentially also linked to the geomorphologic movement of soil deposits over time due to erosion and redeposition. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically, with dams and a power line easement, but not subject to gross disturbance. ***Potential for deposit*** • Field observations and available geomorphological/ geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential.

Site	Scientific significance ranking	Justification
		Rarity and representativeness • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
CCE T3	Low	***Complexity*** • This site consists of an area of PAD associated with a larger artefact scatter site that extends beyond the boundaries of the construction footprint. No known artefacts have been identified within the portion of this PAD area that intersects with the off-airport construction corridor. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically but not subject to gross disturbance. ***Potential for deposit*** • Field observations and available geomorphological/ geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-AS2	Moderate	***Complexity*** • Taken at face value, the uniformly low subsurface artefact densities revealed by test excavation within the mapped boundaries of this site suggest non-intensive use by Aboriginal people. However, consideration of the landscape context of this site suggests that any such behavioural interpretation need not be valid, with observed densities potentially also linked to the geomorphologic movement of soil deposits over time due to erosion and redeposition. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically, with some dams, but not subject to gross disturbance overall. ***Potential for deposit*** • Field observations and available geomorphological/ geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential.

Site	Scientific significance ranking	Justification
		Rarity and representativeness • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-AS3	Moderate	***Complexity*** • The three surface artefacts recorded at this location were in a highly disturbed area that had been subject to vegetation clearance, grading and vehicle movement. No other surface artefacts were identified in the immediate vicinity of this site and none of the five test pits to the immediate north of this site identified any artefacts in subsurface deposits. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site is likely to have been subject to high levels of past disturbance, reducing its integrity to low. ***Potential for deposit*** • The results of test excavations to the immediate north and available geomorphological/geoarchaeological reference materials suggest that past disturbance has reduced the potential for the presence of buried soil horizons with the potential to contain archaeological deposits with research potential. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-AS4	Low	***Complexity*** • Taken at face value, the uniformly low subsurface artefact densities revealed by test excavation within the mapped boundaries of this site suggest non-intensive use by Aboriginal people. However, consideration of the landscape context of this site suggests that any such behavioural interpretation need not be valid, with observed densities potentially also linked to the geomorphologic movement of soil deposits over time due to erosion and redeposition. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically but not subject to gross disturbance. ***Potential for deposit*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type.

Site	Scientific significance ranking	Justification
		• Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-AS6	Low	***Complexity*** • Taken at face value, the uniformly low subsurface artefact densities revealed by test excavation within the mapped boundaries of this site suggest non-intensive use by Aboriginal people. However, consideration of the landscape context of this site suggests that any such behavioural interpretation need not be valid, with observed densities potentially also linked to the geomorphologic movement of soil deposits over time due to erosion and redeposition. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically but not subject to gross disturbance. ***Potential for deposit*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-AS7	Moderate	***Complexity*** • Taken at face value, the uniformly low subsurface artefact densities revealed by test excavation within the mapped boundaries of this site suggest non-intensive use by Aboriginal people. However, consideration of the landscape context of this site suggests that any such behavioural interpretation need not be valid, with observed densities potentially also linked to the geomorphologic movement of soil deposits over time due to erosion and redeposition. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically but not subject to gross disturbance. ***Potential for deposit*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential.

Site	Scientific significance ranking	Justification
		Rarity and representativeness • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-AS8	Moderate	***Complexity*** • Taken at face value, the uniformly low subsurface artefact densities revealed by test excavation within the mapped boundaries of this site suggest non-intensive use by Aboriginal people. However, consideration of the landscape context of this site suggests that any such behavioural interpretation need not be valid, with observed densities potentially also linked to the geomorphologic movement of soil deposits over time due to erosion and redeposition. ***Integrity*** • Field observations and historical aerial photographs suggest that the overwhelming majority of land within the boundary of this site retains a moderate degree of integrity, having been cleared and/or cropped historically but not subject to gross disturbance. ***Potential for deposit*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-IA1	Low	***Complexity*** • Single artefact recovered from test pit. ***Integrity*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Potential for deposit*** • The results of test excavation suggest that untested land in the broader area surrounding this site retains moderate subsurface archaeological potential, but the test pits in the immediate area surrounding this site did not yield further artefacts. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.

Site	Scientific significance ranking	Justification
SMWSA-IA2	Low	***Complexity*** • Single artefact recovered from test pit. ***Integrity*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Potential for deposit*** • The results of test excavation suggest that untested land in the broader area surrounding this site retains moderate subsurface archaeological potential, but the test pits in the immediate area surrounding this site did not yield further artefacts. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.
SMWSA-IA3	Low	***Complexity*** • Single artefact recovered from test pit. ***Integrity*** • Field observations and available geomorphological/geoarchaeological reference materials suggest that the landform elements within the mapped boundary of this site retain good potential for the presence, at depth, of buried soil horizons which may contain further archaeological deposits with research potential. ***Potential for deposit*** • The results of test excavation suggest that untested land in the broader area surrounding this site retains moderate subsurface archaeological potential, but the test pits in the immediate area surrounding this site did not yield further artefacts. ***Rarity and representativeness*** • Artefact scatter sites are a locally and regionally common site type. • Artefact scatter sites with comparable or higher artefact counts, densities, integrity and assemblage richness values are known on a local and regional scale and offer comparable/higher research potential.

7. Impact assessment

This assessment considers both direct impacts and indirect impacts to Aboriginal heritage as a result of the project. Direct impacts are defined as impacts that would have a physical impact on the site, resulting in damage, which could be either partial or total destruction. Direct impacts have been considered both in relation to known and potential Aboriginal archaeological sites and features.

Indirect impacts are those that do not directly impact on the physical site itself but do have an impact on its cultural heritage significance. Indirect impacts for this assessment are likely to be caused by factors such as subsidence and vibration as a result of tunnelling. Surface areas above where tunnelling would occur have been subject to a separate assessment on the likelihood of subsidence occurring and known sites have been mapped in relation to these areas. Potential indirect impacts have also been considered for sites within a 200 metre buffer area outside the construction footprint. The impact rating scheme is defined in Table 7-1 below.

Table 7-1 Impact Risk Rating Scheme

Impact risk	Definition
Low	The proposed activity is unlikely to disturb, destroy, damage or deface an Aboriginal object or objects.
Moderate	The proposed activity has reasonable potential to disturb, destroy, damage or deface an Aboriginal object or objects.
High	The proposed activity will - or is highly likely to - disturb, destroy, damage or deface an Aboriginal object or objects.

7.1 Summary of proposed impacts

As detailed in Section 1.2, Sydney Metro is proposing to construct and operate a new metro railway line between the T1 Western Line at St Marys and the Western Sydney Aerotropolis. The project is characterised into components that are located outside Western Sydney International (off-airport) and components that are located within Western Sydney International (on-airport), to align with their different planning approval pathways required under State and Commonwealth legislation. The off-airport components of the project would include the track alignment and associated operational systems and infrastructure north and south of Western Sydney International, four metro stations, the stabling and maintenance facility, two service facilities and a tunnel portal. The on-airport components of the project would include the track alignment and associated operational systems and infrastructure within Western Sydney International, two metro stations and a tunnel portal.

Construction of the project would involve:

- enabling works
- main construction works, including:
  - tunnelling and associated works
  - corridor and associated works
  - stations and associated works
  - ancillary facilities and associated works
  - construction of ancillary infrastructure including the stabling and maintenance facility
- rail systems fitout
- finishing works and testing and commissioning.

These activities are described in more detail in Appendix B of the Submissions Report.

The project design process has aimed to avoid Aboriginal impacts where possible, with the construction footprint avoiding AHIMS sites wherever possible. The use of subsurface tunnelling for a

large proportion of the project would successfully avoid many known sites and minimise the impacts to areas of both Aboriginal cultural significance and archaeological potential.

7.2 Impacts to identified Aboriginal sites

7.2.1 Off-airport

Potential direct and indirect impacts as a result of the project are discussed below.

Potential direct impacts

Potential direct impacts within each construction site are outlined in Table 7-2.

Table 7-2 Potential off-airport direct impacts summary

Construction site	Impacts
St Marys	• There are no registered AHIMS sites within the curtilage of the St Marys construction site (see Figure 3-1a (note: AHIMS sites are not shown in the public version of this report) and Section 3.2). There are no AHIMS sites within 200 metres of the construction site (see Section 3.2 and Figure 3-1a) • based on the high levels of past disturbance in this construction site (including road corridors, rail corridor, the existing St Marys Station, buildings and services), no areas of archaeological sensitivity have been identified within its bounds (see Figure 3-1a) • there are no known Aboriginal cultural values specifically associated with this construction site • no potential direct impacts to Aboriginal archaeological sites have been identified in this construction site. No specific cultural values have yet been identified in this construction zone.
Claremont Meadows services facility	• There was one registered AHIMS site within the bounds of this construction site (artefact scatter site 45-5-4420) (see Figure 3-1a and Section 3.2). This site has however been destroyed under the conditions of AHIP C0000636 and is no longer extant in this construction site. The AHIP covers the entirety of the Claremont Meadows services facility (see Section 3.2) • there were three AHIMS sites located within 200 metres of this construction site (45-5-0356, 45-5-4418 and 45-5-4419) but all three sites were destroyed under permit conditions (see Section 3.2) and are no longer extant at this location (see Section 3.2 and Figure 3-1a) • based on the high levels of past disturbance in this construction site (including road corridors, clearance and development), no areas of archaeological sensitivity have been identified within its bounds (see Figure 3-1a) • no direct impacts to Aboriginal archaeology have been identified at this location as the pre-existing archaeology has already been removed. The only currently known cultural values were those associated with the since destroyed AHIMS sites. Although the physical markers in the landscape that were provided by the sites have been removed the site locations may still have cultural value to the Aboriginal community as areas of past Aboriginal activity.
Orchard Hills	• There are no registered AHIMS sites within the Orchard Hills construction site (see Figure 3-1a and Section 3.2). The northern-most part of this construction site has been subject to impacts under AHIP C0002113 (see Section 3.2) • there were five artefact scatter sites located within 200 metres of the northern extent of this construction site (45-5-4424, 45-5-4429, 45-5-4430, 45-5-4431 and 45-5-4477) (see Figure 3-1a and Section 3.2). All five of these sites have been destroyed under permit conditions and they are no longer extant (see Section 3.2)

