CHATSWOOD TO SYDENHAM

ENVIRONMENTAL IMPACT STATEMENT

MAY 2016

TECHNICAL PAPER 5: ABORIGINAL HERITAGE – ARCHAEOLOGICAL ASSESSMENT

Sydney Metro Chatswood to Sydenham

Technical paper 5

Aboriginal Heritage – Archaeological Assessment

May 2016

artefact

Artefact Heritage
ABN 73 144 973 526
Level 4, Building B
35 Saunders Street
Pyrmont NSW 2009
Australia

+61 2 9518 8411
office@artefact.net.au

EXECUTIVE SUMMARY

Project overview

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro City & Southwest and Sydney Metro Northwest.

The proposed Sydney Metro City & Southwest comprises two core components:

- The Chatswood to Sydenham project (the project), the subject of this technical paper, would involve construction and operation of an underground rail line between Chatswood and Sydenham
- The Sydenham to Bankstown upgrade would involve the conversion of the 13.5 kilometre Bankstown line to metro standards and upgrade of existing stations between Sydenham and Bankstown.

The Sydenham to Bankstown upgrade will be subject to a separate environmental impact assessment.

Investigations have started on the possible extension of Sydney Metro from Bankstown to Liverpool. The potential extension would support growth in Sydney's south west by connecting communities, businesses, jobs and services as well as improving access between the south west and Sydney's CBD. It would also reduce growth pressure on road infrastructure and the rail network, including the potential to relieve crowding on the T1 Western Line, T2 South Line and T2 Airport Line.

The Sydney Metro Chatswood to Sydenham project (the project) involves the construction and operation of a metro rail line. The project would be mainly located underground in twin tunnels extending from Chatswood on Sydney's north shore, crossing under Sydney Harbour, and continue to Sydenham.

The key components of the project would include:

- About 15.5 kilometres of twin rail tunnels (that is, two tunnels located side-by-side) between Mowbray Road, Chatswood and north of Sydenham Station (near Bedwin Road, Marrickville)
- Realignment of the existing T1 North Shore Line surface track within the existing rail corridor between Chatswood Station and in the vicinity of Brand Street, Artarmon, including a new bridge for a section of the 'down' (northbound) track to pass over the proposed northern dive structure
- About 250 metres of aboveground metro tracks between Chatswood Station and the Chatswood dive structure
- A dive structure (about 400 metres long) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood (the Chatswood dive structure)
- A substation (for traction power supply) at Artarmon
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo; and new underground platforms at Central Station
- A dive structure (about 400 metres long) and tunnel portal between Sydenham Station and Bedwin Road, Marrickville (the Marrickville dive structure)
- A services facility (for traction power supply and an operational water treatment plant) adjacent to the Marrickville dive structure.

The project would also include a number of ancillary components, including new overhead wiring and alterations to existing overhead wiring, signaling, access tracks / paths, rail corridor fencing, noise walls, fresh air ventilation equipment, temporary and permanent alterations to the road network, facilities for pedestrians, and other construction related works.

Approach to Aboriginal heritage assessment

Artefact Heritage has been engaged to prepare an Aboriginal heritage archaeological assessment by the Jacobs / Arcadis / RPS team for inclusion in the environmental impact statement for the project. This assessment has been prepared within the context of the NSW Office of Environment and Heritage (OEH) *'Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation'*[1] and the OEH '*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales'*[2].

The objective of this study is to prepare an Aboriginal heritage archaeological assessment. This report includes the following:

- A description of the project and the extent of the study area
- A description of Aboriginal stakeholder consultation that has been conducted
- Discussion of the environmental context of the study area
- Discussion of the Aboriginal and historical context of the study area
- A summary of the archaeological context of the study area including a discussion of previous archaeological work in the area
- Description and analysis of archaeological potential
- Development of a significance and impact assessment of each portion of the study area
- Development of management and mitigation measures.

Overview of potential impacts

- There are no recorded Aboriginal sites within the study area
- There are seven proposed work sites within the study area (Blues Point temporary site, Barangaroo Station, Martin Place Station, Pitt Street Station, Central Station, Waterloo Station and the Marrickville dive site [southern]) where further archaeological investigation is recommended in areas of archaeological potential where there is a likelihood of natural soil/sand horizons being present.
- There are four proposed work sites within the study area (Chatswood dive site (northern), Artarmon substation, Crows Nest Station and Victoria Cross Station) where there is low archaeological potential and no further archaeological investigation is recommended.
- Works along the proposed power supply routes would involve trenching to a depth of about two metres. In locations where there has been no previous ground disturbance, these activities could affect areas with archaeological potential.

[1] Department of Environment and Conservation 2005
[2] OEH 2010

Summary of mitigation response – Construction

The measures detailed in the table below are proposed to address potential impacts on Aboriginal heritage sites and areas of archaeological potential during construction. They have been developed following consideration of:

- Statutory requirements under the *National Parks and Wildlife Act 1974* as amended.
- The results of the background research, site survey and assessment.
- Consultation with the Metropolitan Local Aboriginal Land Council (MLALC).

Ref	Mitigation measure	Applicable location(s)[1]
AH1	Aboriginal stakeholder consultation would be carried out in accordance with the NSW Office of Environment and Heritage's *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*.	All
AH2	An Aboriginal cultural heritage assessment report would be prepared in accordance with the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*. The Aboriginal cultural heritage assessment report would include: • Details of Aboriginal stakeholder consultation conducted in accordance with AH1 • An assessment of cultural significance for the project area and identification of any specific areas of cultural significance based on consultation with Aboriginal stakeholders • A methodology for archaeological management, including test excavation and salvage (refer to AH3).	All
AH3	Archaeological test excavation (and salvage when required) would be carried out where intact natural profiles with the potential to contain significant archaeological deposits are encountered at the Blues Point temporary site, Barangaroo Station, Martin Place Station, Pitt Street Station, Central Station, Waterloo Station and Marrickville dive site. Excavations would be conducted in accordance with the methodology outlined in the Aboriginal cultural heritage assessment report.	BP, BN, MP, PS, CS, WS and MDS
AH4	Appropriate Aboriginal heritage interpretation would be incorporated into the design for the project in consultation with Aboriginal stakeholders.	All
AH5	Feasible and reasonable mitigation at the ground improvement locations would be identified in consultation with the Office of Environment and Heritage.	GI
AH6	The Aboriginal cultural heritage assessment report would address areas of archaeological potential associated with the power supply routes.	PSR

[1] *STW: Surface track works; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement works; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; MDS: Marrickville dive site; Tunnel: Tunnel not related to other sites (eg. TBM works); PSR: Power supply routes.*

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1.0 INTRODUCTION

1.1 Project background

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro City & Southwest and Sydney Metro Northwest.

The proposed Sydney Metro City & Southwest comprises two core components:

- The Chatswood to Sydenham project (the project), the subject of this technical paper, would involve construction and operation of an underground rail line between Chatswood and Sydenham
- The Sydenham to Bankstown upgrade would involve the conversion of the 13.5 kilometre Bankstown line to metro standards and upgrade of existing stations between Sydenham and Bankstown.

Both components are subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Sydenham to Bankstown upgrade will be subject to a separate environmental impact assessment.

Sydney Metro Northwest (formerly the North West Rail Link) is currently under construction, services will start in the first half of 2019. This includes a new metro rail line between Rouse Hill and Epping and conversion of the existing rail line between Epping and Chatswood to metro standards.

Investigations have started on the possible extension of Sydney Metro from Bankstown to Liverpool. The potential extension would support growth in Sydney's south west by connecting communities, businesses, jobs and services as well as improving access between the south west and Sydney's CBD. It would also reduce growth pressure on road infrastructure and the rail network, including the potential to relieve crowding on the T1 Western Line, T2 South Line and T2 Airport Line.

The Sydney Metro Delivery Office has been established as part of Transport for NSW to manage the planning, procurement and delivery of the Sydney Metro network.

The Sydney Metro rail network is shown in Figure 1.

1.2 The Sydney Metro network

The customer experience underpins how Sydney Metro is being planned and designed. The customer experience incorporates all aspects of travel associated with the transport network, service and project including:

- The decision on how to travel
- The travel information available
- The speed and comfort of the journey
- The range and quantity of services available at stations, interchanges and within station precincts.

A high quality 'door to door' transport product is critical to attract and retain customers and also to meet broader transport and land use objectives. This includes providing a system that is inherently safe for customers on trains, at stations and at the interface with the public domain; providing direct, comfortable, legible and safe routes for customers between transport modes; and provide a clean, pleasant and comfortable environment for customers at stations and on trains.

Key features of the metro product include:

- Comfortable carriages with space for customers to sit or stand
- A 'turn-up-and-go' service, with high frequency trains Reduced journey times with faster trains, and new underground routes through the Sydney CBD
- Increased capacity to safely and reliably carry more customers per hour due to the increased frequency of trains
- Reduced dwell times at stations as each carriage would be single-deck with three doors, allowing customers to board and alight more quickly than they can with double-deck carriages.

The Chatswood to Sydenham project would have the capacity to run up to 30 trains per hour through the Sydney CBD in each direction, which would provide the foundation for delivering a 60 per cent increase in the number of trains operating in peak periods, and cater for an extra 100,000 customers per hour.

Figure 1: The Sydney Metro network

1.3 Overview of the project

1.3.1 Location

The Sydney Metro Chatswood to Sydenham project (the project) involves the construction and operation of a metro rail line. The project would be mainly located underground in twin tunnels extending from Chatswood on Sydney's north shore, crossing under Sydney Harbour, and continue to Sydenham.

1.3.2 Key features

The proposed alignment and key operational features of the project are shown in Figure 2 and would include:

- Realignment of T1 North Shore Line surface track within the existing rail corridor between Chatswood Station and Brand Street, Artarmon, including a new bridge for a section of the 'down' (northbound) track to pass over the proposed northern dive structure
- About 250 metres of aboveground metro tracks between Chatswood Station and the Chatswood dive structure
- A dive structure (about 400 metres long) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood (the Chatswood dive structure)
- About 15.5 kilometres of twin rail tunnels (that is, two tunnels located side-by-side) between Mowbray Road, Chatswood and Bedwin Road, Marrickville. The tunnel corridor would extend about 30 metres either side of each tunnel centre line and around all stations
- A substation (for traction power supply) in Artarmon, next to the Gore Hill Freeway, between the proposed Crows Nest Station and the Chatswood tunnel portal
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo; and new underground platforms at Central Station
- A dive structure (about 400 metres long) and tunnel portal between Sydenham Station and Bedwin Road, Marrickville (the Marrickville dive structure)
- A services facility beside the Marrickville dive structure and tunnel portal, including a tunnel water treatment plant and a substation (for traction power supply).

The project would also include:

- Permanent closure of the road bridge at Nelson Street, Chatswood, and provision of an all vehicle right-turn movement from the Pacific Highway (southbound) into Mowbray Road (westbound)
- Changes to arrangements for maintenance access from Hopetoun Avenue and Albert Avenue, Chatswood as well as a new access point from Brand Street, Artarmon
- Underground pedestrian links at some stations and connections to other modes of transport (such as the existing suburban rail network) and surrounding land uses

- Alterations to pedestrian and traffic arrangements and public transport infrastructure (where required) around the new stations and surrounding Central Station
- Installation and modification of existing Sydney Trains rail systems including overhead wiring, signalling, rail corridor fencing and noise walls, within surface sections at the northern end of the project
- Noise barriers (where required) and other environmental protection measures.

The proposed construction activities for the project broadly include:

- Demolishing buildings and structures at the station sites and other construction sites
- Constructing tunnels, dive structures and tunnel portals
- Excavating, constructing and fitting out metro stations
- Fitting out tunnel rail systems and testing and commissioning of stations, tunnels, ancillary infrastructure, rail systems and trains
- Excavating shafts, carrying out structural work and fitting out ancillary infrastructure at Artarmon
- Carrying out structural work and fitting out ancillary infrastructure at Marrickville.

A number of construction sites would be required to construct the project. These include locations for tunnel equipment and tunnel boring machine (TBM) support at Chatswood, Barangaroo and Marrickville as well as at station sites; a casting yard and segment storage facility at Marrickville and a temporary tunnel boring machine (TBM) retrieval site at Blues Point.

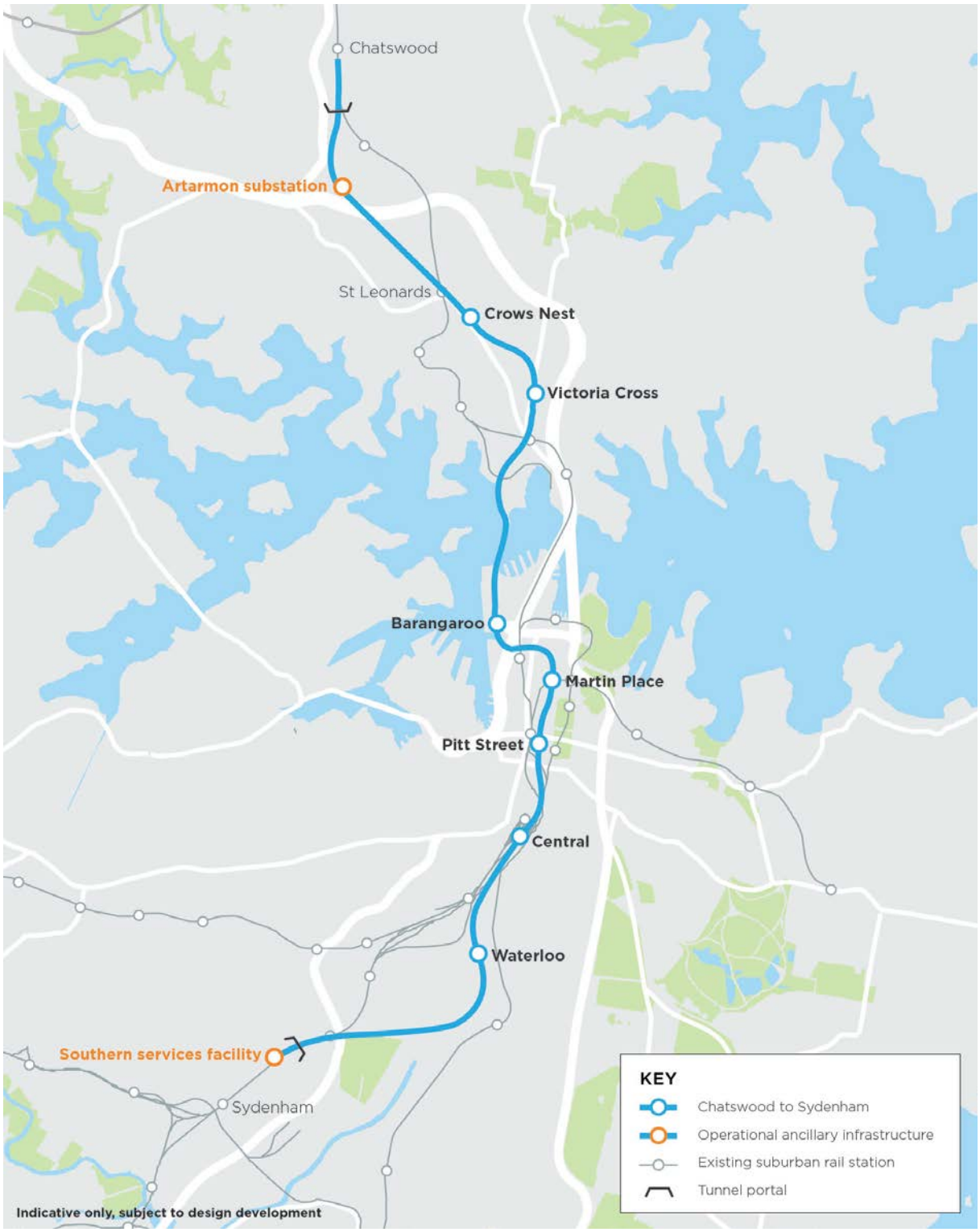
1.4 The study area

For the purpose of this investigation, an 'assessment boundary' has been defined as a 25 metre buffer around each of the sites that incorporates the proposed design footprint and ancillary works, facilities and access ways to each area during construction.