Construction site	Impacts
	• although there have been past impacts in this area, they are not so extensive as to have definitely removed all Aboriginal sites (if present). Based on past impacts, the landform and distance from water channels, archaeological potential has been identified in elevated areas within this construction site (see UVA1 on Figure 3-1a). Access has not yet been provided to undertake survey and testing at this location. If intact subsurface deposits are present in this area there is a risk they may be impacted by the project (see Chapter 9 for details on management and mitigation) • cultural values are associated with the waterways, areas of potential (if sites are identified therein) and the since destroyed AHIMS sites at the northern extent. Although the physical markers in the landscape (provided by the sites) have been removed, the site locations may still have cultural value to the Aboriginal community as areas of past Aboriginal activity.
Stabling and maintenance facility	• One artefact scatter and one isolated artefact site were identified in subsurface deposits (SMWSA-AS2) during testing within the stabling and maintenance facility construction site (see Figure 3-1b and Section 3.2). There are two artefact scatters (45-5-3190 and 45-5-3191) and an isolated artefact (45-5-3776) within 200 metres of this construction site, but are separated from the stabling and maintenance facility by the off-airport construction corridor (northern). As such these three sites are discussed in the off-airport construction corridor (northern) section • although field investigations were undertaken in parts of this construction site, there are sections of it that have not yet been able to be accessed (see Chapters 4 and 5). The northern portion of the construction site is close to the confluence of Blaxland Creek and South Creek and is the location where one subsurface site was identified (see Figure 3-1b) • the known Aboriginal cultural values specifically associated with this construction site are related to the one identified site • the potential for subsurface deposits to be present in areas that have not yet been subject to survey or testing due to access constraints, means that as yet unidentified sites may be impacted. In addition to this potential, one site would be impacted within this construction site (see UAV2 on Figure 3-1b). This construction footprint would need to be managed in line with the mitigation measures outlined in Chapter 9.
Off-airport construction corridor (northern) (between the Orchard Hills and Luddenham Road construction footprint areas)	• No surface expressions of artefacts were identified during the field inspections undertaken to date, although one surface site was identified outside of its bounds but within 200 metres of the area. This surface site (SMWSA-AS5) consisted of 18 artefacts on a vehicle track located to the immediate south of the Warragamba to Prospect Water Supply pipelines and to the immediate north of the airport runway (see Figure 3-1b) • Survey and test excavation have been undertaken in parts of this area, resulting in the identification of two artefact scatters within its bounds (SMWSA-AS3, SMWSA-AS4), meaning this area contains both Aboriginal archaeological sensitivity and confirmed sites • RAPs noted that the water channels crossing through this area had cultural significance as part of the larger cultural landscape, connected by water courses which were used in the past as pathways and resource gathering areas (see Chapters 4 and 5) • the portion of this area located between the Warragamba to Prospect Water Supply Pipelines and the Luddenham Road construction site has been subject to past impacts under AHIP C0003861 (see Section 3.2.1). The non-AHIP parts of the construction site that have

Construction site	Impacts
	archaeological potential (that have not yet been subject to survey or testing) will need to be surveyed and tested • there are eight artefact scatters (45-5-3190, 45-5-3191, 45-5-5087, 45-5-5096 and 45-5-5097) and two isolated artefacts (45-5-3773 and 45-5-3776) within 200 metres of this construction site. Potential impacts could occur if adequate protection/management measures are not put into place (see Chapter 9) • based on the presence of sites in the surrounding area and the identification of three sites in subsurface within this area, it can be confirmed that impacts to archaeological heritage will occur • cultural values are present associated with the waterways, areas of potential (if sites are identified therein) and the known sites. This construction site would need to be managed in line with the mitigation measures outlined in Chapter 9.
Luddenham Road	• There are no registered AHIMS sites within the Luddenham Road construction site (see Section 3.2). There are no known AHIMS sites within 200 metres of this construction site (see Section 3.2) • this construction site has been subject to impacts under AHIP C0003861 (see Section 3.2) which are likely to have removed archaeological values • there are no currently known Aboriginal cultural values specifically associated with this construction site • this construction site would need be managed in line with the mitigation measures outlined in Chapter 9.
Off-airport construction corridor (southern) (Luddenham Road to Elizabeth Drive)	• One artefact scatter site was identified during survey (SMWSA-AS6) within the southern off-airport construction corridor (located between Luddenham Road and the on-airport area) (see Figure 3-1b and Section 4.4) Two previously recorded artefact scatter sites have PAD curtilages associated with them that partially extend into this area (45-5-5297 and 45-5-5298). • during test excavation within this area two artefact scatters and three isolated artefact sites were identified in subsurface contexts (SMWSA-AS7, SMWSA-AS8, SMWSA-IA1, SMWSA-IA2, SMWSA-IA3) • RAPs noted that the water channels crossing through this area had cultural significance as part of the larger cultural landscape, connected by water courses which were used in the past as pathways and resource gathering areas (see Chapter 4) • cultural heritage values are present in the known sites as well as landforms such as waterways and would be present in the areas of archaeological potential if they prove to contain sites. This construction site would need be managed in line with the mitigation measures outlined in Chapter 9.

Construction site	Impacts
Bringelly services facility	• There are no registered AHIMS sites within the curtilage of the Bringelly services facility (see Section 3.2 and Figure 3-1d) • survey undertaken in this area confirmed that it had been subject to high levels of past disturbance due to dam construction and other development activities for a variety of buildings. No surface expressions of artefacts were identified within this area during survey (see Section 4.4 and Figure 3-1d) • there are no known Aboriginal cultural values specifically associated with this construction site • there are three known AHIMS sites within 200 metres of the Bringelly services facility, being modified tree 45-5-2697 (approximately 100 m north of the Bringelly services facility), artefact scatter 45-5-2706 (approximately 50 metres north of the Bringelly services facility) and art site 45-5-2784 (approximately 10 metres south of the Bringelly services facility). As shown on Figure 3-1d these three sites are not within the off-airport construction footprint or directly above the proposed alignment for the tunnel. Impacts could occur if adequate protection/management measures are not put into place (see Chapter 9).
Aerotropolis Core	• There is one AHIMS site located within the bounds of the Aerotropolis Core construction site, artefact scatter 45-5-2640 (see Section 3.1.1 and Figure 3-1d). This area was subject to survey and test excavation during this assessment. No surface artefacts were able to be located at the registered site location (see Section 4.4). No other surface or subsurface expressions of artefacts were identified during survey and test excavation in this area. Test excavation identified deposits across this area to be disturbed • there are two artefact scatter sites within 200 metres of the Aerotropolis Core, located to the south of the construction site in proximity to Moore Gully. One of these (site 45-5-2641) was ground-truthed during investigations and was found to be extant at its registered location in a large area of exposure • site 45-5-2640 has Aboriginal cultural significance as a tangible link for Aboriginal people to their ancestors and evidence of the long-term presence and activity of Aboriginal people in this region (see Section 4.4) • based on the presence of site 45-5-2640 within this area, impacts will occur to both archaeological and cultural heritage values at this location. The sites located within 200 metres to the south of this area can be avoided from impacts. The location of site 45-5-2640 requires management as a valid site area. The remainder of this area has been assessed as unlikely to retain sites and may be managed under stop work procedures (see Figure 3-1d).
Permanent power supply route	• Construction of the permanent power supply route includes trenching works within road reserves where possible and horizontal directional drilling crossing at South Creek to minimise impacts in this area. • The route is located in proximity to a number of previously recorded AHIMS sites.. Ground-truthing would be required for the route to confirm the proximity of these sites. As part of further design development, the permanent power supply route would seek to avoid and/or minimise potential impacts to these sites • the banks of South Creek have archaeological sensitivity. Further investigation would be required prior to ground disturbance works at this location to determine both archaeological and cultural heritage values.

Construction site	Impacts
Temporary power supply route (Kemps Creek)	• Construction of the temporary power supply route includes trenching works. Trenching works would be within road reserves where possible • no previously recorded AHIMS sites were identified along the proposed alignment outside of the construction footprint. No surface sites were identified during survey along the proposed alignment • the banks either side of South Creek and Badgerys Creek have archaeological sensitivity. Further investigation would be required prior to ground disturbance works at this location to determine both archaeological and cultural heritage values.
Temporary power supply route (Claremont Meadows to Orchard Hills)	• Trenching works are to be within road reserves where possible • two destroyed sites were located immediately adjacent to this area and one destroyed site was within its bounds. Although the archaeological values have been removed through site destruction these areas may retain cultural values for the Aboriginal community • one valid artefact scatter site (45-5-4423) is present along the proposed temporary power supply route at its southern end • ground-truthing would be required for the route to confirm the proximity of AHIMS sites. The intention is for further design development for the route to be informed both by known sites and areas of past disturbance • further investigation would be required prior to ground disturbance works at this location to determine both archaeological and cultural heritage values.

As noted in Table 7-2 above, the permanent power supply route includes trenching works within road reserves where possible and horizontal directional drilling crossing at South Creek. The proposed route is located in proximity to a number of previously recorded AHIMS sites.

Further works

At this stage of the project, limited access to land parcels has prevented some areas of the construction footprint from being subject to survey and test excavation. Further investigation will be required to determine the total cultural and archaeological values within the construction footprint.

As discussed in Section 5.2, off-airport construction footprint has been classified into the following zones including:

- areas of unverified sensitivity (refer to Figure 3-1a to 3-1d) - this zone comprises the areas that have been identified as having Aboriginal archaeological sensitivity based on desktop data, but which have not yet been subject to survey or test excavation due to access restrictions
- areas of verified Aboriginal archaeological sensitivity (refer to Figure 3-1a to 3-1d (note: Areas of verified archaeological sensitivity are not shown in the public version of this report)) – this zone comprises areas that have sites that have been identified by the results of survey and test excavation, with curtilages capturing associated PAD as appropriate. PAD curtilages were informed by artefact distribution and landform, as per the predictions made in Section 3.3
- areas to be managed by unexpected finds procedures - these areas have been identified through survey and testing as not to have a high likelihood to contain sites based on disturbance, landform and a lack of result from the survey and test excavation. Although these areas cannot be said to have nil potential, the low potential for them to contain sites means that further investigation is unwarranted, and any unexpected finds encountered during works can be managed through the appropriate stop work procedures.

The management of these areas is further described in the ACHMP.

Potential indirect impacts

Potential indirect impacts as a result of the project, in the off-airport area, are summarised in Table 7-2. Indirect impacts to Aboriginal heritage can include visual impacts. However, no visual impacts have been identified as aesthetic values were not contributory elements to any of the previously

recorded sites. All existing sites within the construction footprint or 200 metres of it were open artefact sites. These types of sites have their scientific significance resting primarily with the research value, while cultural values are tied to the artefacts and to the way in which these sites connect across a broader cultural landscape.

As such, indirect impacts associated with the project include risks to cultural heritage by subsidence and vibration as a result of the tunnel alignment. Vibration from tunnelling is unlikely to impact artefact bearing deposits as the depth of the tunnels is such that they would not impact subsurface deposits, being many levels deeper than the maximum archaeological deposits. The most likely site types to be impacted are rockshelters, art sites and grinding grooves which can all be negatively affected by cracking and rock collapse caused by vibration and settlement. None of these site types have been identified in surface contexts above the tunnel routes in previously recorded AHIMS sites or during survey in above tunnel areas for this project.

7.2.2 Potential on-airport impacts

Potential impacts to identified values

Potential on-airport direct and indirect impacts as a result of the project are discussed below.

Potential direct impacts

The direct impacts in the on-airport area that have been identified through this assessment have been summarised in Table 7-3. It should be noted that these impacts are in relation to current known sites and the construction footprint.

The existing Aboriginal Cultural Heritage CEMP for Western Sydney International contain protocols for the removal and protection of all known sites within Western Sydney International. Sydney Metro would prepare a CEMP for the on-airport rail works, consistent with the existing Aboriginal Cultural Heritage CEMP for Western Sydney International, for approval by the Commonwealth. This would include the related methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, as well as outlining nominated sites for protection. It should be noted that the areas nominated for protection are outside the bounds of the construction footprint for the project. The Sydney Metro CEMP would also align with the Western Sydney International Survey and Salvage Plan.

Table 7-3 On-airport direct impact summary

Construction site	Impacts
On-airport construction corridor	• There are four artefact scatter sites (45-5-2665, 45-5-5089, 45-5-5094 and 45-5-5100) and one isolated artefact (45-5-5068) located within the on-airport construction corridor in the Stage 1 area (see Sections 3.1.1 and Figure 3-1c and d (note: AHIMS sites are not shown in the public version of this report)) • there are four artefact scatter sites located within 200 metres of the on-Airport construction corridor in the Stage 1 area, being 45-5-2632, 45-5-2763, 45-5-5086 and 45-5-5173 (see Section 5.4, Chapter 6 and Figure 3-1c and Figure 3-1d) • the only known Aboriginal cultural values in this area are associated with the sites • it has been assumed that on-airport sites and areas of archaeological sensitivity will be removed as a part of the Western Sydney International development and will therefore not pose a constraint on this project.
Airport Business Park	• There are no known Aboriginal cultural values specifically associated with this area • there are no known AHIMS sites within the Airport Business Park in the Stage 1 area or within 200 metres of the construction site (see Sections 3.1.1 and Figure 3-1d).

Construction site	Impacts
Western Sydney International tunnel portal	• There are no known Aboriginal cultural values specifically associated with this area • there are no known AHIMS sites within the Western Sydney International tunnel portal construction site in the Stage 1 area or within 200 metres of the construction site (see Sections 3.1.1 and Figure 3-1d).
Airport Terminal	• There is one artefact scatter site (45-5-2687) located within the Airport Terminal construction site in the Stage 1 area (see Sections 3.1.1 and Figure 3-1c and 3-1d) • there are three artefact scatter sites located within 200 metres of the on-Airport construction corridor in the Stage 1 area, being 45-5-5082, 45-5-2680 and 45-5-2681 (see Figure 3-1d) • the only known Aboriginal cultural values in this area are associated with the sites • it has been assumed that the on-airport sites and areas of archaeological potential will be removed as a part of the Western Sydney International development and will therefore not pose a constraint on this project.
Airport construction support site (Stage 1)	• There is one artefact scatter site (45-5-5085) located in the airport construction support site, on-airport, within the Stage 1 area (see Sections 3.1.1 and Figure 3-1c and 3-1d) • there are eight artefact scatter sites (45-5-2705, 45-5-2673, 45-5-2770, 45-5-2788, 45-5-2813, 45-5-5099, 45-5-5102 and 45-5-5175) and one isolated artefact (45-5-5022) within 200 metres of the Airport construction support site in the Stage 1 area (see Sections 3.1.1 and Figure 3-1c and 3-1d) • it is assumed that the on-airport development works will remove any sites and areas of archaeological sensitivity and will therefore not pose a constraint on this project.
Airport construction support site (on-airport, outside Stage 1)	• There is one artefact scatter site (45-5-2637) and two isolated artefact sites (45-5-5078 and 45-5-2586) located in the airport construction support site, on-airport, outside the Stage 1 area (see Sections 3.1.1 and Figure 3-1c and 3-1d) • there are nine artefact scatters (45-5-2623, 45-5-2658, 45-5-2659, 45-5-2682, 45-5-2683, 45-5-2690, 45-5-2814, 45-5-5083 and 45-5-5090), three isolated artefacts (45-5-2586, 45-5-5055 and 45-5-5067), one modified tree (45-5-2630) and one grinding groove site (45-5-5057) within 200 metres of the airport construction support site, on-airport, outside the Stage 1 area. The modified tree and grinding groove sites have already been protected from impacts and are planned for long term conservation (see Sections 3.1.1 and Figure 3-1a to 3-1d) • the only known Aboriginal cultural values in this area are associated with the sites • the existing Aboriginal Cultural Heritage CEMP for Western Sydney International contains methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, as well as outlining nominated sites for protection. Areas nominated for protection are outside the bounds of the construction footprint for the project. The Sydney Metro CEMP would align with the Western Sydney International Survey and Salvage Plan (see Chapter 9).

Potential indirect impacts

Since it has been assumed that the on-airport sites and areas of archaeological potential will be removed as a part of the Western Sydney International development and will therefore not pose a constraint on this project, no indirect impacts have been identified as likely for any of the on-airport construction footprint. For sites that are not removed as part of the Western Sydney International development, Sydney Metro would prepare an Aboriginal Cultural Heritage CEMP for the on-airport works in consultation with Western Sydney Airport, for approval by the Commonwealth. The Sydney Metro CEMP would be consistent with the existing Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan (Western Sydney Airport, 2019).

7.3 Summary

Existing data has identified 10 previously recorded sites within the on-airport area. Only three of these sites are located outside the Stage 1 area. Taking into account the results of all archaeological survey and test excavation works undertaken for the project up to and including February 2021, a total of 10 Aboriginal archaeological sites are recognised as being wholly within the off-airport section of the construction footprint, with a further two sites that have PAD curtilages partially extending into it. Identified sites consist of three valid previously recorded artefact scatter sites, being B22 (45-5-2640) BWB (45-5-5298) and CCE T3 (45-5-5297). Survey identified another artefact scatter site (SMWSA-AS6), while test excavation has identified five artefact scatters (SMWSA-AS2, SMWSA-AS3, SMWSA-AS4, SMWSA-AS7 and SMWSA-AS8) and three isolated artefact sites (SMWSA-IA1, SMWSA-IA2 and SMWSA-IA3) within the off-airport construction footprint.

All other sites in proximity to but outside the construction footprint are proposed to be avoided and protected. Of the sites that were identified as having registered centroids within 200 metres of the construction footprint, five sites were assessed based on site card recordings as being wholly outside the construction footprint, but within close enough proximity to warrant protective fencing or some other form of demarcation being used to ensure impacts to them can be avoided during construction. These sites were 45-5-2784 (an isolated artefact in an area disturbed by road construction), 45-5-3190 (consisting of three surface artefacts in a disturbed area), 45-5-3191 (consisting of 19 surface artefacts and seven subsurface artefacts in a disturbed area, on either side of a gully), 45-5-3773 (consisting of six artefacts in disturbed area at 289 Luddenham Road, adjacent to DEOH) and 45-5-3776 (an isolated artefact in a disturbed area). Additionally, site SMWSA-AS5, identified during survey, was identified as being in close enough proximity to warrant protective fencing during works.