The application of a buffer allows for assessment of any potential design changes and any reference to the 'study area' in the following document is also referring to the 25 metre buffer, unless otherwise stated.

The indicative alignment for the project is shown in Figure 2. The alignment diverts from the North Shore Line rail corridor in the St Leonards area in an underground stratum towards Crows Nest and North Sydney to the east. For the purposes of assessment, works extend from north of the northern dive site at Chatswood to a southern dive site at Marrickville. The alignment extends under Sydney Harbour on the western side of the Sydney Harbour Bridge towards the Sydney CBD, before resurfacing north of Sydenham Station.

Figure 2: The project



1.5 Purpose and scope of this report

This technical paper, Technical Paper 5: Aboriginal Heritage is one of a number of technical documents that forms part of the Environmental Impact Statement.

The purpose of this technical paper is to identify and assess Aboriginal heritage impacts of the project. In doing so, it responds directly to the Secretary's environmental assessment requirements outlined in Section 1.6.

This technical paper has also been prepared within the context of the NSW Office of Environment and Heritage (OEH) *'Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation'*[3] and the OEH '*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales'*[4].

This technical paper includes the following:

- A description of the project and the extent of the study area
- A description of Aboriginal stakeholder consultation that has been conducted
- Discussion of the environmental context of the study area
- Discussion of the Aboriginal and historical context of the study area
- A summary of the archaeological context of the study area including a discussion of previous archaeological work in the area
- Description and analysis of archaeological potential
- Development of a significance assessment and impact assessment of each portion of the study area
- Development of management and mitigation measures.

An outline of the site inspection methodology and significance and impact assessment for each location within the study area is provided below.

[3] Department of Environment and Conservation 2005
[4] OEH 2010

1.6 Secretary's environmental assessment requirements

The Secretary's environmental assessment requirements relating to *Aboriginal Heritage* and where these requirements are addressed in this technical paper are outlined in Table 1.

Table 1: Secretary's environmental assessment requirements – Aboriginal Heritage

Secretary's environmental assessment requirements	Where addressed
The Proponent must identify and assess any direct and/or indirect impacts (including cumulative impacts) to the heritage significance of: (a) Aboriginal places and objects, as defined under the *National Parks and Wildlife Act 1974* and in accordance with the principles and methods of assessment identified in the current guidelines (b) Aboriginal places of heritage significance, as defined in the Standard Instrument – Principal Local Environmental Plan	Section 7.3 – Section 7.14
Where archaeological investigations of Aboriginal objects are proposed these must be conducted by a suitably qualified archaeologist, in accordance with section 1.6 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010).	Section 8.2
Where impacts to Aboriginal objects and/or places are proposed, consultation must be undertaken with Aboriginal people in accordance with the current guidelines.	Section 3.1 Section 8.2

1.7 Study Methodology

1.7.1 Site inspection

Site definition

An Aboriginal site is generally defined as an Aboriginal object or place. An Aboriginal object is the material evidence of Aboriginal land use, such as stone tools, scarred trees or rock art. Some sites, or Aboriginal places can also be intangible and although they might not be visible, these places have cultural significance to Aboriginal people.

OEH guidelines state in regard to site definition that one or more of the following criteria must be used when recording material traces of Aboriginal land use:

- The spatial extent of the visible objects, or direct evidence of their location
- Obvious physical boundaries where present, e.g. mound site and middens (if visibility is good), a ceremonial ground
- Identification by the Aboriginal community on the basis of cultural information.

For the purposes of this study an Aboriginal site, or potential Aboriginal site, was defined by recording the spatial extent of visible traces or the direct evidence of their location.

Survey methodology

A site inspection was conducted with Jay Daley, Culture and Heritage Officer at Metropolitan Local Aboriginal Land Council (MLALC) on Tuesday 8 December 2015 and 3 March 2016 (Blues Point only).

For the purposes of the field survey, each of the accessible components of the study area was designated as a survey unit. All survey units were covered on foot. Areas of surface visibility within the study area were virtually non-existent, with the majority of each survey unit covered by buildings, roads and concrete footpaths. Private property and areas within the rail corridor were not accessed during the survey. Discussions and observations during the survey focussed on archaeological potential and verifying background information on landform context. Although Waterloo was visited during the site inspection and the archaeological potential of the area discussed, the proposed location of Waterloo Station was not inspected as that information was not publically available at the time of the site inspection.

Aerial photographs and topographic maps were carried by the survey team. A photographic record was kept of all sections of the study area. Photographs were taken to document the built environment at each location.

A discussion of the survey results for each accessed portion of the study area is included in the discussion of each study area location.

1.7.2 Discussion of recorded Aboriginal sites and areas of archaeological potential

A discussion of recorded Aboriginal sites, including type and location, is included in the discussion of each study area location.

An assessment of archaeological potential is included in the discussion of each study area location. The assessment of archaeological potential incorporates available information on existing and past structures, including the location of basements and underground car parks that are likely to have removed archaeological deposits.

1.7.3 Geotechnical information

Relevant information for each site from a geotechnical investigation prepared for the Sydney Metro project in August 2015 will be included for each location.

1.7.4 Significance assessment

An assessment of archaeological significance will be presented for each location in the study area. The following criteria will be utilised for the significance assessment.

Archaeological significance refers to the archaeological or scientific importance of a landscape, site or area. This is characterised using archaeological criteria such as archaeological research potential, representativeness and rarity of the archaeological resource and potential for educational values. These are outlined below:

- Research potential: does the evidence suggest any potential to contribute to an understanding of the area and/or region and/or state's natural and cultural history?
- Representativeness: how much variability (outside and/or inside the subject area) exists, what is already conserved, how much connectivity is there?

- Rarity: is the subject area important in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised? Is it in danger of being lost or of exceptional interest?
- Education potential: does the subject area contain teaching sites or sites that might have teaching potential?

An assessment of cultural significance would be completed following consultation with Metropolitan Local Aboriginal Land Council (MLALC) and with other registered Aboriginal stakeholders where comprehensive consultation is conducted (see Section 3).

1.7.5 Impact assessment

The impact assessment section will include a discussion of potential impacts to any identified Aboriginal sites or areas of archaeological potential as a result of the proposed works at each study area location.

1.7.6 Management measures

General management measures for the study area are presented in Section 8 and include:

- Guiding principles
- Further archaeological investigation
- Construction Heritage Management Plan (CHMP) and unexpected finds procedure
- Discovery of human remains – outlines procedures for discovery of human remains at each site.

1.8 Investigator and contributors

Josh Symons, Senior Archaeologist (Artefact Heritage) prepared this report with management input and review by Project Director Dr Sandra Wallace (Artefact Heritage).

2.0 CONSTRUCTION OF THE PROJECT

2.1 Tunnel construction

2.1.1 Tunnel elements

The project would involve the excavation of twin tunnels around 15 kilometres in length. The two bored tunnels would have a circular cross section with an internal lined diameter of about six metres and an excavated diameter of about seven metres.

In addition to the twin tunnels, the following underground features would also be excavated:

- Cross passages between the two tunnels would be provided at intervals of about 240 metres to allow for emergency access
- Stub tunnels from the twin tunnels near Victoria Cross Station and Sydenham to allow for future extensions to the metro network.

The depth of the twin tunnels, due to topography and the crossing of Sydney Harbour, would vary from about 20 metres to 60 metres deep. The shallower sections of the tunnel are generally approaching each tunnel portal.

2.1.2 Tunneling methods

Tunnel excavation is likely to be carried out using TBMs with roadheaders used for cross passages and stub tunnels.

Excavators with rock hammers would also be used to excavate cross passages and niches within the tunnels.

2.1.3 Ground improvement

Due to the expected ground conditions, ground improvement works may be required at specific locations underneath Sydney Harbour. Ground improvement works may be required at the rock-sediment transition zones to reduce construction risks associated with TBM work.

For the purposes of assessment, ground improvement works involve jet grouting which comprises the injection of a cement grout into the harbour bed from barges on the harbour. The grout would be delivered to the barges from an on-shore grout facility and would be injected from the barge via a crane and drilling lead.

2.1.4 Tunnel boring machine launch and support sites

It is anticipated that the TBM operations would occur from three sites. These sites are:

- A TBM launch and support site in Chatswood (to the south of Chatswood Station and north of Mowbray Road), referred to as the Chatswood dive site
- A TBM launch and support site north of Sydenham Station (south of Bedwin Road), referred to as the Marrickville dive site
- A TBM launch and support site at the Barangaroo Station site for the crossing of Sydney Harbour.

A temporary site would also be established at Blues Point for the retrieval of the cutter head and shields of the TBM driven from the Chatswood dive site and from the Barangaroo Station site.

The three sites would require support services for the TBMs.

Additional information regarding tunnel construction work is provided in Chapter 7 of the Environmental Impact Statement.

2.2 Station construction

New metro stations would be located at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo, with new metro platforms at Central Station (see Table 2).

The metro stations would be configured as either a large 'single span' cavern that accommodates tracks for both directions of travel and a central island platform or a 'binocular cavern' arrangement whereby each platform and track is housed in a single smaller cavern.

Single span cavern stations are proposed at Crows Nest, Victoria Cross, Barangaroo, Central and Waterloo. Binocular cavern stations are proposed at Martin Place and Pitt Street.

Table 2: Proposed stations and method of construction

Proposed station	Methodology	Approximate depth (metres)
Crows Nest	Single span (island) cavern cut and cover	25
Victoria Cross	Single span (island) cavern - mined	31
Barangaroo	Single span (island) cavern cut and cover	25
Martin Place	Binocular Cavern - mined	25-27
Pitt Street	Binocular Cavern - mined	17-20
Central	Single span (island) cavern cut and cover	16
Waterloo	Single span (island) cavern cut and cover	25

Further detail regarding station construction and the scope of construction activities at stations is provided in Chapter 7 of the Environmental Impact Statement.

3.0 ABORIGINAL COMMUNITY CONSULTATION

The following consultation with the Metropolitan Local Aboriginal Land Council has occurred during preparation of this report:

- Phone and email contact regarding the project
- Arrangement for an archaeological survey of those portions of the study area referenced on the Sydney Metro website (as dated November 2015)
- Conducting archaeological survey on Tuesday 8 November 2015 and 3 March 2016 with Jay Daley, Cultural and Heritage Officer at the Metropolitan Local Aboriginal Land Council (MLALC)
- The survey provided the opportunity to visit the majority of sites within the study area with Jay Daley and discuss landform setting and archaeological potential with respect to the heavily built environment at each location.
- A draft version of this assessment was forwarded to MLALC for review and comment.

3.1 Comprehensive Aboriginal stakeholder consultation

Comprehensive Aboriginal stakeholder consultation would be required prior to commencement of further archaeological investigation within the study area. As a State Significance Infrastructure (SSI) project assessed under Part 5.1 of the EPA Act, Aboriginal stakeholder consultation should be conducted in accordance with the NSW Office of Environment and Heritage '*Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*'[5], using the NSW Office of Environment and Heritage '*Aboriginal cultural heritage consultation requirements for proponents*'[6] as best practice.

[5] Department of Environment and Conservation 2005
[6] Department of Environment, Climate Change and Water 2010

4.0 LEGISLATIVE CONTEXT

4.1 National Parks and Wildlife Act (1974) (NPW Act)

The NPW Act, administered by the OEH provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Aboriginal occupation of NSW) under Section 90 of the Act, and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community) under Section 84.

The protection provided to Aboriginal objects applies irrespective of the level of their significance or issues of land tenure. However, areas are only gazetted as Aboriginal Places if the Minister is satisfied that sufficient evidence exists to demonstrate that the location was and/or is, of special significance to Aboriginal culture.

The NPW Act was amended in 2010 and as a result, the legislative structure for seeking permission to impact on heritage items has changed. A Section 90 permit is now the only Aboriginal Heritage Impact Permit (AHIP) available and is granted by the OEH. Various factors are considered by OEH in the AHIP application process, such as site significance, Aboriginal consultation requirements, Environmentally Sustainable Development (ESD) principles, project justification and consideration of alternatives. The penalties and fines for damaging or defacing an Aboriginal objects have also increased.

The project has been assessed under Part 5.1 of the *Environmental Planning & Assessment Act* 1979 and therefore permits issued under the NPW Act 1974 are not required, however similar processes would be followed where required.

4.2 Environmental Planning & Assessment Act (1979) (EP&A Act)

The EP&A Act establishes the framework for cultural heritage values to be formally assessed in the land use planning, development assessment and environmental impact assessment processes.