With regard to known sites, therefore, the project is wholly impacting a total of 10 sites in the off-airport portion of the project, being artefact scatter and isolated artefact sites, and partially impacting two artefact scatter with PAD sites whose PAD curtilages partially extend into the off-airport construction footprint. Many similar site types as these are represented across the wider region (i.e. no rarity value by site type). It is also likely that the project would impact upon a number of unidentified sites within its curtilage in both surface and subsurface contexts in areas that have not yet been subject to survey or test excavation, due to access limitations. All sites have cultural heritage values associated with them.

There remain areas of Aboriginal archaeological sensitivity that have not yet been surveyed and proposed test pits that have not yet been excavated due to access restrictions. As a result, further investigation will be required to determine the total cultural and archaeological values within the construction footprint, as specified in the ACHMP for the off-airport construction footprint.

8. Cumulative impact assessment

For the purposes of this assessment, cumulative impacts are impacts that, when considered together, have different and/or greater impacts than a single impact on its own. Cumulative impacts result from the successive, incremental and/or combined effects of multiple projects occurring across a shared geographical area. While the project has been assessed in this document in relation to impacts to Aboriginal heritage, so is the surrounding region being impacted by other development projects, including Western Sydney International, Elizabeth Drive road upgrades, M12 Motorway and The Northern Road Upgrade. The Elizabeth Drive project is in its early stages (Transport for NSW, 2020) and due to the lack of availability of further information it is not possible to accurately gauge the cumulative impacts that the Elizabeth Drive road upgrade works may contribute. Consideration of the total impact represented by the other projects is summarised below.

8.1.1 Western Sydney International

The currently available data has identified a total of 115 Aboriginal sites within the bounds of Western Sydney International, consisting of 88 artefact scatters, 24 isolated artefacts, two modified trees and one grinding groove site. The Western Sydney Airport Aboriginal Cultural Heritage CEMP notes that salvage (including surface collection and archaeological excavation) will occur across the site but does not specify at which locations. Two of the 115 sites within the Western Sydney International curtilage have been specified as being conserved and protected, being a possible culturally modified tree site (45-5-2630 - B40) and a grinding groove site (45-5-5057 - B120). Areas of sensitivity crossing into its bounds include Oaky Creek and various unnamed drainage lines and tributaries. The south-eastern side of the curtilage is bordered by Badgerys Creek, but sections of this are to be preserved within an Environmental Conservation Zone (Western Sydney Airport, 2019). The project does not propose to impact any sites not previously approved for impact by the airport construction works. Therefore, cumulative impacts within the on-airport area would not result from the project in combination with the development of Western Sydney International according to the available data, but the combination of both would have a cumulative impact on the Aboriginal cultural values and archaeology of the wider region (as discussed further in Section 8.1.4).

8.1.2 Future M12 Motorway

The revised construction footprint of the M12 Motorway project covers an area of approximately 429 hectares (Jacobs, 2020) and encompasses areas of archaeological sensitivity associated with several major Cumberland Plain creek systems including Ropes Creek, Kemps Creek, South Creek, Badgerys Creek and Cosgroves Creek. The new motorway is being delivered between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham. The timing of opening of the M12 Motorway is subject to planning approval and the completion of detailed design. However, the project is expected to open prior to the opening of Western Sydney International in 2026. Nineteen Aboriginal archaeological sites are expected to be impacted by the construction of the M12 Motorway, with a complete loss of value reported for eight sites and a partial loss of value reported for the remaining 11 sites (Roads and Maritime, 2019; TfNSW, 2020). Data provided in the M12 Motorway ACHAR indicates that the impacted portions of these sites represent around 17 per cent of the motorway's revised construction footprint (Roads and Maritime Services, 2019:93-94, Table 11-1). Of the nineteen sites identified within this area, two - artefact scatters CCE T3 (45-5-5297) and BWB (45-5-5298) - extend into the project's construction footprint and would be subject to additional impacts. Ultimately, these additional impacts would result in a partial loss of value for both sites, with sections of both remaining undisturbed subsequent to the completion of both the M12 Motorway and the project.

8.1.3 The Northern Road Upgrade

The Northern Road is proposed for upgrades along a 35-kilometre section between Mersey Road, Bringelly and Glenmore Parkway in Glenmore Park. The Northern Road upgrades are being delivered in stages, with some stages completed and the final stages having started construction in 2019. A total of 28 Aboriginal archaeological sites have been identified as being directly impacted by the proposed upgrade works for The Northern Road. Of the total 28 impacted sites, 20 of them were proposed for salvage (Roads and Maritime Services, 2019:96). The proposed works for the Northern Road upgrade are outside the bounds of the construction footprint, generally to the south and south-west of the Aerotropolis Core. The sites that will be impacted by the Northern Road upgrade are additional to those impacted within the construction footprint, increasing the cumulative impact of the wider region.

8.1.4 Cumulative impacts

The available evidence of other projects in the surrounding region is that the finite resource of Aboriginal sites is diminishing rapidly as the impacts of multiple developments have an overall cumulative impact on the Aboriginal cultural record of this area. The currently available data has identified seven artefact scatters and three isolated artefact sites subject to destruction within the off-airport portion of the project, with two additional artefact scatter sites to be partially destroyed. Additionally, 10 sites would be impacted within the on-airport area. All other sites in proximity to but outside the construction footprint are proposed to be avoided and protected. It has been assumed that the 10 on-airport sites will be removed as a part of Western Sydney International and would therefore not pose a constraint on this project. With regard to known sites, therefore, the project is increasing the number of impacted sites by 22 (two being partial impacts), all open artefact sites, being a common site type represented across the wider region (i.e. no rarity value by site type). In addition to the known sites, impact is likely to occur upon a number of unidentified sites in both surface and subsurface contexts in those areas that have not yet been subject to survey or test excavation. Consultation with RAPs to date has identified cultural values associated with identified sites and waterways, with representative Colin Gale also stating that the location of sites is not necessarily restricted to water resource areas alone.

The principles of an ecologically sustainable development follow the precautionary principle, which states that full scientific certainty about the threat of harm should never be used as a reason for not taking measures to prevent harm from occurring. The principle of inter-generational equity holds that the present generation should make every effort to ensure the health, diversity and productivity of the environment – which includes cultural heritage – is available for the benefit of future generations (NSW Office of Environment & Heritage, 2011). As the cumulative impacts have been identified as impacting on the finite resource of Aboriginal sites in this region, management and mitigation measures are required to protect this resource for the future.

9. Recommendations

9.1 Approach to management and mitigation

A Construction Environmental Management Framework (CEMF) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor in developing the CEMPs, sub-plans, and other supporting documentation for each specific environmental aspect.

As previously noted in Section 3.2.1 there is an existing HMP to manage heritage within the bounds of DEOH, being Commonwealth land. The Defence Establishment Orchard Hills, NSW: HMP (GML Heritage Pty Ltd, 2013) should be utilised to guide any further heritage work undertaken in that section of the off-airport construction footprint.

Mitigation measures have been developed to manage potential impacts to the known and potential Aboriginal cultural heritage values of the study area. These mitigation measures are contained in full in the Revised ACHAR.

An ACHMP has been developed for the project, as the document to be used to manage Aboriginal heritage during construction of the project. The ACHMP also includes details of test excavation and survey yet to be completed as well as related methodologies for collection and salvage where required, and unexpected find procedures.

The existing Aboriginal Cultural Heritage CEMP for Western Sydney International contains protocols for the removal and protection of all known sites within Western Sydney International. Sydney Metro will prepare a separate Aboriginal Cultural Heritage CEMP for the on-airport works in consultation with Western Sydney Airport, for approval by the Commonwealth. The Sydney Metro CEMP would be consistent with the existing Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan (Western Sydney Airport, 2019). This would include the related methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, as well as outlining nominated sites for protection. The Sydney Metro CEMP would also align with the Western Sydney International Survey and Salvage Plan.

10. References

AECOM Australia Pty Ltd. (2015). *Archaeological Salvage of Open Artefact Site MPIP5 (45-5-3726)* (Vol. 5). Unpublished report for Winten (No. 26) Pty Ltd.

Allen, J., & O'Connell, J. F. (1995). Transitions: Pleistocene to Holocene in Australia and Papua New Guinea. *Antiquity*, *69*(265), ix-862.

AMBS. (2014). *Environmental Survey of Commonwealth Land at Badgerys Creek: Aboriginal Heritage*.

Andrefsky, W. (2005). *Lithics: Macroscopic Approaches to Analysis*. Cambridge: Cambridge University Press.

Appleton, J. (2002). *The Archaeological Investigation of Lot 2, DP 120673 The Site of a Proposed New Clay and Shale Extraction Area - Old Wallgrove Road Horsley Park, West of Sydney NSW*.

Archaeological & Heritage Management Solutions Pty Ltd. (2013). *Fernadell Precinct, Pitt Town, NSW: Aboriginal Heritage Impact Permit #1129099 Excavation Report*. Unpublished report for Johnson Property Group Pty Ltd.

Archaeological & Heritage Management Solutions Pty Ltd. (2015). *Water Related Infrastructure for the North West Growth Centre (NWGC) First and Second Release Precincts: Aboriginal Archaeological Excavation Report*. Unpublished report for Lend Lease/Sydney Water.

Archaeological and Heritage Management Solutions Pty Ltd. (2012). *Aboriginal Archaeological Survey Report: Werrington Arterial Road (M4 Motorway – Great Western Highway), Claremont Meadows, Nsw*.