The project is assessed under Part 5.1 of the EP&A Act, which establishes an assessment and approval regime for SSI. An Environmental Impact Statement (EIS) is being prepared to assess the impacts of the project, in accordance with requirements issued by the Secretary of the Department of Planning and Environment (DP&E).

4.3 Aboriginal Land Rights Act (1983)

The *Aboriginal Land Rights Act 1983* is administered by the NSW Department of Human Services - Aboriginal Affairs. This Act established Aboriginal Land Councils (at State and Local levels). These bodies have a statutory obligation under the Act to; (a) take action to protect the culture and heritage of Aboriginal persons in the council's area, subject to any other law, and (b) promote awareness in the community of the culture and heritage of Aboriginal persons in the council's area. The study area is located within the MLALC boundaries.

4.4 Native Title Act (1994)

The *Native Title Act 1994* was introduced to work in conjunction with the Commonwealth Native Title Act. Native Title claims, registers and Indigenous Land Use Agreements are administered under the Act. No Native Title Claims within the study area are shown in the National Native Title Tribunal (NNTT) 'Native Title Vision' mapping service.[7]

[7] Accessed on 6 October 2015 http://www.ntv.nntt.gov.au/IntraMaps80/default.htm?project=NTV_NSW

5.0 ENVIRONMENTAL CONTEXT

An overall summary of the study area environmental context is outlined below. More specific geology, soil, landform and hydrology information for each portion of the study area is provided in Section 7.

5.1 Geology and soils

The study area is located within the Sydney Basin, a large depositional geological feature that spans from Batemans Bay to the south, Newcastle to the north and Lithgow to the west. The underlying geology of the study area consists of Hawkesbury Sandstone and Ashfield Shale, with unique Quaternary units overlying the sandstone and shale at Marrickville, Waterloo and Central Station. Hawkesbury Sandstone consists of medium to coarse-grained sandstone, very minor shale, and laminate lenses.[8] Hawkesbury Sandstone is one of the most ubiquitous geological layers of the Sydney Basin, and was used extensively by both Aboriginal and colonists for a variety of shelter and subsistence requirements.

Evidence of Aboriginal use of Hawkesbury Sandstone in the Sydney area includes occupation deposits in natural shelter formations created by weathering processes in exposed sandstone, grinding grooves where edge-ground stone axes were manufactured or maintained, and rock engravings or pigment motifs that were applied to exposed sandstone. British colonisers primarily utilised Hawkesbury Sandstone for building material, and many buildings and bridges were constructed with sandstone before clay bricks became the predominant construction material.

Generally shallow soils existed across the Hawkesbury Sandstone slope south of the shoreline, with soil developed *in situ* from the underlying sandstone geology. These soil contexts include the Gymea and Hawkesbury soil landscapes, which consisted generally of shallow sandy soils with high erosion hazard in cleared areas.[9] The upper lens of Hawkesbury sandstone beneath both soil landscapes is likely to be weathered and fractured, resulting in 'floating' bedrock at the soil/bedrock transition.[10]

The underlying geology of the slightly higher, northern portions of the study area (northern construction site, Artarmon substation, Crows Nest Station and portions of Victoria Cross Station) and southern portions of the study area (Central Station) consist of Ashfield Shale, which is composed of black to dark-grey shale and laminate.[11] Ashfield Shale caps the broad ridges of Hawkesbury Sandstone west of the study area and across northern Sydney.[12] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be residual soils developed *in situ*. The Blacktown soil landscape is located across the underlying Ashfield Shale in the southern portion of the study area, a soil landscape that consisted of deep to moderately deep soils and generally low soil fertility.[13]

Unique soil profiles within the study area include a deep Quaternary Period sand body associated with the Central Station works and Waterloo Station, and deep Quaternary soils across a portion of the Marrickville dive site.

[8] Herbert, C 1983, *Geology of the Sydney 1:100,000 Sheet 9130*, NSW Department of Mineral Resources, Sydney.
[9] Chapman, GA and Murphy, CL 1989, *Soil Landscapes of the Sydney 1:100,000 Sheet (Report),* Department of Conservation and Land Management, Sydney
[10] Lawrie, R 1999, 'Soil Chemical Properties at Historical Archaeological Sites of Inner Sydney, New South Wales', in *Australasian Historical Archaeology*, 17: 70.
[11] Herbert 1983 p
[12] Ibid p.22
[13] Chapman and Murphy 1989.

The Quaternary Botany sand sheet is located across most of the Eastern Suburbs of Sydney and consists of deep (>200 cm) sand associated with the Tuggerah soil landscape.[14] The Quaternary sediments across a portion of the Marrickville dive site consist of peat, sandy peat and mud, and consist of deep soils (250 cm) of the Birrong soil landscape.[15] The Birrong soil landscape is typically comprised of soils that are water-logged and subject to localised flooding, and are a high erosion hazard.[16]

5.2 Landform and Hydrology

The northern construction site, Artarmon substation, Crows Nest Station and Victoria Cross Station are located across a broad sandstone plateau overlooking the northern side of Sydney Harbour. Drainage from these locations, particularly the ridge crest location at Crows Nest, would likely have consisted of the headwaters of creeks that flowed into Sydney Harbour.

The Barangaroo Station site is located in the vicinity of the original shoreline in that area and on the western margin of the sandstone ridge crest associated with The Rocks.

The natural drainage catchment within the inner Sydney portion of the study area (Martin Place and Pitt Street Stations) area is a watercourse called the Tank Stream that originally flowed north from a swampy area stretching between Market Street and Park Street. The watercourse flowed between the current alignments of Pitt Street and George Street, with the mouth of the creek originally a tidally influenced estuarine flat covering the area north from Bridge Street, east from Pitt Street and west from Loftus Street. Tank Stream was the main watercourse through inner Sydney.[17]

The Central Station site is located south of a low-lying area associated with the Haymarket area and in the vicinity of the original shoreline of Darling Harbour. Drainage around Central Station would have flowed north towards Haymarket and eventually into Darling Harbour.

The Marrickville dive site is located across undulating eastern margins of the Cumberland Plain. Drainage across this area would generally have flowed south and east towards heavily modified estuarine areas into the Cooks River and Botany Bay.

[14] Chapman and Murphy 1989 p.112
[15] Bannerman and Hazelton 1990 p.83
[16] Ibid p.83
[17] Godden Mackay Heritage Consultants 1997, *Angel Place Project 1997 Volume 3: Prehistory Report, Salvage Excavation of Site # 45-6-2581*, report prepared for AMP Asset Management Australia Ltd, the NSW Heritage Council and the National Parks and Wildlife Service (NSW): 11.

6.0 ABORIGINAL HISTORICAL AND ARCHAEOLOGICAL CONTEXT

6.1 Aboriginal material culture

Evidence of Aboriginal occupation within NSW has been dated to 50-60,000 years Before Present (yBP) at Lake Mungo and up to 30,000 yBP in Parramatta.[18] The archaeological material record provides evidence of this long occupation, but also provides evidence of a dynamic culture that has changed through time.

The existing archaeological record is limited to certain materials and objects that were able to withstand degradation and decay. As a result, the most common type of Aboriginal objects remaining in the archaeological record are stone artefacts, followed by bone and shell. There is potential for Aboriginal objects to occur across the landscape. The nature of the underlying geology and proximity of water sources to portions of the study area indicates the potential for the occurrence of artefact sites and/ or midden sites.

Stone artefacts are one of the most common types of Aboriginal objects remaining in the archaeological record. Archaeological analyses of these artefacts in their contexts have provided the basis for the interpretation of change in material culture over time. Technologies used for making tools changed, along with preference of raw material. Different types of tools appeared at certain times. It is argued that changes in material culture were an indication of changes in social organisation and behaviour.

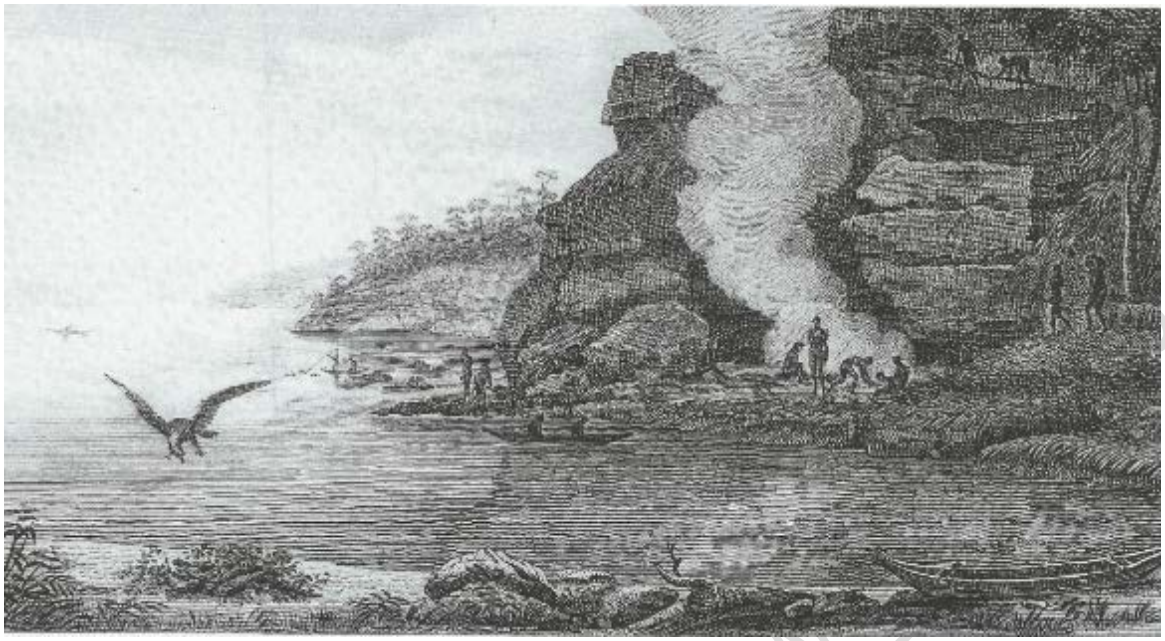
6.2 Aboriginal history and the contact period

Prior to the appropriation of their land by Europeans, Aboriginal people lived in small family or clan groups that were associated with particular territories or places. It seems that territorial boundaries were fairly fluid, although details are not known. The language group spoken across Sydney was known as Darug (Dharruk – alternate spelling). This term was used for the first time in 1900, as before the 1800s language groups or dialects were not discussed in the literature.[19] The Darug language group is thought to have covered the area south from Port Jackson, north from Botany Bay, and west from Parramatta.[20]

The name Gadigal and its alternative spellings (Cadigal, Cadi) was used in the earliest historical records of the European settlement in Sydney to describe the Aboriginal band or clan that lived on the southern shore of Port Jackson, from South Head west to the Darling Harbour area. The term Eora is also used as a name for the Aboriginal people south of Port Jackson. The term Eora was likely a word used by the Gadigal people to refer to an Aboriginal person, rather than a reference to a clan or band in particular.[21] However, it became a widespread term for the Aboriginal people on the southern shore of Port Jackson and is currently used by Gadigal people to refer to the central Sydney area – referred to as 'Eora Country'.[22]

[18] JMcD CHM 2005.
[19] Matthews, RH and Everitt, MM 1900, 'The Organisation, Language and Initiation Ceremonies of the Aborigines of the South-East Coast of N.S. Wales', *Journal and Proceedings of the Royal Society of NSW*, 34: 262-281; Attenbrow, V 2010, *Sydney's Aboriginal Past: Investigating the Archaeological and Historical Records. 2nd Edition*, University of New South Wales Press Ltd, Sydney: 31.
[20] Attenbrow 2010: 34.
[21] Ibid: 22, 35-36.
[22] City of Sydney Council 2002, Indigenous History of City of Sydney, viewed 21 September 2012, http://www.cityofsydney.nsw.gov.au/barani/

Figure 3: Aboriginal activities on the shore of Port Jackson in 1824 (source: Peron and Freycinet 1824 in McBryde 1989: 26).



The subject site was located across a landscape of varying subsistence resources. The tidally influenced mud flats associated with the mouth of the Tank Stream were located to the north of Martin Place and to the east of Barangaroo Station, while fresh water was available from the stream itself to the southwest in the vicinity of Pitt Street. Archaeological and historical records indicate that marine and estuarine resources formed an important part of the subsistence activities of the Aboriginal people that inhabited the Port Jackson area (Figure 3). Shellfish not only formed an important subsistence resource, but were also utilised as tools. Shell tools included fish-hooks, shell hafted onto spears in various forms, as a tool to repair spears, and as a cutting edge.[23] Other locally available raw materials, including quartz, were also favoured for cutting edges, and in some areas bordering readily abundant shellfish in inner Sydney, quartz may have actually been favoured as a cutting edge.[24]

6.2.1 Initial interactions at Sydney Cove

The European colonisation of Australia began with the establishment of a colony at Sydney Cove by Captain Arthur Phillip in January 1788 on land inhabited by the Gadigal people. The subject site and immediately surrounding area were an integral part of the pre- and post-contact history of both the Gadigal people and the Aboriginal peoples across the surrounding region.

The likely location of Captain Arthur Phillip's landing site was on the southern shore of Sydney Cove.[25] Many of the documented early interactions between the British and the Gadigal were amicable. Watkin Tench, Captain of the Marine with the First Fleet, documented his first meeting with the Gadigal people, when he and a landing party visited the south shore of Port Jackson. Tench noted that they were greeted by a dozen Aboriginal people, with the landing party and the Aboriginal people cautiously approaching each other before observing one another and exchanging items.[26]

[23] Attenbrow 2010: 118.
[24] Baker, N 2004, *Archaeological Salvage of an Aboriginal Site at William Street, East Sydney*, report to Zonie Construction and Design Pty Ltd: 31.
[25] Thorp 1995:33.
[26] Tench, W 1789, *A Narrative of the Expedition to Botany Bay*, Printed for J Debrett, opposite Burlington House, Piccadilly, London: 54-58.

Within days of the initial landing at Sydney Cove, visits by Aboriginal people to the settlers had dropped in frequency to the point where the colonists were aware that they were being deliberately avoided.[27]In 1789, Watkin Tench noted that the local Aboriginal people:

> …for a little while after out arrival paid us frequent visits, but in a few days they were observed to be more shy of our company. From what cause their distaste arose we never could trace….. No quarrel had happened, and we had flattered ourselves, from Governor Phillip's first reception among them, that such a connection might be established as would tend to the interest of both parties[28]

The reference to Governor Phillip seeking to establish a connection with the local Aboriginal inhabitants and treat them amicably stemmed from his instructions on setting out from England in 1787 to open a discourse with the 'Aborigines' and attempt to live in friendship without unnecessary interruption of their activities.[29]

Other historical records also note the avoidance of the colony by Aboriginal people, including letters written by Governor Phillip and David Blackburn, Master of the First Fleet ship *HMS Supply*.[30] On 12 August 1790 in a letter to his sister, Blackburn noted that 'they will not come among us though every method has been used to invite them'.[31] By November 1788, Phillip noted that:

> The natives now avoid us more than they did when we first landed, and which I impute to the robberies committed on them by the convicts, who steal their spears and fish – gigs which they frequently leave in their huts when they go out a fishing and which the people belonging to the transports purchase, though every possible precaution has been taken to prevent it.[32]

With the exception of the first days of the colony at Sydney Cove, the remainder of 1788 was marked by the general avoidance of the area by the Aboriginal people.

At the time of British arrival, the North Shore was inhabited by the Cammeraygal

British colonisation had a profound effect on the Aboriginal population of the Sydney region. In the early days of the colony Aboriginal people were disenfranchised from their land as the British claimed areas for settlement and agriculture. The colonists, often at the expense of the local Aboriginal groups, also claimed resources such as grasses, timber, fishing grounds and water sources. Overall the devastation of the Aboriginal culture did not come about through war with the British, but instead through disease and forced removal from traditional lands. It is thought that during the 1789 smallpox epidemic, over half of the Aboriginal people of the Sydney region died[33].

In 1883 the Aboriginal protection board was created with the power to develop reserves and direct Aboriginal people to live on them[34]. Reserves were established in areas such as Plumpton, Hunter Valley, Penrith and Sackville and generally functioned to remove Aboriginal people from the population centres around Sydney.

[27] Attenbrow 2010:14.
[28] Tench 1789: 63-64.
[29] McBryde, I 1989, *Guests of the Governor: Aboriginal Residents of the First Government House*, The Friends of the First Government House Site, Sydney: 5.
[30] Attenbrow 2010:14; Neville, D 1975, *Blackburn's Isle*. Terence Dalton Limited, Lavenham, Suffolk.
[31] Neville 1975:152.
[32] Governor Phillip 1788, quoted in McBryde 1989:7.
[33] Currie 2008, Bo-rà-ne Ya-goo-na Par-ry-boo-go, Yesterday Today Tomorrow: An Aboriginal History of Willoughby: 65
[34] Currie 2008

Despite the impacts to the Aboriginal community following British colonisation, Aboriginal community connections to the area and culture in the central Sydney area are strong and ongoing.

6.3 Registered Aboriginal sites in the local area – AHIMS search results

An Aboriginal Heritage Information System (AHIMS) basic search for the Chatswood area was undertaken on 18 August 2015. Details are included below:

Search 1:	GDA 1994 MGA 56	330600E – 331950E 6257000N – 6259650N
	Buffer	0 metres
	Number of sites	0
	AHIMS Search ID	186225

No AHIMS sites were identified within the Search 1 area and subsequently an extensive search for the Chatswood area was not required.

Two extensive AHIMS searches were undertaken on 2 October 2015 to determine whether Aboriginal sites had been recorded within the study area (excluding the Chatswood study area identified in Search 1) and to ascertain its archaeological context. The searches encompassed the study area within the following coordinates:

Search 2:	GDA 1994 MGA 56	331950E – 336700E 6254000N – 6258800N
	Buffer	50 metres
	Number of sites	116
	AHIMS Search ID	193694
Search 3:	GDA 1994 MGA 56	329500E – 335160E 6243800N – 6254000N
	Buffer	50 metres
	Number of sites	91
	AHIMS Search ID	193689

Figure 4 shows the location and extent of AHIMS search areas 1, 2 and 3.

Further details of registered Aboriginal sites in each study area are provided in Section 7.

The location of recorded Aboriginal sites in the study area is shown in Figures 5, 6 and 7.

[Note: Information on the location of Aboriginal sites, including maps and site coordinates, has been removed from the public version of this document]

Figure 4: Extent of AHIMS search areas 1, 2 and 3

This map showing the location of Aboriginal sites has been removed from the public version of this document.

Figure 5: Location of AHIMS registered sites – northern portion of the study area

This map showing the location of Aboriginal sites has been removed from the public version of this document

Figure 6: Location of AHIMS registered sites – central portion of the study area

This map showing the location of Aboriginal sites has been removed from the public version of this document

Figure 7: Location of AHIMS registered sites – southern portion of the study area

This map showing the location of Aboriginal sites has been removed from the public version of this document

6.4 Previous archaeological investigations in the local area

A presentation of the location and findings of relevant previous archaeological investigations has been divided into geographical sections, as outlined below.

6.4.1 Sydney CBD (Central Station, Pitt Street, Martin Place and Barangaroo)

A relatively limited number of Aboriginal sites have been identified in the dense urban development of the area, largely due to the intensive development of the area and associated sub-surface impacts, and the limited number of archaeological excavations that have taken place.

Moore's Wharf

Lampert and Truscott[35] excavated beneath the rubble floor of the Bond Store at Moore's Wharf, Millers Point in 1984 after Aboriginal midden material was identified at the site. Ten centimetres of shell midden overlay approximately 30 cm of compact grey sand with stone artefacts. The shells recovered included Rock and Mud Oyster (*Saccostrea* and *Ostrea*), cockle (*Anadara trapezia*), whelk (*Pyrazus ebininus*) and mussel (*Trichomya*). Approximately 392 stone artefacts were recovered. The assemblage included cores, used flakes and fabricators. There was also evidence for the use of unusually small pebbles and bi-polar flaking. Raw materials included silcrete, quartz, quartzite and chert. It was concluded that the artefacts were typical of the post-Bondaian (most recent) phase of Aboriginal culture in the area. Evidence for continued Aboriginal use of the site into the historic period was found in the small number of European ceramic fragments recovered from the grey sand.

Lilyvale Cottage

Salvage excavation of a midden in The Rocks was reported by Attenbrow in 1992[36]. The site is located at Lilyvale Cottage, Cumberland Street and retrieved Aboriginal objects included shell and fish bone material. The site is approximately 300 metres east of Barangaroo Station. The midden assemblage was carbon dated to around 340 years prior to the European settlement of Sydney Cove. The assemblage included bones of Snapper (*Pagrus auratus*) and Bream (*Acanthopagrus australis*), and shells of Rock Oyster (*Saccostrea cucullata*) and Hairy Mussel (*Trichomya hirsuta*).

Customs House

An archaeological assessment conducted for Customs House near Circular Quay indicated that there was a small possibility that Aboriginal archaeological deposit may be located across the former foreshore area at depths of two-three metres below the current ground surface[37].

The subject site and Customs House were located across the gardens and associated area between the site of the First Government House on Bridge Street and the southern foreshore of Sydney Harbour. Thorp has suggested that the association of this area with the First Government House site may have protected it to a certain extent from significant disturbance prior to the foreshore area being buried with fill for the start of the Circular Quay reclamation works in the 1830s. Thorp indicated that if any intact Aboriginal archaeological deposit was located in the foreshore area it would be of outstanding significance and that 'the rarity of such archaeological evidence within the CBD is greater than that of first European settlement".

[35] Lampert, R J and Truscott, M C 1984, The Archaeological Investigation of the Bond Store, Moore's Wharf, 1980, report prepared for the Maritime Services Board and the Heritage Council of NSW.
[36] V Attenbrow, 1992. 'Shell Bed or Shell Midden', *Australian Archaeology* 34:3-21.
[37] Thorp, W 1995, *Customs House, Sydney: Archaeological Assessment*, report prepared for Sydney City Council.

Since Thorp's 1995 archaeological assessment, archaeological monitoring within the Customs House site has taken place as part of excavation works associated with an adaptive re-use program for the site. Most of the excavated trenches did not extend below the thick layer of fill that covered the area for the Circular Quay reclamation works, whilst the few places where excavation reached the original foreshore level tidal waters prevented further examination. No Aboriginal archaeological deposit was identified during the monitoring works, although Thorp maintained that there was high probability that intact foreshore deposit would be located beneath the reclamation fill.

The Quadrant Site

Aboriginal archaeological test excavation and monitoring was undertaken by Steele in 2001 at a block ('the Quadrant site') positioned between Broadway and Mountain Streets in Ultimo. Blackwattle Creek once traversed the site, and testing in 1 metre squares was undertaken along the creek bank and upslope of the creek. A 5 x 15 metre remnant patch of original topsoil was tested. Fourteen Aboriginal flaked stone artefacts were recovered from this, all of which were less than 10 millimetres in maximum dimension, and most of which were non-diagnostic.

In the final report, Steele and Czastka[38] suggest that the lack of more substantial Aboriginal archaeological material identified on the Quadrant site may relate to the poorly-drained nature of the Blackwattle Creek landscape. The food and raw material resources of the creek line/swamp environments within and immediately adjacent to the Quadrant site are likely to have been exploited by Aboriginal people. However, they are unlikely to have established long-term occupation sites on land that was low-lying and poorly drained. Rather, the higher site elevations overlooking Blackwattle Creek are more likely to contain more substantial evidence for past Aboriginal visitation and use.

William Street, Woolloomooloo

At the William Street site, East Sydney, archaeological excavation at AHIMS site 45-6-2651 included salvage of an intact sandy deposit bordering a watercourse that flowed north to Woolloomooloo Bay, which was identified during the course of historical archaeological investigation of the site[39].

Predominant raw material types amongst the stone artefact assemblage retrieved from the William Street site included quartz, grey tuff, silcrete and mudstone. Bipolar flaking techniques were frequent amongst the quartz assemblage, with Baker[40] suggesting that utilised quartz pebbles were likely sourced from exposed portions of Hawkesbury Sandstone in the area. Baker also suggested that the prevalence of bipolar quartz flakes with sharp cutting edges in the assemblage showed a preference for quartz over the sharp edges of shellfish, which were abundantly available in nearby estuarine environments[41].

A definite date for the archaeological deposit excavated at the William Street site was not determined. Based on the artefact assemblage and geomorphology of the site, it was assessed that the archaeological deposit represented cumulative occupation of the site over the last 6,500 years. Baker has noted that the implications of Aboriginal archaeological deposit being identified beneath several phases of building construction was that the survivability of Aboriginal heritage should be considered on inner Sydney building sites, especially areas adjacent to former watercourses.[42]

[38] Steele, D, and Czastka, J 2003, Archaeological Salvage Excavations at the Quadrant, Broadway, report to Australand Holdings.
[39] Baker, N 2004, *Archaeological Salvage of an Aboriginal Site at William Street, East Sydney,* Report to Zonie Construction and Design Pty Ltd.
[40] Baker 2004
[41] Baker 2004 p.31
[42] Ibid p.37-39

Darling Walk

An assessment of the Darling Walk project area (Cockle Bay) was undertaken by Jillian Comber[43]. Comber found that it was likely that Aboriginal objects such as stone artefacts or shell midden may be present along the former shoreline. The western section of the study area was assessed to be of low potential as it was within reclaimed land.

Subsequent archaeological excavations conducted during historical archaeological investigations at the site identified an area of shell midden deposit in the north-west corner of the Darling Walk project area.[44]

The shell midden comprised a grey sandy deposit incorporating shell and stone artefacts. The deposit was found resting directly on sandstone. Comber interpreted the site as being part of a larger midden deposit that had slumped down towards the shoreline.

Wynyard Walk

Aboriginal objects were retrieved as part of archaeological excavations on Wynyard Walk by GML, located between Clarence and Kent Street and listed on the AHIMS site register as AHIMS site 45-6-3116. No further information on the Wynyard Walk was available during preparation of this report.

Barangaroo South and North

No Aboriginal objects were identified during extensive historical excavation at Barangaroo South. Barangaroo South is located immediately to the south and southwest of the proposed location of Barangaroo Station.

The excavation report for Barangaroo North, located to the west of the proposed location of Barangaroo Station, has not yet been completed. However, based on the fact that no Aboriginal sites in that area have been recorded on the AHIMS site register it is assumed that no Aboriginal sites were identified during historical excavation in that area.

Wattle Street, Ultimo

Biosis completed an Aboriginal Cultural Heritage Assessment Report (ACHAR) for the Urbanest redevelopment on Wattle St, Ultimo[45]. The ACHAR investigation was based on background research, ethno-historic data and geotechnical investigation. Biosis determined that, despite significant impact to the area since European occupation, it was likely that substantial and deep portions of alluvial soils would be present across the study area beneath European deposits[46].

Historical layers were identified to a depth of at least 2.5 metres and assessed as having low Aboriginal archaeological potential. However, alluvial soils located underneath extended to a depth of at least 7 metres below the surface and were considered to have moderate to high Aboriginal archaeological potential[47]. The potential was considered to be heightened by the proximity of the site to Blackwattle Creek. The project area was registered with AHIMS as a PAD (AHIMS site 45-6-3064). Test excavations and avoidance of alluvial soils where possible were recommended.[48]

[43] Comber 2009. Aboriginal Archaeological and Cultural Heritage Assessment, Darling Walk, Darling Harbour. Unpublished report to Casey & Lowe on behalf of the Sydney Harbour Foreshore Authority.
[44] Casey and Lowe 2009 Darling Walk Archaeological Excavation – Preliminary Results. Report to Lend Lease Development.
[45] Biosis. 2012a. 445-473 Wattle Street, Ultimo: Proposed Student Accommodation Development. Aboriginal Cultural Heritage Assessment Report. Report to Cultural Resources Management.
[46] Ibid
[47] Ibid
[48] Ibid

Test excavations reports from this project may still be under production as none were available from OEH at the time of this study.

Quay Street, Haymarket

Biosis completed a due diligence assessment for The Quay Project at Haymarket, approximately 285 m northwest of Central Station[49]. The assessment determined that the area, prior to European modification, would have been an attractive place for Aboriginal people to occupy and camp on due to the topography and close proximity of resources. However, due to extensive modification of the area since the 18th century it was considered highly likely that the natural soil profile had been completely removed and with it any traces of Aboriginal occupation. The due diligence recommended that the works proceed without further investigation or approvals on the condition that if the works encountered any natural soil profiles they immediately cease until further archaeological investigation was undertaken[50].