Artefact Heritage. (2012). *The Northernn Road Upgrade from the The Old Northern Road, Narellan, to Mersey Road, Bringelly - Aboriginal Archaeological Survey Report*. Unpublished report for Roads and Maritime Services.

Attenbrow, V. (2010). *Sydney's Aboriginal Past: Investigating the Archaeological and Historical Records*. Sydney: University of New South Wales Press.

Attenbrow, V. (2012a). Archaeological Evidence of Aboriginal Life in Sydney. Retrieved from Dictionary of Sydney website: http://dictionaryofsydney.org/entry/archaeological_evidence_of_aboriginal_life_in_sydney

Attenbrow, V. (2012b). The Aboriginal Prehistory and Archaeology of Royal National Park and Environs : A Review. *Proceedings of the Linnean Society of New South Wales*, *134*, 39–64.

Attenbrow, V., Graham, I., Kononenko, N., Corkill, T., Byrnes, J., Barron, L., & Grave, P. (2012). Crossing the Great Divide: A Ground-Edge Hatchet-Head from Vaucluse, Sydney. *Archaeology in Oceania*, *47*, 47–52.

Attenbrow, V., Robertson, G., & Hiscock, P. (2009). The Changing Abundance of Backed Artefacts in South-Eastern Australia: A Response to Holocene Climate Change. *Journal of Archaeological Science*, *36*, 2765–2770.

Austral Archaeology Pty Ltd. (2007). *Archaeological Salvage Excavations: 95-101 George Street, Parramatta, NSW*. Unpublished report for Cultural Resources Management on behalf of Leighton Properties.

Austral Archaeology Pty Ltd. (2011). *Windsor Museum, NSW: Aboriginal Archaeological and Cultural Salvage Excavation AHIP #2119*. Unpublished report for Hawkesbury City Council.

Australian Museum Business Services. (2000). *Mungerie Park Town Centre: Archaeological Salvage Excavations near Kellyville, Cumberland Plain, NSW*.

Australian Museum Business Services. (2002). *Western Sydney Orbital (WSO) Plumpton Ridge Archaeological Test Excavations*. Sydney: Unpublished report for Roads and Traffic Authority.

Baker Archaeology Pty Ltd. (2019). *Aboriginal Cultural Heritage Assessment Report University of Sydney lands at Badgerys Creek, NSW DRAFT*.

Baker, N. (1996). *Archaeological Test Excavations at Plumpton Ridge, Proposed Sydney Orbital Road*

Route EIS. Unpublished report for Robynne Mills and Sinclair Knight Pty Ltd.

Balek, C. L. (2002). Buried Artifacts in Stable Upland Sites and the Role of Bioturbation: A Review. *Geoarchaeology*, *17*(1), 41–51.

Bannerman, S. M., & Hazelton, P. A. (1990). *Soil Landscapes of the Penrith 1:100 000 Sheet*. Sydney: Soil Conservation Service of NSW.

Bannerman, S. M., & Hazelton, P. A. (2011). *Soil Landscapes of the Penrith 1:100 000 Sheet*. Sydney: Soil Conservation Service of NSW.

Barham, T. (2005). *A Preliminary Geoarchaeological Assessment of the Archaeological Potential of the Area Mapped as Quaternary Alluvium on the Eastern Margins of Ropes Creek Based on Observations of Geotechnical Test Pits*. Unpublished report for Marys Dallas Consulting Archaeologists.

Barham, T. (2007). *Eastern Creek Geoarchaeological Model and Strategy Assessment, Interpretation and Strategic Conservation of the Archaeological Resource*. Unpublished report for Hyder Consulting.

Barry, F. (2005). *It's Not Set in Stone: A Landscape Approach to Archaeology in the Cumberland Plain: Investigations from the Western Sydney Orbital (WSO/Westlink M7)*. Sydney University.

Beaton, J. M. (1985). Evidence for a Coastal Occupation Time-Lag at Princess Charlotte Bay (North Queensland) and Implications for Coastal Colonization and Population Growth Theories for Aboriginal Australia. *Archaeology in Oceania*, *20*, 1–20.

Bickford, A., & Sullivan, S. (1984). Assessing the research significance of historic sites. In S. Sullivan & S. Bowdler (Eds.), *Site survey and significance assessment in Australian Archaeology* (1st ed., pp. 19–26). Canberra: Australian Institute of Aboriginal Affairs.

Binns, R. A., & McBryde, I. (1972). *A Petrological Analysis of Ground-Edge Artefacts from Northern New South Wales*. Canberra: Australian Institute of Aboriginal Studies.

Biosis Research Pty Ltd. (2008). *Rosehill Recycled Water Scheme: Aboriginal Archaeological and Cultural Heritage Assessment*. Unpublished report for Jemena Management Pty Ltd.

Biosis Research Pty Ltd. (2016). *Mamre West Precinct, Orchard Hills: Archaeological Report*.

Bowdler, S. (1981). Unconsidered Trifles? Cultural Resource Management, Environmental Impact Statements and Archaeological Research in New South Wales. *Australian Archaeology*, *12*.

Bowler, J., Jones, R., Allen, H., & Thorne, A. (1970). Pleistocene Human Remains From Australia: A Living Site and Human Cremation from Lake Mungo, Western New South Wales. *World Archaeology*, *2*, 29–60.

Brayshaw, H. (1995). *Elizabeth Drive Upgrade Environmental Impact Statement Archaeological Survey for Aboriginal Sites*. Unpublished report to the NSW Roads & Traffic Authority.

Brayshaw McDonald Pty Ltd. (1992). *Archaeological Survey of the Proposed 33kV Transmission Line Between Bringelly and Rossmore, NSW*. Unpublished report for EDAW Australia.

Brumm, A., & Moore, M. W. (2005). Symbolic Revolutions and the Australian Archaeological Record. *Cambridge Archaeological Journal*, *15*(02), 157–175.

Burke, H., & Smith, C. (2004). *The Archaeologist's Field Handbook*. Sydney: Allen & Unwin.

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

Corkill, T. (1997). Red, Yellow and Black: Colour and Heat in Archaeological Stone. *Australian Archaeology*, *45*, 54–55.

Corkill, T. (1999). *Here and There: Links Between Stone Sources and Aboriginal Archaeological Sites in Sydney, Australia*. Unpublished M.Phil thesis, University of Sydney.

Corkill, T. (2005). Sourcing Stone from the Sydney Region: A Hatchet Job. *Australian Archaeology*, *60*, 41–50.

Coutts, P. J. F., & Witter, D. C. (1977). Summer Field Programme of the Victoria Archaeological

Survey. *Australian Archaeology*, *6*.

Cowan, F. L. (1999). Making Sense of Flake Scatters: Lithic technological Strategies and Mobility. *American Antiquity*, *64*(4), 593–607.

Craib, J. ., Bonhomme, T., Mangold, G. R., & Williams, S. S. (1999). *Archaeological Salvage Excavations at Site RS1 (45-5-982), Regentville, Western Sydney: Final Report*. Unpublished report for TransGrid.

Dallas, M. (1982). *An Archaeological Survey at Riverstone, Schofields and Quakers Hill, N.S.W.* Unpublished report for Land Commission of NSW.

Dallas, M. (1988). *Preliminary archaeological study of the Luddenham Equestrian Centre, Luddenham Road, Erskine Park, NSW*.

Dallas, M., & Smith, L. (1988). *Appendix C: Site Investigations at the Luddenham Equestrian Centre, Erskine Park, NSW.* Report to the Signature Corporation Australia Limited.

Dallas, M., & Witter, D. C. (1983). *Investigation of an Aboriginal Open Site at Plumpton, NSW*. Unpublished report for Land Commission of NSW.

Dean-Jones, P. (1991). *Proposed Clay/Shale Extraction, Lot 3 DP 623799, Adams Road, Luddenham Archaeological Survey*.

Dean-Jones, P., & Mitchell, P. B. (1993). *Hunter Valley Aboriginal Sites Assessment Project. Environmental Modelling for Archaeological Site Potential in the Central Lowlands of the Hunter Valley.* Unpublished report for NSW National Parks and Wildlife Service.

Department of Infrastructure and Regional Development. (2016). *Western Sydney Airport - Environmental Impact Statement*.

Doelman, T. (2008). *Time to Quarry: The Archaeology of Stone Procurement in Northwestern New South Wales, Australia* (BAR Intern). Oxford: Archaeopress.

Douglas, P., & McDonald, J. (1993). *Archaeological Investigation of RH/CD5, PAD17 (RH/CD10) and PAD 18 (RH/CD6) at Rouse Hill, NSW: Test Excavation Report*. Unpublished report for Rouse Hill (Stage 1) Pty Ltd.

Ebert, J. I. (1992). *Distributional Archaeology*. Albuquerque: University of New Mexico Press.

Eco Logical Australia. (2011). *Box Hill Precinct Planning Study - Biodiversity Assessment*. Unpublished report for NSW Department of Planning.

Environmental Resources Management Australia Pty Ltd. (2003). *Aboriginal and Historic Heritage Assessment - Claremont Meadows*. Unpublished report for Land Solutions.

Environmental Resources Management Australia Pty Ltd. (2006a). *Aboriginal Archaeological Salvage Excavation Report of Aboriginal Site OAD1 at Claremont Meadows*. Unpublished report for Landcom.

Environmental Resources Management Australia Pty Ltd. (2006b). *Lots 8, 10, 11 (DP27107) & Lot 19 (DP239091), Caddens Road, Claremont Meadows, Heritage Assessment*. Unpublished report for Landcom.

Environmental Resources Management Australia Pty Ltd. (2010). *Claremont Meadows South West 1, Section 90 Excavation, Aboriginal Heritage Excavation Report*. Unpublished report for Investa Property Group.