Cultural Resources Management (CRM) encountered remanent deposits of natural topsoils while completing historical excavations at the site and engaged Biosis to undertake excavations focused on recovering Aboriginal cultural heritage. The excavations comprised five 0.5 x 0.5 metre test pits focussed on areas retaining remanent soil profiles. The excavations revealed that the study area, while containing very shallow and minor portions of the original soil profile, was highly disturbed and no Aboriginal objects were identified[51].

During the historical excavations undertaken by CRM an isolated stone artefact was recovered from the spoil of a European post hole. As the stone artefact, recorded as AHIMS site 45-6-2987, was found in a highly disturbed context it was assessed as having low scientific significance. The site was considered to have low potential to contain any further Aboriginal cultural heritage and no further archaeological investigation was conducted[52].

KENS Site

The KENS site block is defined by Kent, Erskine, Napoleon and Sussex Streets (KENS) in the northwest of the Sydney CBD. The KENS site was originally situated on a slope running off a north-south orientated ridge. The rocky shoreline of Cockle Bay ran through the western portion of the site.

The area was identified as having Aboriginal archaeological potential due to the location of the site benched slopes and minor escarpments overlooking the Cockle Bay shoreline. Test and salvage excavations for Aboriginal archaeology were undertaken at the site by Dominic Steele Consulting Archaeology[53]. Three areas were subject to salvage excavation, each revealing the remains of past Aboriginal knapping, including flaked glass. It was tentatively suggested that the assemblage indicates a Late Bondaian through to early post-Contact date, possibly including a Middle Bondaian element (c. 2800 BP to 1788). It was noted that the natural soil profile was truncated and rapidly buried. The excavators concluded that the KENS site is an example of evidence of Aboriginal settlement surviving despite impacts during the historical period.

[49] Biosis. 2012b. The Quay Project, Haymarket: Aboriginal and Cultural Heritage Assessment Final Report. Report to Cultural Resources Management.
[50] Higgs and Gibbins. 2012a. The Quay Project, Haymarket: Archaeological Report. Unpublished report prepared for Cultural Resources Management. AHIMS #102765.; Higgs and. Gibbins. 2012b. The Quay Project, Haymarket: Archaeological Report. Unpublished final report prepared for Cultural Resources Management. AHIMS #102494.
[51] Ibid
[52] Ibid
[53] Steele, D 2006, Final Aboriginal Archaeological Excavation Report. The KENS Site (Kent, Erskine, Napoleon and Sussex Streets), Sydney, NSW, containing DECC Site 45-6-2647 and associated areas of PAD, unpublished report to Leighton Contractors Pty Ltd.

Angel Place

At Angel Place, Aboriginal archaeological deposit was identified when a small number of Aboriginal stone artefacts were retrieved during the course of historical excavation at the site. The site, AHIMS site # 45-6-2581, was located across a 4 x 4 metre area of surviving topography bordering the Tank Stream. Excavation revealed that only small portions within that area were relatively free of disturbance.[54]

A total of 54 stone artefacts were retrieved from excavation of the Aboriginal archaeological deposit at Angel Place, consisting predominantly of silicified tuff raw material, followed by mudstone, silcrete and quartz. The distribution of the artefacts across the intact portions of a tiny area bordering the Tank Stream led Godden Mackay to conclude that the banks of the stream were likely the site of repetitive Aboriginal occupation.[55]

6.4.2 North Shore (northern construction site, Artarmon, Crows Nest, Victoria Cross and Blues Point)

F2 (now M2) Freeway

During an archaeological survey along the route of the F2 [now M2]-Castlereagh Freeway in 1989 Laila Haglund located two rock shelters with archaeological deposit. Both shelters (AHIMS site 45-6-1855 and AHIMS site 45-6-1854) contained middens with oyster and whelk shell recorded, while the later also had possible remnants of stencil art along the back wall.

The route of the proposed M2 upgrade was investigated by AECOM in 2009/2010[56]. The route was from Lane Cove Road in North Ryde, to Windsor Road at Baulkham Hills. Fifteen Aboriginal sites were found or previously recorded within the M2 corridor.

Lane Cove National Park

In 1990 Conyers conducted a comprehensive survey of the Lane Cove River State Recreation Area (SRA), now known as Lane Cove National Park. Approximately one third of the SRA was surveyed during a twelve-day survey. Seven previously unrecorded Aboriginal sites were located - two engraving sites, two middens, and three rock shelters with deposit. Five potential habitation sites were also recorded along with three engraving sites which had previously been recorded.

In 2000 Bobbie Oakley completed a survey for a proposed sewerage upgrade within Lane Cove National Park[57]. Two new Aboriginal sites were located in the southern portion of the National Park. Both new sites (LCRM1 and LCRM2) are shell midden scatters and associated areas of potential archaeological deposit (PAD). It was recommended that the sewer line should be redirected to avoid these sites, or if this was not possible that further archaeological work, such as a test excavation, should be conducted.

[54] Godden Mackay 1997 p. 9, 45.
[55] GML 1997 p.4, 59.
[56] AECOM 2010, M2 Upgrade Project – Preliminary Aboriginal Heritage Assessment. Unpublished report to Leighton Contractors
[57] Oakely, B. 2000, Indigenous Heritage Assessment – Proposed Sewerage Upgrade REF, Lane Cove National Park,unpublished report to Australian Water Technologies Pty. Ltd.

In 2011 Artefact Heritage conducted a survey of an area along the northern edge of Stringybark Creek in Lane Cove West, approximately 3 kilometres west of the northern construction site[58]. A previously recorded rock shelter with a charcoal drawing of two fish was relocated. Although the shelter had been disturbed by construction of a sewer pipe, the art remained in good condition. No new Aboriginal sites were located during the study.

Delhi Road, Ryde

In 1995 Wirrima Consulting conducted a survey for Aboriginal sites for the widening of Delhi Rd, Ryde by the RTA[59]. A rock shelter with midden (AHIMS site 45-6-2211), which was first recorded by Conyers, was revisited.

In 1997 Tessa Corkhill conducted an excavation of a rock shelter with potential archaeological deposit (CSIRO PAD1) at Riverside Corporate Park[60]. The PAD was first located in 1991 and it was recommended at that time that further investigation would be required if the site was to be affected by development. Ten test pits were excavated to bedrock at depths varying from 47 cm to 18 cm. Fourteen stone artefacts were recovered although the deposit was found to be relatively disturbed with evidence of European material throughout much of the profile.

Artefact Heritage prepared an archaeological assessment of the North Ryde Station Precinct for a rezoning study[61]. That investigation concluded that there were no recorded Aboriginal objects within the Precinct and that overall there was limited archaeological potential. The study area was assessed as demonstrating low archaeological significance.

North West Rail Link (NWRL) and Epping to Thornleigh Third Track

Archaeological investigations conducted for the NWRL included an initial assessment of an earlier version of the proposed NWRL corridor by JMcD CHM [62] and a later Aboriginal heritage assessment as part of the EIS prepared for NWRL major civil construction works.[63]

The assessment prepared by JMcD CHM identified the rail corridor between Epping and Beecroft train stations as demonstrating low archaeological sensitivity. The areas around Epping Station investigated for the EIS, including Construction Sites 1 and 2 (Decline and Epping services facility), were described as disturbed with a high level of surface impact and no potential for Aboriginal heritage.[64] These sites were situated in a similar ridge crest landform context to the current north shore component of the study area.

An Aboriginal cultural heritage assessment prepared by Artefact Heritage for the Epping to Thornleigh Third Track Project (ETTT) did not identify any Aboriginal sites and concluded that the entire rail easement between Epping and Thornleigh demonstrated low/ no archaeological potential[65].

[58] Artefact Heritage 2011, 150 Epping Rd, Lane Cove West–Heritage Study Aboriginal Cultural Heritage Assessment and Assessment of non-Indigenous heritage for a Concept Plan application. Unpublished report to Rose Group.
[59] Wirrina Consulting,1995, Archaeological survey for Aboriginal sites. Delhi Rd – Main Rd No. 191, CSIRO to Northern Suburbs Crematorium, Lane Cove, NSW. Report to RMS.
[60] Corkill, T,1997, Test Excavation of Rockshelter, CSIRO PAD 1, site 2 Riverside Corporate Park, North Ryde, NSW, unpublished report to Australia Pacific Projects.
[61] Artefact Heritage, 2012a, North Ryde Station Precinct Rezoning Study, Report to Transport for New South Wales.
[62] JMcD CHM 2006
[63] GML+JMCD CHM 2012
[64] Ibid p.59
[65] Artefact, 2012b, Northern Sydney Freight Corridor: Epping to Thornleigh Third Track Project, Historic Cultural Heritage Assessment. Report to Parson Brinckerhoff.

During the ETTT works several unexpected Aboriginal finds were encountered. These sites included three surface artefact concentrations and one isolated find. Contextually, the artefacts were identified in similar ridge crest settings to the Chatswood, Artarmon, Crows Nest and Victoria Cross settings for the current investigation. That ridge crest context and distance from water was one of the key attributes of each sites that suggested low associated archaeological potential[66]. The generally high levels of surface disturbance associated with rail infrastructure and residential development also justified the assessment of low archaeological potential and low archaeological significance for each site.

Chatswood West

Total Earth Care[67] conducted an Aboriginal heritage and archaeological assessment of a property at 126 Greville Street, Chatwsood West. The subject site was located on the western margin of the main Chatswood Ridge and associated with the incised drainage channels draining into Lane Cove River. 126 Greville Street is located approximately 1.3 km northwest of the northern construction site.

Although the subject site was located adjacent to Blue Gum Creek, a tributary of Lane Cove River, Total Earth Care did not identify any Aboriginal objects or areas of archaeological potential. It was noted that there were no suitable areas for occupation within the subject site[68], and that the primary focus of occupation was likely to have been located closer to Lane Cove River.[69]

The results of the investigation at 126 Greville Street are significant for the current investigation, as they suggest a close association of more frequent evidence of Aboriginal occupation in the area with estuarine resources of Lane Cove River and its major tributaries.

Royal North Shore Hospital

An Aboriginal heritage assessment of the Royal North Shore Hospital site did not identify any Aboriginal objects or areas of archaeological potential.[70] Survey observations of that area by Steele note the highly disturbed context of that area, including 'clearance of original timber and consequent heightened natural erosion, and more significantly by the extensive earthworks and construction works associated with the building of the hospital complex'. [71]

6.4.3 Southern area (Waterloo and Marrickville dive site)

Alexandra Canal

During the early 19th century, the area in the vicinity of the Marrickville dive site was initially a residential area for the wealthy, who tended to live on the prominent ridge line overlooking Botany Bay[72]. The prominent ridge line was also significant for St Peters Church on the Cooks River Road (now Princes Highway), with the elevation of that area making the church visible to the surrounding region[73]. The St Peters Church is located approximately 800 m southwest of the Marrickville dive site.

[66] Artefact, 2014a. 'ETTT Aboriginal Sites Assessment of Significance'. Report to ETTT Alliance.: 10
[67] Total Earth Care, 2007. '126 Greville Street, Chatswood West: Aboriginal Heritage and Archaeological Assessment'. Report prepared for EDAW Pty Ltd.
[68] Ibid p.11
[69] Ibid p.9-10
[70] Steele, D 2006, Final Aboriginal Archaeological Excavation Report. The KENS Site (Kent, Erskine, Napoleon and Sussex Streets), Sydney, NSW, containing DECC Site 45-6-2647 and associated areas of PAD, unpublished report to Leighton Contractors Pty Ltd
[71] Steele, D. 2006 p.26
[72] Ibid p.88
[73] Ibid p.89

Residential subdivision in the area commenced in the 1870s and 1880s. Due to the corresponding establishment of industry in the St Peters and Tempe area, the population increase from residential subdivision was not as large as that in neighbouring Marrickville[74]. Industry that was established in the area during the 1870s included tanneries, wool washers, and boiling down works[75]. Residential subdivision and industrial development continued into the twentieth century. Many of the former wealthy estates and associated mansions demolished for industrial estates and housing for workers.[76]

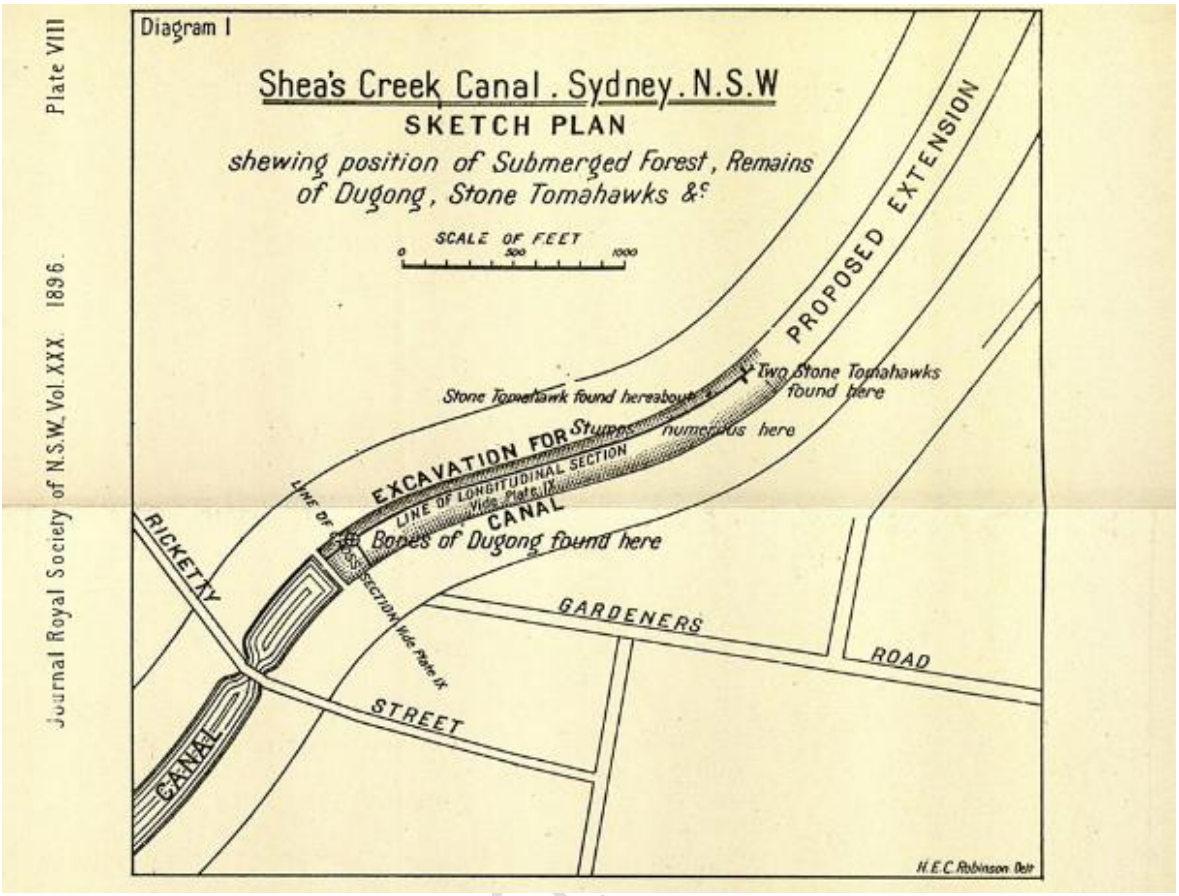
Although the industrial development in the Sydenham/ Alexandria area is likely to have comprehensively disturbed large areas of ground and areas of archaeological potential, animal bones (Dugong) and Aboriginal stone artefacts were identified by workers during extension of the Alexandra Canal in the 1890s at Shea Creek. Palaeontologist Etheridge identified cuts and scars on the bones consistent with the animal being butchered. Two hatchet heads were also retrieved from the same area.[77]

The finds were located less than one kilometre southeast of the southern construction site and are shown in Figure 8.

The identification of the animal bones (Dugong) and artefacts associated with deep deposits at Shea Creek demonstrate that even in areas where there has been surface disturbance from industrial/ residential activity there is a remaining likelihood of archaeological material at depth in appropriate soil landscapes. Only industrial activities such as extraction of materials for brick-making, which may have occurred at the Marrickville dive site, and installation of underground services are likely to have significantly disturbed or entirely removed Aboriginal objects beneath the ground surface.

[74] Ibid p.94.
[75] Ibid p.94.
[76] Thorp 1994, Page viii
[77] Etheridge 1905

Figure 8: Location of retrieved Dugong bones and stone artefacts during extension of Alexandra Canal[78]



445-473 Wattle Street, Ultimo: Proposed Student Accommodation. AHIMS site 102763

An Aboriginal cultural heritage assessment was undertaken by Biosis for proposed student accommodation on Wattle Street, Ultimo. The assessment found that despite quite significant disturbance and impact to the immediate area since European occupation, there still remained potential for substantial and deep portions of alluvial soils to be present across the entire study area. The archaeological sensitivity of the study area was considered to be further increased due to the site's close proximity to Blackwattle Creek[79].

The assessment identified that the soil profile of the study area comprised fill deposits present from the current ground surface until 2.5 metres depth. Below the fill deposits alluvial soils were thought to be present to approximately 7.0 metres depth. Due to the presence of these potentially sensitive soil deposits the study area was registered on AHIMS as a PAD (AHIMS site 45-6-3064)[80].

It was not understood whether the buildings situated within the study area were built on top of original ground surfaces or built onto fill materials. It was also unknown whether the study area was situated on an area of reclaimed land surrounding Blackwattle Bay. European fill material was assessed as having low potential to contain intact Aboriginal archaeological deposits. It was also considered that if the study area was within an area of reclaimed land it should also be considered to have low potential for Aboriginal cultural heritage.

[78] Retrieved from http://dictionaryofsydney.org/item/97186 on 29 September 2015
[79] Gibbins, S & S. Higgs (2012) 445-473 Wattle Street, Ultimo: Proposed Student Accommodation Development: Aboriginal Cultural Heritage Assessment Report. Unpublished report prepared for Cultural Resources Management. AHIMS #102763.
[80] Ibid

The assessment also asserted that if the alluvial deposits were natural then they should be considered to have high potential to contain intact archaeological deposits. It was recommended that the alluvial soils be avoided by construction works if possible and that test excavation for Aboriginal cultural heritage be conducted prior to the commencement of any development[81].

Alexandria to Waterloo proposed gas line

Artefact prepared an Aboriginal heritage due diligence assessment for installation of a Jemena gas pipeline between Alexandria and Waterloo[82]. The investigation found that due to the high concentration of existing underground services along the proposed gas pipeline corridor that there was low potential for the proposed gas line route to contain intact natural soil deposits and therefore any Aboriginal objects or archaeological deposits.

60-78 Regent Street, Redfern

Artefact prepared a preliminary Aboriginal heritage assessment for proposed student accommodation at 60-78 Regent Street, Redfern. Artefact identified that the environmental background indicates that the site was on the fringe of a former dune system.[83] The expected soils would comprise wind-blown, fine to medium grained, well sorted marine quartz sand. The results of geotechnical investigation within the proposed accommodation site indicated the sand A-horizon soils have been removed from the area. It appears that fill has subsequently been deposited directly onto silty clay subsoils. Based on the site location on a crest landform not near any permanent water sources and the identified disturbance to the A horizon at the site, Artefact considered that the accommodation site demonstrated low archaeological potential.[84]

Redfern Courthouse and Police Station (Preliminary Desktop Assessment)

A preliminary desktop assessment was undertaken by Austral Archaeology for the proposed redevelopment of Redfern Courthouse and Police Station into a community health centre. The desktop indicated that the site was present on former sand dune landform, with numerous resources available within the region[85]. However, the land use history of the site indicated significant ground disturbance, including land clearance and construction of the Courthouse/Police Station with subsequent modifications and extensions to structures. An examination of a geotechnical investigation within the site also indicated that natural deposits had been significantly disturbed. Therefore any potential Aboriginal sites or objects within subsurface contexts would have been removed or destroyed since European modification[86]. It was concluded that the area had a very low potential for subsurface cultural material.

Development of the National Indigenous Development Centre

Archaeological and Heritage Management Solutions (AHMS) completed an Aboriginal heritage impact assessment of proposed development of a National Indigenous Development Centre (NIDC).[87] The impact assessment was prepared to accompany a Part 3A development application as a Major Project.

[81] Ibid
[82] Artefact 2014b, Aboriginal heritage due diligence assessment for proposed gas pipeline installation Alexandria to Waterloo, unpublished report to Parsons Brinckerhoff
[83] Artefact 2014c, Proposed Student Accomodation Development at 60-78 Regent St, Redfern: Preliminary Aboriginal Heritage Assessment, unpublished report to Iglu Pty Limited: 19
[84] Ibid: 26
[85] Austral Archaeology. 2007. Redfern Courthouse and Police Station – Preliminary Aboriginal Desktop Assessment. Report for Atkinson Capital Insight.
[86] Ibid
[87] AHMS, 2007. National Indigenous Development Centre - Aboriginal Heritage Impact Assessment. Report to Incoll Management.

The assessment identified that the soil profile of the study area comprised fill deposits across the site, ranging from 0.2 to 3 metres depth. However, geotechnical testing identified substantial portions of natural Aeolian sand below the fill deposit. The identified sands were grey coloured, which indicated potential humic content from former vegetation, suggesting that the sands are A-horizon soil[88]. Due to the presence of A-horizon sands below European fill and the abundance of resources associated with the former dunes in the region, it was concluded that the area had a potential for subsurface cultural material. The predictive modelling suggested site types could consist of artefact scatters, isolated artefacts, shell deposits or burials. Therefore it was determined that any development works that removed or destroyed the Aeolian sand deposits would potentially disturb Aboriginal archaeological deposits[89]. Therefore it was recommended that the development design be altered to avoid Aeolian sand, or an archaeological test excavation be completed to investigate the potential for archaeological deposits.

Redevelopment of Redfern RSL

CRM completed an Aboriginal archaeological assessment for the proposed redevelopment of the Redfern RSL; located at 157-159 Redfern Street, Redfern[90]. The archaeological assessment was prepared to accompany a Part 3A development application as a Major Project.

The archaeological assessment determined that there was a potential for Aboriginal objects to be located within the area, due to the resource rich nature of the area, pre-European settlement[91]. It found that the most likely site types present were camp sites, artefact scatters, isolated finds and middens. The assessment included an investigation into historic land use to determine the integrity of the subsurface soil profile within the site as the construction of the buildings could have degraded or removed evidence of past Aboriginal occupation. However, it was believed that the evidence could not accurately identify the depth of impacted natural terrain. Evidence cited included geotechnical investigations which identified up to 80 centimetres of fill material over sandy clay. While it was noted that the geotechnical investigation showed that no residual soils were present at the site, the archaeological assessment believed that this was insufficient evidence to prove disturbance across the entire site[92]. Subsequently the assessment recommended a small test excavation programme to identify the presence or absence of intact archaeological resource.

Archaeological investigation of the Botany sand sheet

Archaeological excavations within the Eastern Suburbs sand sheet system at Rose Bay[93], Prince of Wales Hospital Randwick[94], Long Bay, Prince of Wales Medical Research Institute[95] and Discovery Point Tempe[96] have located evidence of Aboriginal occupation. The Aboriginal sites located during those archaeological excavations are some of the oldest so far recorded in the Sydney Basin with dates for Discovery Point at around 10,000 yBP.

[88] Ibid p.14
[89] AHMS 2007 p.53
[90] CRM, Cultural Resources Management. 2009a. 157-159 Redfern Street, Redfern: Archaeological Assessment Aboriginal Archaeology. Report to Deicorp Pty Ltd
[91] Ibid p.16
[92] Ibid p.34
[93] Jo McDonald Cultural Heritage Management Pty Ltd, 2010. Archaeological Subsurface Investigations at the Royal Sydney Golf Club, Rose Bay. Report prepared for the Royal Sydney Golf Club.
[94] Godden Mackay Heritage Consultants Pty Ltd and Austral Archaeology Pty Ltd, 1997. Prince of Wales Project 1995, Randwick Destitute Children's Asylum Cemetery. Archaeological Investigation, Volume 2 – Archaeology, Parts 3, 4 and 5. Report prepared for the South Eastern Area Health Service, Heritage Council of NSW and NSW Department of Health.
[95] Mary Dallas Consulting Archaeologists, 2008. Prince of Wales Medical Research Institute Project. Proposed Neuroscience Research Precinct. Concept Plan and Project Application. Aboriginal Archaeology – Preliminary Assessment. Report to Winton Associates Pty Ltd.
[96] Jo McDonald Cultural Heritage Management Pty Ltd, 2005. Archaeological Testing and Salvage Excavation at Discovery Point in the Former Grounds of Tempe House, NSW. Report to Australand Holdings Pty Ltd.

In all the cases of archaeological excavations mentioned above, Aboriginal artefacts have been located within the A horizon, with the highest density of artefacts in general found in the upper grey sand layer.

The Rose Bay sand sheet is a separate Quaternary formation from the Moore Park sand sheet. Archaeological excavation within the Rose Bay sand sheet at the Royal Sydney Golf Club (JMcD CHM 2010: i) recovered skeletal remains from at least three Aboriginal people and an artefact scatter comprising over 5,700 objects.

The majority of the objects were retrieved from redistributed sand layers, while in some portions of the site intact podzol soil profiles onto coffee rock (B horizon silicified sands) were encountered[97].

Geological and archaeological investigations across the sand sheet associated with Moore Park indicates that the basal layers of the sand, associated with a layer of coffee rock, date to the terminal Pleistocene, between 30,000 to 40,000 years ago[98]. The oldest dated Aboriginal site in the sand sheet is 8,400 +/- 800 years yBP[99].

Attenbrow outlines information from sub-surface investigations which indicates that following the commencement of aeolian sand deposition across the Botany Bay Basin during the terminal Pleistocene, that there were several differing phases of sand deposition and movement associated with a range of environments[100]. The large sand dunes across the northern portion of the sand layer, associated with the Moore Park area, was likely to have formed across an environment of freshwater creeks and sandstone valleys[101].

Recent excavation by Artefact Heritage on the Botany sand sheet at Moore Park for the CBD and South East Light Rail (CSELR) early works retrieved a stone artefact from portions of the sand sheet that had been buried in the 19th and 20th century with up to 1 metre of introduced fill and rubbish. The investigation found that the greyish sand A1 horizon was absent or very fine, and that underneath the A1 horizon was bleached A2 sands onto 'coffee rock'. The results of that excavation demonstrate the fragility of the A1 horizon as it was the main interface between buried sand deposit and surface disturbances associated with vegetation clearance, erosion, fill and rubbish deposition, and in the case of the Waterloo Station area, construction of several phases of commercial, industrial and residential buildings.

6.5 Archaeological implications for the study area

The survivability of Aboriginal archaeological deposit on sites throughout the study area depends largely on the extent and nature of subsequent phases of historical construction activities. The excavation of basements or car parks substantially lowers the survivability potential of intact archaeological deposit.

[97] Mitchell, P., 2009. Geomorphology and soil materials of a sand ridge on the Royal Sydney Golf Club in relation to Aboriginal archaeology. Report to Jo McDonald Cultural Heritage Management Pty Ltd p.3
[98] Attenbrow, V., 2002. Pre-colonial Aboriginal land and resource use in Centennial, Moore and Queens Parks – assessment of historical and archaeological evidence for Centennial Parklands Conservation Management Plan. Report for incorporation into overall Conservation Management Plan prepared by Beyond Consulting for Conybeare Morrison and Partners:p.9-10
[99] Godden et al 1997
[100] Attenbrow 2002:9-10
[101] Ibid p.10

In some cases, phases of construction can act to preserve intact natural profiles. For example, in the Sydney CBD area, excavation at William Street demonstrated that the sandstone footings from the first phase of building construction had acted to protect the underlying Aboriginal archaeological deposit during subsequent demolition and deposition of fill across the site.[102]

In comparison, identified Aboriginal archaeological deposit at Angel Place was largely destroyed by subsequent building construction and other related activities bordering the Tank Stream.[103] Only a very small portion of archaeological deposit remained intact.

In summary, whilst the study area is likely to have been a site of Aboriginal occupation in the past, the likelihood of evidence of this occupation surviving to the present is influenced by a range of factors. These factors include the durability of the material evidence and subsequent impacts such as demolition and construction.