Fanning, P. C., & Holdaway, S. J. (2004). Artifact Visibility at Open Sites in Western New South Wales, Australia. *Journal of Field Archaeology*, *29*, 255–271.

Fanning, P. C., Holdaway, S. J., & Rhodes, E. (2008). A New Geoarchaeology of Aboriginal Artefact Deposits in Western NSW, Australia: Establishing Spatial and Temporal Geomorphic Controls on the Surface Archaeological Record. *Geomorphology*, *101*(3), 524–532. https://doi.org/10.1016/j.geomorph.2007.04.027

Fanning, P. C., Holdaway, S. J., Rhodes, E. J., & Bryant, T. G. (2009). The Surface Archaeological Record in Arid Australia: Geomorphic Controls on Preservation, Exposure, and Visibility. *Geoarchaeology*, *24*(2), 121–146.

Foley, R. (1981). *Off-site Archaeology and Human Adaption in Eastern Africa. An Analysis of Regional Artefact Density in the Amboseli, Southern Kenya* (BAR Intern). Oxford: British Archaeological Reports.

GML Heritage Pty Ltd. (2012). *East Leppington Aboriginal Archaeological Technical Report*. Unpublished report for Stockland Development.

GML Heritage Pty Ltd. (2013). *Defence Establishment Orchard Hills, NSW: Heritage Management Plan*.

GML Heritage Pty Ltd. (2016). *East Leppington Open Area Archaeological Excavation Report*. Unpublished report for Stockland Development Pty Ltd.

Godwin, L. (2011). The Application of Assessment of Cumulative Impacts in Cultural Heritage Management: A Critique. *Australian Archaeology*, *73*(73), 88–91.

Gould, R. (1969). Puntutjarpa Rockshelter: A Reply to Messrs Glover and Lampert. *Archaeology and Physical Anthropology in Oceania*, *4*, 229–237.

Grave, P., Attenbrow, V., Sutherland, L., Pogson, R., & Forster, N. (2012). Non-Destructive PXRF of Mafic Stone Tools. *Journal of Archaeological Science*, *39*(6), 1674–1686. https://doi.org/10.1016/j.jas.2011.11.011

Haglund, L. (1978). *Major Airport Needs of Sydney Study: Survey of Aboriginal Sites and Relics*. Unpublished report to MANS Committee.

Hanrahan, J. (1981). *Report on Proposed Subdivision at South Werrington, Near Penrith*. Unpublished report for the Housing Commission of NSW.

Helen Brayshaw Heritage Consultants. (1996). *M4 Upgrade, Archaeological Survey for Aboriginal Sites for Proposal to Upgrade the M4 Motorway from Church Street Parramatta to Coleman Street, Marys Hill and Prospect to Emu Plains*. Unpublished report for SWR Constructors Pty Ltd.

Hiscock, P. (1986). *A Technological Analysis of Stone Artefact Assemblages from the Hunter River Valley Region. NSW National Parks and Wildlife Service Hunter Valley Region Archaeology Project: Stage 1. Vol 4a.* Unpublished report for the NSW National Parks and Wildlife Service.

Hiscock, P. (1993a). Bondian Technology in the Hunter Valley, New South Wales. *Archaeology in Oceania*, *28*, 65–76.

Hiscock, P. (1993b). The Distribution of Points Within Nauwalabila 1. *The Beagle*, (10), 173–178.

Hiscock, P. (1994). Technological Responses to Risk in Holocene Australia. *Journal of World Prehistory*, *8*(3), 267–292.

Hiscock, P. (2002). Pattern and Context in the Holocene Proliferation of Backed Artefacts in Australia. In R. Elston & S. Kuhn (Eds.), *Thinking Small: Global Perspectives on Microlithization* (pp. 163–177). Archaeological Papers of the American Anthropological Association.

Hiscock, P. (2005). Artefacts on Aru: Evaluating the Technological Sequences. In S. O'Connor, M. Spriggs, & P. Veth (Eds.), *The Archaeology of the Aru Islands, Eastern Indonesia* (pp. 205–234). Canberra: Pandanus Books.

Hiscock, P. (2006). Blunt and to the Point: Changing Technological Strategies in Holocene Australia. In I. Lilley (Ed.), *Archaeology of Oceania: Australia and the Pacific Islands* (pp. 69–95). Oxford: Blackwell.

Hiscock, P. (2008). *Archaeology of Ancient Australia*. London: Routledge.

Hiscock, P., & Attenbrow, V. (1998). Early Holocene Backed Artefacts From Australia. *Archaeology in Oceania*, *33*(2), 49–63.

Hiscock, P., & Attenbrow, V. (2004). A Revised Sequence of Backed Artefact Production at Capertee 3. *Archaeology in Oceania*, *39*(2), 49–63.

Hofman, J. L. (1986). Vertical Movement of Artifacts in Alluvial and Stratified Deposits. *Current Anthropology*, *27*(2), 163–171.

Holdaway, S. J. (1993). *Hunter Valley Aboriginal Sites Assessment Project Archaeological Assessment Standards and Methodological Design*. Unpublished report for NSW National Parks and Wildlife service.

Holdaway, S. J., Fanning, P., & Witter, D. C. (2000). Prehistoric Aboriginal Occupation of the Rangelands: Interpreting the Surface Archaeological Record of Far Western NSW. *The Rangeland Journal*, *22*(1), 44–57.

Holdaway, S. J., & Stern, N. (2004). *A Record in Stone: The Study of Australia's Flaked Stone Artefacts*. Canberra: Aboriginal Studies Press.

Holdaway, S. J., Witter, D. C., & Fanning, P. (1998). New Approaches to Open Site Spatial Archaeology in Sturt National Park, New South Wales, Australia. *Archaeology in Oceania*.

ICOMOS (Australia). (2013). *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. Retrieved from Australia ICOMOS website: http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf

Jacobs. (2020). *M12 Motorway Amendment Report – Appendix E Aboriginal heritage supplementary technical memorandum*.

JAJV. (2019). *M12 Motorway Concept Design and Environmental Impact Assessment - Archaeological Assessment Report DRAFT*.

Jo McDonald Cultural Heritage Management Pty Ltd. (1997a). *Archaeological Salvage of Site RMI at Richmond, NSW: Test and Salvage Excavation Report*. Unpublished report for Restifa & Partners.

Jo McDonald Cultural Heritage Management Pty Ltd. (1997b). *Interim Heritage Management Report: ADI Site St Marys. Volume 1 - Test Excavation Report*. Unpublished report for Lend lease - ADI Joint Venture.

Jo McDonald Cultural Heritage Management Pty Ltd. (2000). *Archaeological Survey For Aboriginal Sites : Proposed Light Industrial Subdivision, "Austral Site", Mamre Road, Erskine Park, NSW*.

Jo McDonald Cultural Heritage Management Pty Ltd. (2001a). *Salvage Excavations of Six Sites along Caddies, Second Ponds, Smalls and Cattai Creeks in the Rouse Hill Development Area, NSW*. Unpublished report for Rouse Hill Infrastructure Consortium.

Jo McDonald Cultural Heritage Management Pty Ltd. (2001b). *Survey for Aboriginal Sites, 1503 Elizabeth Drive, Kemps Creek, NSW, October 2001*.

Jo McDonald Cultural Heritage Management Pty Ltd. (2002a). *Archaeological Excavations at Balfour Drive, Kellyville, NSW (Site RH/SC5). Archaeological Salvage Programme Prior to Residential Development*. Unpublished report for Mepstead & Associates on behalf of Bake Investments Pty Ltd and Cardno BLH Pty Ltd.

Jo McDonald Cultural Heritage Management Pty Ltd. (2002b). *Archaeological Excavations at Windsor Road, Kellyville, NSW (Site RH/CD12: NPWS #45-5-962).* Unpublished report for Australand Holdings Pty Ltd.

Jo McDonald Cultural Heritage Management Pty Ltd. (2003). *Archaeological Salvage Excavations at the proposed Xavier College: Site ADI 47+48 (NPWS #45-5-1048), Ninth Avenue, Llandilo, NSW*. Unpublished report for PMDL on behalf of the Catholic Education Office, Diocese of Parramatta, NSW.

Jo McDonald Cultural Heritage Management Pty Ltd. (2005a). *Archaeological Salvage Excavation of Eight Archaeological Landscapes in the Second Ponds Creek Valley, Rouse Hill Development Area, NSW*. Unpublished report for Rouse Hill Infrastructure Pty Ltd and Landcom.

Jo McDonald Cultural Heritage Management Pty Ltd. (2005b). *Archaeological Salvage Excavation of Site CG1 (NPWS #45-5-2648), at the Corner of Charles & George Streets, Parramatta, NSW*. Unpublished report for Meriton Apartments Pty Ltd.

Jo McDonald Cultural Heritage Management Pty Ltd. (2005c). *Archaeological Salvage Excavation of Site RTA-G1, 109-113 George Street, Parramatta, NSW*. Sydney: Unpublished report for Landcom.

Jo McDonald Cultural Heritage Management Pty Ltd. (2006a). *Archaeological Salvage Excavation at the St Marys Project Eastern Precinct: Site ADI:EPI (NPWS #45-5-2994)*. Unpublished report for Lend Lease.

Jo McDonald Cultural Heritage Management Pty Ltd. (2006b). *Archaeological Salvage Excavation of Site CG3: 101a-105 George Street, Parramatta, NSW*. Unpublished report for Rahi Developments Ltd.

Jo McDonald Cultural Heritage Management Pty Ltd. (2006c). *Archaeological Salvage Excavation of the Colebee Release Area, Schofields, NSW: Volume 1*. Unpublished report for Medallist Gold Holdings Pty Ltd.

Jo McDonald Cultural Heritage Management Pty Ltd. (2007). *Salvage Excavation of Four Archaeological Sites in the Caddies Creek Precinct, Rouse Hill Regional Centre, NSW*. Unpublished report for Lend Lease GPT (Rouse Hill) Pty Ltd.

Jo McDonald Cultural Heritage Management Pty Ltd. (2008a). *Archaeological Salvage at ADI-FF22: The ADI Eastern Precinct Fauna Fence, St Marys*. Unpublished report for Delfin Lend Lease.

Jo McDonald Cultural Heritage Management Pty Ltd. (2008b). *Assessment of Aboriginal Heritage, Lot 2, DP 771679 Gipps Street, Claremont Meadows*.

Jo McDonald Cultural Heritage Management Pty Ltd. (2008c). *Austral Land Mamre Rd, Erskine Park: Archaeological Salvage Excavations*. Unpublished report for Macquarie Goodman.

Jo McDonald Cultural Heritage Management Pty Ltd. (2009a). *Archaeological Subsurface Investigations at the Cadden's Release*. Unpublished report for Landcom.

Jo McDonald Cultural Heritage Management Pty Ltd. (2009b). *Archaeological Subsurface Investigations at WP3 and WP4 - Western Precinct St Mary's Development Site,*. Unpublished report for Marylands Development Company.

Johnson, D. L. (1989). Subsurface Stone Lines, Stone Zones, Artifact-Manuport Layers, and Biomantles Produced by Bioturbation via Pocket Gophers (Thomomys Bottae). *American Antiquity*, *54*(2), 370–389.

Johnson, D. L., Domier, J. E. J., & Johnson, D. N. (2005). Reflections on the Nature of Soil and Its Biomantle. *Annals of the Association of American Geographers*, *95*(1), 11–31.

Jones, R., & White, N. (1988). Point Blank: Stone Tool Manufacture at the Ngilipitji Quarry, Arnhem Land 1981. In B. Meehan & R. Jones (Eds.), *Archaeology with Ethnography: An Australian Perspective* (pp. 51–87). Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.

Kelleher Nightingale Consulting Pty Ltd. (2009). *Marsden Park Industrial Precinct: Aboriginal Heritage Assessment.* Unpublished report to NSW Department of Planning.

Kelleher Nightingale Consulting Pty Ltd. (2012). *Werrington Arterial Road M4 Motorway to Great Western Highway Cultural Heritage Assessment Report*. Unpublished report for Roads and Maritime Services.

Kelleher Nightingale Consulting Pty Ltd. (2013a). *M4 Managed Motorway from Lapstone (Western End) to Strathfield (Eastern End). Review of Environmental Factos: Aboriginal Archaeological Survey Report*.

Kelleher Nightingale Consulting Pty Ltd. (2013b). *Sydney Science Park Planning Proposal: Aboriginal Heritage Assessment. Report to APP Corporation Pty Ltd*.

Kelleher Nightingale Consulting Pty Ltd. (2016a). *M4 Managed Motorway, from Lapstone (Western End) to Church Street, Parramatta (Eastern End). Review of Environmental Factors: Cultural Heritage Assessment Report*.

Kelleher Nightingale Consulting Pty Ltd. (2016b). *The Northern Road Upgrade Stage 3 Jamison Road , Penrith to Glenmore Parkway , Glenmore Park Aboriginal Cultural Heritage Assessment Report*. Unpublished report for Roads and Maritime Services.

Kelleher Nightingale Consulting Pty Ltd. (2018a). *Sydney Science Development Luddenham, NSW Aboriginal Archaeological Assessment Test Excavation Report*.

Kelleher Nightingale Consulting Pty Ltd. (2018b). *Sydney Science Park Development Luddenham, NSW Cultural Heritage Assessment Report*.

Koettig, M., & Hughes, P. J. (1995). *Test Excavations at RS1 Regentville near Penrith on the Cumberland Plain*. Unpublished report for Pacific Power.

Kohen, J. (1986). *Prehistoric Settlement in the Western Cumberland Plain: Resources, Environment and Technology*. Macquarie University, Sydney.

Kohen, J. (1988). The Dharug of the Western Cumberland Plain: Ethnography and Demography. In B. Meehan & R. Jones (Eds.), *Archaeology with Ethnography: An Australian Perspective* (pp. 238–250). Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.

Kohen, J., & Lampert, R. (1987). Hunters and Fishers in the Sydney Region. In D. J. Mulvaney & J. P. White (Eds.), *Australians to 1788* (1st ed., pp. 343–365). Sydney: Fairfax, Syme & Weldon Associates.

Kohen, J., Stockton, E., & Williams, M. (1984). Shaws Creek KII Rockshelter: A Prehistoric Occupation Site in the Blue Mountains Piedmont, Eastern New South Wales. *Archaeology in Oceania*, *19*(2), 57–73.

Kuskie, P. J. (2000). An Aboriginal Assessment of the Proposed Mount Arthur North Coal Mine, Near Muswellbrook, Hunter Valley, New South Wales. In HLA-Envirosciences Pty. Ltd. (Ed.), *Environmental Impact Statement and Statement of Environmental Effects, Proposed Jerrys Plains Coal Terminal, Rail Spur and Associated Infrastructure.* Canberra: Report prepared by South Eastern Archaeology to Umwelt (Australia) Pty. Ltd.

Lance, A., & Hughes, P. J. (1984). *Second Sydney Airport Aboriginal Archaeological Study: Badgerys Creek/Wilton*. Unpublished report to Kinhill Stearns pty Ltd.

Long, A. (2003). *Scarred Trees: An Identification and Recording Manual*. Prepared for Aboriginal Affairs Victoria.

Lourandos, H. (1983). Intensification. A Late Pleistocene-Holocene Archaeological Sequence from Southwestern Victoria. *Archaeology in Oceania*, *18*, 81–94.

Lourandos, H. (1997). *Continent of Hunter-Gatherers. New Perspectives in Australian Prehistory*. Cambridge: Cambridge University Press.

Lourandos, H., & Ross, A. (1994). The Great “Intensification Debate”: Its History and Place in Australian Archaeology. *Australian Archaeology*, *39*, 54–63.

MacDonald, K., & Davidson, I. (1998). *Bayswater Archaeological Research Project: Volume 1*. Armidale: School of Human and Environmental Studies, University of New England.

Matthiesen, H. (2004). In Situ Measurement of Soil pH. *Elsevier*, *31*(10), 1373–1381. Retrieved from https://doi.org/10.1016/j.jas.2004.03.005

McBryde, I. (1973). Stone Arrangements and a Quartzite Quarry at Brewarrina. *Mankind*, *9*, 118–121.

McBryde, I. (1984). Kulin Greenstone Quarries: The Social Contexts of Production and Distribution for the Mt William site. *World Archaeology*, *16*(2), 267–285.

McCarthy, F. D. (1948). The Lapstone Creek Excavation: Two Culture Periods Revealed in Eastern New South Wales. *Records of the Australian Museum*, *22*(1), 1–34.

McCarthy, F. D. (1964). The Archaeology of the Capertee Valley, New South Wales. *Records of the Australian Museum*, *26*(6), 197–264.

McCarthy, F. D. (1967). *Australian Aboriginal Stone Implements* (2nd Ed.). Sydney: The Australian Museum Trust.

McDonald, J. (1986). *Preliminary Archaeological Reconnaissance of the Proposed Schofields Regional Depot, Plumpton, N.S.W.* Unpublished report for the Metropolitan Waste Disposal Authority.

McDonald, J. (1993). *Excavation of Two Sites on Eastern Creek (PB1 and PB2), Doonside*. Unpublished report for Blacktown City Council.

McDonald, J. (1996). The Conservation of Landscapes: A Strategic Approach to Cultural Heritage Management. In S. Ulm, I. Lilley, & A. Ross (Eds.), *Australian Archaeology '95: Proceedings of the 1995 Australian Archaeological Association Annual Conference* (Tempus 6, Vol. 6, pp. 113–121). Brisbane: Anthropology Museum, University of Queensland.

McDonald, J. (2008). *Dreamtime Superhighway: Sydney Basin Rock Art and Prehistoric Information Exchange*. Canberra: Australian National University Press.

McDonald, J., Mitchell, P., & Rich, E. (1996). *A Further Investigation of Site RS1 (#45-5-892) at Regentville, Mulgoa Creek, Western Sydney, NSW.* Unpublished report for Pacific Power.

McDonald, J., & Rich, E. (1994). The Discovery of a Heat Treatment Pit on the Cumberland Plain, Western Sydney. *Australian Archaeology*, (38), 46–47.

McDonald, R. C., & Isbell, R. F. (2009). Soil Profile. In *Australian Soil and Land Survey Field Handbook* (Third Edit, pp. 147–200). Collingwood: CSIRO Publishing.

McNiven, I. (1992). Shell Middens and Mobility: The Use of Off-Site Faunal Remains, Queensland, Australia. *Journal of Field Archaeology*, *19*(4), 495–508.

Mitchell, P. (2010). *Geomorphology and soils in relation to archaeological investigations on the Cranebrook Terrace, Penrith lakes, NSW*.

Mitchell, P. B. (2002). *Geomorphology and Pedology of Plumpton Ridge at the Western Sydney Orbital Crossing*. Unpublished report for Australian Museum Business Service.

Mitchell, P. B. (2005). *Geology, Geomorphology and Pedology of the Schofields Project Site, Plumpton Ridge, Colebee, Western Sydney*. Unpublished report to Jo McDonald Cultural Heritage Management P/L.