6.6 Predictive model

Archaeological data gathered in the locality has demonstrated the widespread and varying use of the area by Aboriginal people. The study area is located across a broad range of contexts, including areas within close proximity to marine and estuarine resources, fresh water, varying terrestrial subsistence resources, sandstone platforms and overhangs.

Previous archaeological investigations of the greater Sydney area in general demonstrate the distribution of recorded Aboriginal sites as reflecting the use of the landscape by Aboriginal people, including movement between resources and activity areas. The distribution of recorded Aboriginal sites in particularly built environments, such as the Sydney CBD area, is largely limited to areas that have been subject to archaeological excavation and/ or not impacted by development.

The distribution of overlapping and higher concentrations of stone artefacts in the Sydney area tended to be associated with high order watercourses and creek confluences, whilst lower density and more isolated activity areas in other parts of the landscape represented different and varying activities important to the understanding of overall landscape use.[104]

The distribution of Aboriginal sites also demonstrates the association of recorded Aboriginal sites with sandstone outcrops, including sandstone platforms where engravings are typically identified, and sandstone overhangs that were utilised for art, subsistence activities and artefact manufacture.

The predictive statements for the study area are as follows:

- The survivability of Aboriginal objects would be largely dependent on the extent and nature of subsequent phases of historical construction activities
- Sub-surface artefact sites tend to consist of lower density isolated occurrences in areas away from major watercourses, including freshwater, marine and estuarine areas
- More frequent and higher concentrations of sub-surface artefact sites are likely to occur in the vicinity of major watercourses

[102] Baker 2004
[103] Godden Mackay 1997
[104] White, E. & McDonald, J. 2010. Lithic Artefact Distribution in the Rouse Hill Development Area, Cumberland Plain, New South Wales. Australian Archaeology. 70: 29-38.

- Shell midden sites are more likely to be identified in close proximity to marine and estuarine areas. Note that due to land reclamation in the Sydney area former marine and estuarine areas may be set-back from contemporary shoreline areas
- Sandstone shelters suitable for archaeological deposit and outcrops suitable for engravings may be preserved in ridge crest and ridge slope landform contexts
- Surviving portions of deeper soil profiles within the study area, including the Botany sand sheet (Central Station and Waterloo Station) and Birrong soil landscape (Marrickville dive site) may provide stratified evidence of occupation.

7.0 HERITAGE IMPACT ASSESSMENT

7.1 Introduction

The following sections discuss the study area as it relates to the project. An overview of the environmental and archaeological context for each site, as well as an overview of archaeological potential and potential impacts is also included.

7.2 Chatswood dive site (northern)

The Chatswood dive site would be about 24,000 square metres in area and located adjacent to the T1 North Shore Line in Chatswood (see Figure 9). The site formerly included a service station and is currently occupied by an Ausgrid depot and a number of commercial and retail buildings.

The Chatswood dive site would be used to:

- Support surface metro track works and adjustment to the T1 North Shore Line between Chatswood Station and Brand Street, Artarmon including track slewing and construction of the T1 North Shore Line 'Down' (northbound) track viaduct
- Excavate and construct the tunnel dive structure and portal
- Launch and support two TBMs for the major tunnelling works
- Support tunnel rail systems fit out works

The southern portion of the site would be used for offices, workshops and car parking; spoil storage and handling would be located at the northern end of the site adjacent to the existing rail line, with segment storage adjacent to the Pacific Highway. The dive structure would be constructed in the eastern portion of the site.

7.2.1 Environmental context overview

The Chatswood dive site is located across a broad ridge crest landform. The closest watercourses to the site include Swaines Creek approximately 600 m to the west and Flat Rock Creek approximately 750 m to the southeast. Prior to the significant modification of the area for residential and commercial development, it is likely that there would have been several ephemeral first order tributaries of Flat Rock Creek and Swaines Creek across the subject site.

The underlying geology of the Chatswood dive site is Ashfield Shale, which is generally composed of black to dark-grey shale and laminate.[105] Ashfield Shale caps the broad ridge of Hawkesbury Sandstone west.[106] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be residual soils developed *in situ.*[107] This includes the residual Blacktown soil landscape across the slightly higher crest landform context[108] and the erosional Glenorie soil landscape across the slightly lower portions of the crest landform context overlying the Ashfield Shale.[109]

[105] Herbert 1983 p.22
[106] Ibid
[107] Chapman G.A., Murphy, C.L., Tille P.J., Atkinson G. and Morse R.J., 2009 Ed. 4, *Soil Landscapes of the Sydney 1:100,000 Sheet* map, Department of Environment, Climate Change and Water, Sydney
[108] Ibid
[109] Ibid

Archaeological implications of the soil landscape within the subject site are that the residual Blacktown soils represent a moderately deep (<1m) soil with limited erosion characteristics in areas with ground cover.[110] The Glenorie soil landscape is highly erodible, including sheet erosion and gully formation.[111] This erosion may affect the contextual integrity of archaeological deposits over time.

Figure 9: Location of the Chatswood dive site (northern)

[110] Ibid pg.22
[111] Ibid pg.66

7.2.2 AHIMS

No recorded Aboriginal sites are located within 100 metres of Chatswood dive site (see Figure 9). The closest recorded Aboriginal site is AHIMS site 45-6-2938, a surface artefact(s) site recorded adjacent to the rail corridor 1.6 kilometres to the south.

7.2.3 Archaeological context overview

A limited number of archaeological investigations have occurred in the Chatswood area. The closest Aboriginal site is AHIMS site 45-6-2938. Aboriginal heritage assessments in the local area have highlighted the predominance of evidence relating to Aboriginal activities in the following areas:

- Adjacent to major watercourses, such as Lane Cove River
- In areas of exposed sandstone platforms and shelter formations, such as in slope landform contexts and at a break of slope
- Areas that have not been heavily developed and modified.

Results from the ETTT project indicated that there are occurrences of Aboriginal objects across ridge crest areas away from water sources and adjacent to developed and modified areas. However, that assessment also noted that the likely archaeological potential associated with those finds was low and that no further archaeological investigation was warranted.[112]

Aboriginal heritage assessments at Chatswood West[113] and Artarmon[114] did not identify any Aboriginal objects or areas of archaeological potential. The assessments suggested that distance from major watercourses and disturbance associated with residential/ commercial/ industrial development were contributing factors to the low/ nil archaeological potential in both subject areas.

7.2.4 Site inspection results

The Chatswood dive site consists of built environment intersected by Mowbray Road and the North Shore Line. The survey unit is covered either by hard surfaces, such as concrete and bitumen, or built structures. Exotic plantings are located along road verges and associated with built structures.

The existing rail corridor is located within a cutting beneath Mowbray Road, and raised on an embankment and viaduct structure across the low-lying terrain north of Nelson Street. The proposed tunnel entrance includes a large cutting on the western side of the existing railway easement. The proposed work site area between Mowbray Road, Pacific Highway and Nelson Road includes built structures and a large hardstand car park.

Discussion and analysis of site inspection results

Observations of the rail corridor during the survey indicate that any natural landform associated with the rail corridor is likely to have either been removed for the cutting or built over for the embankment and viaduct structure.

The area between Mowbray Road, Pacific Highway and Nelson Road consists of one – two storey built structures and a large hardstand car park. No evidence of basements or underground car parks associated with any of those structures were observed.

[112] Artefact 2014
[113] Total Earth Care 2007
[114] Steele, D. 2006

Plate 1: View north along North Shore line towards Chatswood CBD

Plate 2: View north across hardstand car park bordering the Pacific Highway

7.2.5 Assessment of archaeological potential

The construction of commercial buildings, roads and the large rail cutting through the Chatswood dive site is likely to have impacted or removed portions of any remaining natural deposits at the at the northern dive site. A petrol station was located in the northwestern portion of the site at the corner of the Pacific Highway and Nelson Street. That area is likely to have undergone sub-surface disturbance related to installation and subsequent removal of underground petrol tanks. The least impacted portion of the site is likely to be the area currently beneath a hardstand car park between Bryson Street and Nelson Street and immediately east of the former petrol station site. In that area a number residential dwellings have been demolished within the last six years and the area covered by bitumen to form a hardstand car park.

The relatively shallow soils associated with Ashfield Shale suggest that even minor surface disturbance associated with building, road construction and removal of structures is likely to have a significant impact or result in the removal of natural A horizon contexts.

The predictive model (Section 6.6) indicates that more frequently visited areas likely to demonstrate evidence of repeated and overlapping activities are likely to occur in close proximity to high order watercourses, raw material resources, or prominent features in the landscape. The Chatswood dive site is located on a crest landform context away from major watercourses, suggesting that overall archaeological potential is likely to be low.

7.2.6 Significance assessment

The archaeological significance of the Chatswood dive site is assessed as low due to its low archaeological potential resulting from high levels of ground disturbance that would have impacted any surface or subsurface Aboriginal sites. No Aboriginal sites have been identified within the study area.

7.2.7 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the Chatswood dive site.

Due to the landscape context and largely modified nature of the Chatswood dive site and surrounding area, no areas of archaeological potential have been identified within the proposed area of works.

7.3 Artarmon substation

A traction substation is required to service the metro between Chatswood and Crows Nest (see Figure 10). The proposed site is adjacent to the Gore Hill Freeway. The site is elevated above freeway level, with a retaining wall immediately below the site. A 3 metre internal diameter cable shaft is required to access the metro, which would intersect a cross-passage between the two running tunnels.

The Artarmon substation would be constructed in the following sequence:

- Excavation of a vertical shaft to the tunnels below
- Lining and reinforcement of the shaft
- Building works for aboveground components
- Installation of electrical equipment.

7.3.1 Environmental context overview

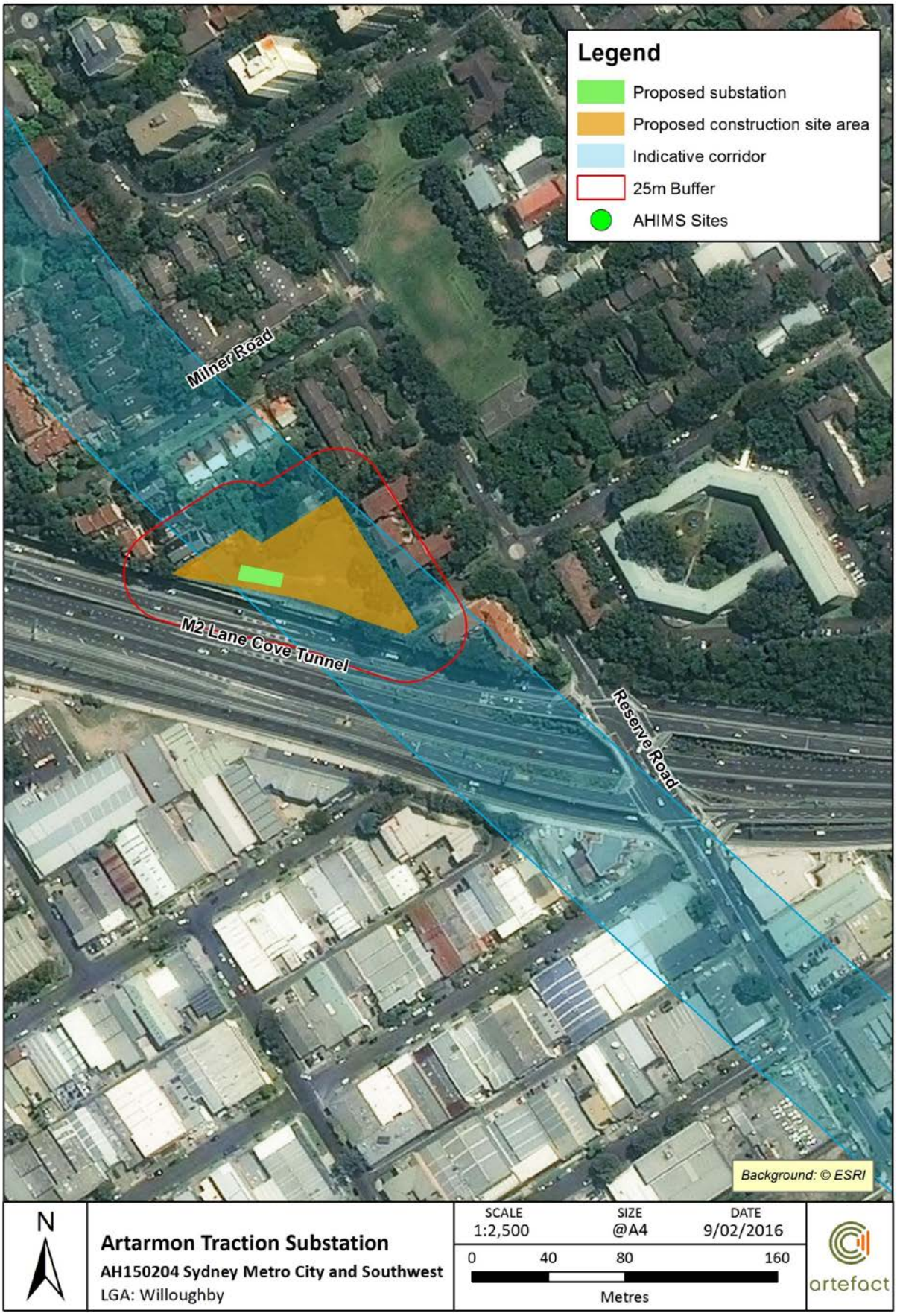
The Artarmon substation is located across a broad ridge crest landform. The closest watercourses to the site include Flat Rock Creek approximately 900 m to the southeast and Gore Creek approximately 950 metres to the southwest. Prior to the significant modification of the area for residential and commercial development, it is likely that there were first and/ or second order tributaries of Flat Rock Creek close to the subject site.

The underlying geology of the Artarmon substation site is Ashfield Shale, which is generally composed of black to dark-grey shale and laminate.[115] Ashfield Shale caps the broad ridge of Hawkesbury Sandstone west.[116] Soils associated with the site consists of the erosional Glenorie soil landscape.[117]

Archaeological implications of the soil landscape within the subject site are that the Glenorie soil landscape is highly erodible, including sheet erosion and gully formation.[118] This erosion over time may affect the contextual integrity of archaeological deposits.