Mitchell, P. B. (2009). *Soil Materials and Landscape Disturbance on the Southwestern Sector of the ADI Site at St Marys in Relation to Aboriginal Archaeological Investigations*. Unpublished report for Jo McDonald CHM.

Moore, M. W. (2000). Technology of Hunter Valley microlith assemblages, New South Wales. *Australian Archaeology*, *51*, 28–39.

Moore, M. W. (2013). Simple Stone Flaking in Australasia: Patterns and Implications. *Quaternary International*, *285*, 140–149.

Mulvaney, D. J., & Kamminga, J. (1999). *The Prehistory of Australia*. Crows Nest: Allen & Unwin Pty Ltd.

Nanson, G. C., Young, R. W., & Stockton, E. (1987). Chronology and Palaeoenvironment of the Cranebrook Terrace (near Sydney) Containing Artefacts More than 40,000 Years Old. *Archaeology in Oceania*, *22*, 72–78.

National Heritage Studies Pty Ltd. (1990). *Report on Test Excavations at Schofields, N.S.W.* A Report to R.W. Corkery and Co.

Navin Officer Heritage Consultants Pty Ltd. (1997). *Technical Paper No. 11 Aboriginal Cultural Heritage*.

Navin Officer Heritage Consultants Pty Ltd. (2015). *Western Sydney Airport - Aboriginal Cultural Heritage Assessment*. Unpublished report for GHD.

Navin Officer Heritage Consultants Pty Ltd. (2017). *Initial Survey and Salvage Plan Western Sydney Airport - Enabling Activities Aboriginal Cultural Heritage Management Plan*.

NSW Department of Environment Climate Change & Water. (2010). *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Department of Environment, Climate Change and Water.

NSW Office of Environment & Heritage. (2011). *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*. Office of Environment and Heritage.

Paton, T. R., Humphreys, G. S., & Mitchell, P. B. (1995). *Soils: A New Global View*. London: UCL Press.

Peacock, E., & Fant, D. W. (2002). Biomantle Formation and Artifact Translocation in Upland Sand Soils: An Example from the Holly Springs National Forest, North-Central Mississippi, U.S.A. *Geoarchaeology*, *17*(1), 91–114.

Pearson, M., & Sullivan, S. (1995). *Looking After Heritage Places: The Basics of Heritage Planning for Managers, Landowners and Administrators*. Carlton: Melbourne University Press.

Przywolnik, K. (2007). *The Western Sydney Regional Aboriginal Heritage Study.* Unpublished report to DECCW.

Rhoads, J.W.; Dunnett, G. (1985). *Aboriginal Resources Planning Study: City of Penrith*. Unpublished report prepared for the National Parks and Wildlife Service of New South Wales.

Roads and Maritime Services. (2019a). *M12 Motorway Aboriginal Cultural Heritage Assessment Report*. Retrieved from https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSI-9364%2120191004T003628.449 GMT

Roads and Maritime Services. (2019b). *M12 Motorway Environmental Impact Statement - Appendix I Aboriginal Cultural Heritage Assessment*. Unpublished report.

Robins, R. (1997). Patterns in the Landscape: A Case Study in Nonsite Archaeology from Southwest Queensland. *Memoirs of the Queensland Museum, Cultural Heritage Series*, *1*(1), 23–56.

Ross, A. (1976). *Inter-Tribal Contacts: What the First Fleet Saw*. University of Sydney.

Ross, A. (1988). Tribal and Linguistic Boundaries in Sydney at the Time of First British Settlement: A Reassessment of the Evidence. In G. Aplin (Ed.), *A Difficult Infant: Sydney Before Macquarie* (pp. 42–53). Sydney: University of New South Wales Press.

Shiner, J. (2008). *Place as Occupational Histories: An Investigation of the Deflated Surface Archaeological Record of Pine Point and Langwell Stations, Western New South Wales, Australia* (BAR Intern). Oxford: Archaeopress.

Smith, C., & Burke, H. (2007). *Digging It Up Down Under: A Practical Guide to Doing Archaeology in Australia*. New York: Springer.

Smith, L. (1988). *Aboriginal Site Planning Study in the Sydney Basin Stage 1: The Cumberland Plain - Interim Report: Site Survey and Site Analysis on the Northern Cumberland Plain*. Sydney: Unpublished report for NSW National Parks and Wildlife Service.

Steele, D. (1999). *Archaeological Survey Report for land between Luddenham & Mamre Roads, Luddenham, NSW*. Unpublished report prepared for Camelot Grange Pty Ltd.

Steele, D. (2001). *Preliminary Archaeological Test Excavation Project within Land Between Luddenham and Mamre Roads*. Unpublished report for Camelot Grange Pty Ltd.

Steele, D. (2004). *Aboriginal Heritage Conservation Action Plan. Application for a Section 90 Heritage Impact Permit (Consent with Salvage & Collection). Twin Creeks Estate, Luddenham Road, Luddenham, NSW*. Unpublished report for Luddenham Management Pty Ltd.

Steele, D. (2007). *Aboriginal Archaeological Excavation & Monitoring Report: Twin Creeks Estate, Luddenham Road*. Unpublished report for Luddenham Management Pty Ltd.

Stein, J. K. (1983). Earthworm Activity: A Source of Potential Disturbance of Archaeological Sediments. *American Antiquity*, *48*(2), 277–289.

Streat, B., & Pavinich, Y. (2018). *Aboriginal Test Excavation Report Lot 2 Section 4 DP 2954 111-1141 Elizabeth Drive, Cecil Park, NSW (Fairfield LGA)*.

Sydney Metro (2020). *Sydney Metro Greater West Technical paper 3: Biodiversity Development Assessment Report*.

Thorp, W. (1986). *The Penrith Heritage Study – The Historical Archaeology Component*.

Tozer, M. (2003). The Native Vegetation of the Cumberland Plain , Western Sydney: Systematic Classification and Field Identification of Communities. *Cunninghamia*, *8*(1), 1–75.

URS Australia Pty Ltd. (2001). *Gipps Street Landfill Rehabilitation Proposal: Environmental Impact Statement, Werrington, NSW*.

Walker, F. (1906). Penrith and district: some items of Early Australian history. *Journal and Proceedings of the Royal Australian Historical Society*, *2*, 43–48.

Western Sydney Airport. (2019). *Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan*.

White, B., & McDonald, J. (2010). Lithic Artefact Distribution in the Rouse Hill Development Area, Cumberland Plain, New South Wales. *Australian Archaeology*, (70), 29–38.

White, E. (1997). *Knapping Floors in the Central Hunter Lowlands, NSW*. Unpublished manuscript.

Williams, A. N., Atkinson, F., Lau, M., & Toms, P. S. (2014). A Glacial Cryptic Refuge in South-East Australia: Human Occupation and Mobility from 36,000 years ago in the Sydney Basin, New South Wales. *Journal of Quaternary Science*, *29*(8), 735–748.

Williams, A. N., Mitchell, P., Wright, R., & Toms, P. (2012). A Terminal Pleistocene Open Site on the Hawkesbury River, Pitt Town NSW. *Australian Archaeology*, *85–97*.

WSA Co. (2018). *Western Sydney Airport Construction Environmental Management Plan Aboriginal Cultural Heritage Construction Environmental Management Plan*.

Appendix A

Plates

45-5-2027 artefacts

45-5-2365 artefacts

45-5-5298 artefacts

45-5-5298 artefacts

SMWSA-AS1 artefacts

SMWSA-AS1 artefacts

SMWSA-AS1 artefacts

SMWSA-AS1 artefacts

SMWSA-AS1 site area

SMWSA-AS2 artefacts

SMWSA-AS3 artefacts

SMWSA-AS4 artefacts

SMWSA-AS5 artefacts

SMWSA-AS5 artefacts

SMWSA-AS5 site area

SMWSA-AS6 artefacts

SMWSA-AS6 artefacts

SMWSA-AS6 artefacts

SMWSA-AS6 site area

SMWSA-AS7 artefacts

SMWSA-AS8 artefacts

SMWSA-IA1 artefacts

SMWSA-IA2 artefacts

SMWSA-IA3 artefacts

	
Survey	Survey
	
Survey	Survey
	
Sieve station	Survey
	
Survey	Survey

Test Pit 27

Test Pit 28

Test Pit 29

Test Pit 30

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Test Pit 32

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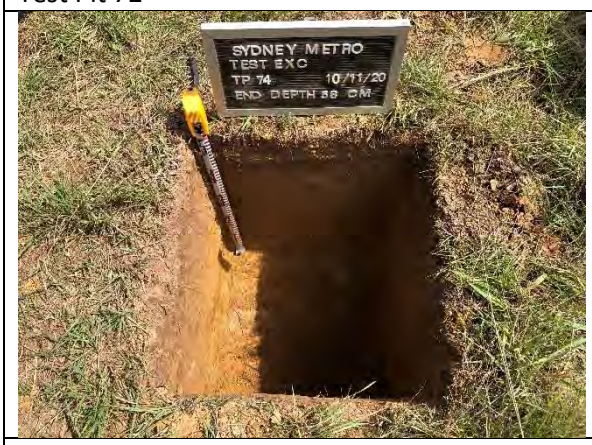

Test Pit 74

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Appendix B

AHIMS search results

Appendix B AHIMS search results

This appendix has been removed for the public version of this report.

Appendix C

AHIMS site card summaries

Appendix C AHIMS site card summaries

This appendix has been removed for the public version of this report.

Appendix D

Previous and current AHIPs

Appendix D Previous and current AHIPs

This appendix has been removed for the public version of this report.

Appendix E

Test pit descriptions

Appendix E Test pit descriptions

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