[115] Herbert 1983 p.22
[116] Ibid
[117] Ibid
[118] Ibid p.66

Figure 10: Location of the Artarmon substation



7.3.2 AHIMS

No recorded Aboriginal sites are located within 100 metres of Artarmon substation site (see Figure 10). The closest recorded Aboriginal site is AHIMS site 45-6-2938, a surface artefact(s) site recorded adjacent to the rail corridor 1.2 kilometres to the south.

7.3.3 Archaeological context overview

A limited number of archaeological investigations have occurred in the Artarmon area. The closest Aboriginal site is AHIMS site 45-6-2938. Aboriginal heritage assessments in the local area have highlighted the predominance of evidence relating to Aboriginal activities in the following areas:

- Adjacent to major watercourses, such as Lane Cove River
- In areas of exposed sandstone platforms and shelter formations, such as in slope landform contexts and at a break of slope
- Areas that have not been heavily developed and modified.

Results from the ETTT project indicated that there are occurrences of Aboriginal objects across ridge crest areas away from water sources and adjacent to developed and modified areas. However, that assessment also noted that the likely archaeological potential associated with those finds was low and that no further archaeological investigation was warranted.[119]

Aboriginal heritage assessments at Chatswood West[120] and Artarmon[121] did not identify any Aboriginal objects or areas of archaeological potential. The assessments suggested that distance from major watercourses and disturbance associated with residential / commercial / industrial development were contributing factors to the low / nil archaeological potential in both subject areas.

7.3.4 Site inspection results

The Artarmon substation site was an active construction site at the time of the site survey, and was therefore not accessed.

Discussion and analysis of site inspection results

Observations of the work site from Barton Road support the background information that the site is extensively disturbed. Vegetation has been cleared from the site and it appears that the ground surface is covered with introduced material.

[119] Artefact Heritage 2014
[120] Total Earth Care 2007
[121] Steele, D. 2006

Plate 3: View northwest across the Artarmon construction site from Barton Crescent

7.3.1 Assessment of archaeological potential

Based on a review of available literature and historical aerial photography, the Artarmon substation site has previously been subject to varying levels of surface disturbance. This includes:

- Residential subdivision and house construction on each of the individual lots within the site
- Demolition of the houses during construction/ widening of the Gore Hill Freeway
- Use of the site as a stockpile/ site compound area during construction of the Lane Cove Tunnel
- Current construction activities on the site for (temporary) education buildings associated with Artarmon Public School.

Each of the listed activities, especially use of the site during construction of the Lane Cove Tunnel, is likely to have significantly altered and / or removed existing A horizon and potentially artefact bearing layer across the Artarmon substation. Google Earth images of the area from 2005-2007 show that the Lane Cove Tunnel works included extensive use of the Artarmon substation site, including construction of a site compound/ storage facility, storage of containers and equipment, and site remediation following completion of works.

The archaeological potential of the Artarmon substation site is assessed as low due to high levels of surface disturbance.

7.3.2 Significance assessment

The archaeological significance of the Artarmon substation site is assessed as low due to its low archaeological potential resulting from high levels of ground disturbance that would have impacted any surface or subsurface Aboriginal sites. No Aboriginal sites have been identified within the study area.

7.3.3 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the Artarmon substation site.

Due to the largely modified nature of the Artarmon substation site and surrounding area there are no identified areas of archaeological potential that would be impacted by the proposed works at the Artarmon substation.

7.4 Crows Nest Station

7.4.1 Proposed scope of works

Crows Nest Station is located to the south of the existing St Leonards Station and close to the entertainment and retail strip along Willoughby Road (see Figure 11). The station box would be located between the Pacific Highway, Oxley Street, Clarke Lane and Hume Street. The station entrances would be from Clarke Street and corner of Pacific Highway and Oxley Street.

7.4.2 Construction

The Crows Nest Station construction site would be about 6,000 square metres. The site currently contains a variety of commercial and residential buildings.

This station would be constructed using a cut-and-cover methodology, resulting in a total of about 150,000 cubic metres of spoil being removed through the site. The site would function as two separate construction zones split by Hume Street. The cut-and-cover construction through Hume Street would be staged to allow two-way traffic access to be maintained, although there may be some short term periods of closure.

Access and egress to and from the site would be to and from Hume Street and Clarke Street.

The station excavation would comprise the majority of the site, necessitating a street level temporary working platform to be installed. Support services including office, amenities, spoil handling and storage, and workshops would be provided on the working platforms.

7.4.3 Environmental context overview

Crows Nest Station is located on gently undulating terrain on the northern margin of a broad sandstone ridge. The sandstone ridge extends to North Sydney in the southwest and is bordered by Long Bay to the north and Sydney Harbour to the south. The surface context of Crows Nest Station has been substantially modified through building and road construction. The closest watercourse is Berrys Creek, approximately 700 metres to the southwest. Prior to the significant modification of the area for commercial and residential development it is likely that Crows Nest Station would have been located across the watershed between Berrys Creek to the west and drainage into Long Bay to the east. Local watercourses in the vicinity of Crows Nest Station would likely have consisted of ephemeral first order tributaries.

The underlying geology of Crows Nest Station is Ashfield Shale, which is generally composed of black to dark-grey shale and laminate.[122] Ashfield Shale caps the broad ridge of Hawkesbury Sandstone west.[123] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be residual soils developed *in situ.*[124] This includes the residual Blacktown soil landscape.

Archaeological implications of the soil landscape within the subject site are that the residual Blacktown soils represent a moderately deep (<1m) soil with limited erosion characteristics in areas with ground cover.[125] Unless removed or disturbed through commercial/ road / infrastructure development or extreme erosion events, archaeological material is likely to remain relatively *in situ* (subject to bioturbation).

7.4.4 Geotechnical information

Boreholes on Oxley Street and Hume Street indicate a layer of up to 1 metre of clay fill overlying residual clay.

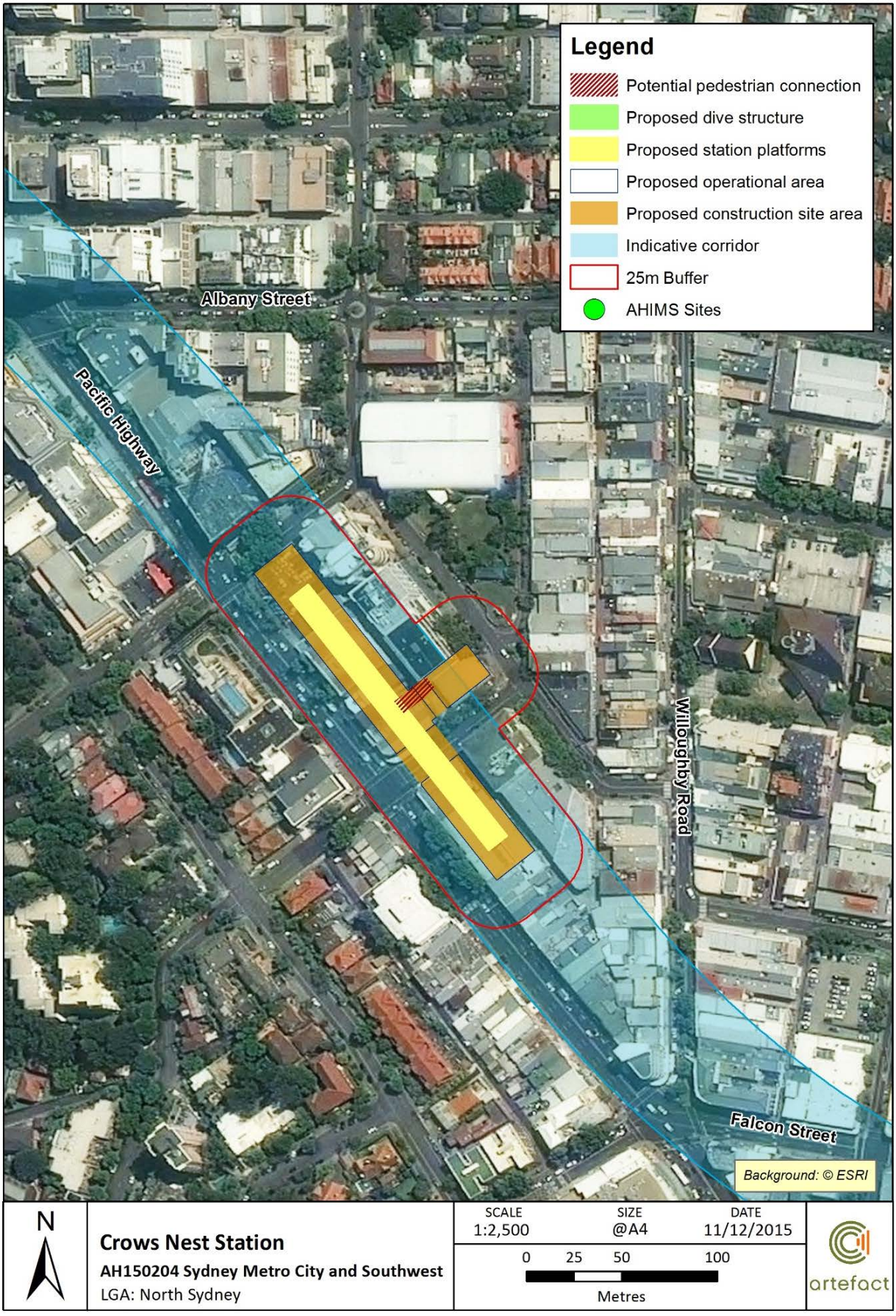
This information suggests that any remnant A horizon soils has been removed from the two borehole locations. This also provides an indication of the type of residual soil removal expected in a significantly built environment with basements, underground car parks and services.

7.4.5 AHIMS

No recorded Aboriginal sites are located within 100 metres of Crows Nest Station (see Figure 11). The closest recorded Aboriginal site is AHIMS site 45-6-2938, a surface artefact site recorded adjacent to the rail corridor 925 metres to the northwest (see Figure 5).

[122] Herbert 1983 p.22
[123] Ibid
[124] Chapman G.A., Murphy, C.L., Tille P.J., Atkinson G. and Morse R.J., 2009 Ed. 4, *Soil Landscapes of the Sydney 1:100,000 Sheet* map, Department of Environment, Climate Change and Water, Sydney
[125] Ibid pg. 22

Figure 11: Location of Crows Nest Station site



7.4.6 Archaeological context overview

A limited number of archaeological investigations have occurred in the Crows Nest area. The closest Aboriginal site is AHIMS site 45-6-2938. Aboriginal heritage assessments in the local area have highlighted the predominance of evidence relating to Aboriginal activities in the following areas:

- Adjacent to major watercourses, such as Lane Cove River
- In areas of exposed sandstone platforms and shelter formations, such as in slope landform contexts and at a break of slope
- Areas that have not been heavily developed and modified.

Results from the ETTT project on a similar ridge crest landform at Beecroft indicated that there are occurrences of Aboriginal objects across ridge crest areas away from water sources and adjacent to developed and modified areas. However, that assessment also noted that the likely archaeological potential associated with those finds was low and that no further archaeological investigation was warranted.[126]

Aboriginal heritage assessments at Chatswood West[127] and Artarmon did not identify any Aboriginal objects or areas of archaeological potential. The assessments suggested that distance from major watercourses and disturbance associated with residential/ commercial/ industrial development were contributing factors to the low / nil archaeological potential in both subject areas.

An Aboriginal heritage assessment of the Royal North Shore Hospital site did not identify any Aboriginal objects or areas of archaeological potential.[128] Survey observations of that area by Steele note the highly disturbed context of that area, including 'clearance of original timber and consequent heightened natural erosion, and more significantly by the extensive earthworks and construction works associated with the building of the hospital complex'. [129]

7.4.7 Site inspection results

The proposed Crows Nest Station site is located across a built environment between the Pacific Highway and Clare Street. The station site is situated across a gentle slope down to the north. No areas of surface visibility or intact ground surface were observed.

Discussion and analysis of site inspection results

Due to the gentle slope across the proposed station site, many of the built structures are cut into the slope. This is likely to have removed sections of the natural ground surface and consequently removed any archaeological deposits.

[126] Artefact 2014
[127] Total Earth Care 2007
[128] Steele, D 2006, Final Aboriginal Archaeological Excavation Report. The KENS Site (Kent, Erskine, Napoleon and Sussex Streets), Sydney, NSW, containing DECC Site 45-6-2647 and associated areas of PAD, unpublished report to Leighton Contractors Pty Ltd
[129] Steele, D. 2006 p.26

Plate 4: View north along Clarke Lane from Hume Street

Plate 5: View southeast across the Pacific Highway towards the proposed station site

7.4.8 Assessment of archaeological potential

Limited archaeological investigation has occurred at Crows Nest. The closest recorded Aboriginal site to Crows Nest Station (AHIMS site 45-6-2938) is mapped in a car park adjacent to the rail corridor. No heritage assessment report is associated with that recording. The Aboriginal heritage assessment conducted for the Royal North Shore Hospital site to the northwest of Crows Nest Station[130] identified that due to large-scale disturbance there was no assessed archaeological potential across that area.

The construction of commercial buildings and roads across the Crows Nest Station site are likely to have impacted or removed archaeological deposits. The relatively shallow soils associated with Ashfield Shale suggest that even minor surface disturbance associated with building or road construction is likely to have had a significant impact or have resulted in the removal of natural A horizon contexts.

Limited basement information available for preparation of this version of the report indicates that a basement covers the majority of the lot located at 477 Pacific Highway (Lot 100 DP747672). The rear of the basement appears to be at the same level as Clarke Lane. The basement fronting Pacific Highway appears to be substantially cut in, but AHD levels on plan are not clear. Ground level off the Pacific Highway is listed as 92.91 metres AHD, whilst basement floor level is listed as 93.05 metres AHD. It can be assumed that any archaeological resource in this location has been removed.

The predictive model (Section 6.6) indicates that more frequently visited areas likely to demonstrate evidence of repeated and overlapping activities, are likely to occur in close proximity to high order watercourses, raw material resources, or prominent features in the landscape. Crows Nest Station is located on a crest landform context away from major watercourses, suggesting that the overall archaeological potential of Crows Nest Station is likely to be low.

7.4.9 Significance assessment

The archaeological significance of Crows Nest Station site is assessed as low due to its low archaeological potential resulting from high levels of ground disturbance that would have impacted any surface or subsurface Aboriginal sites. No Aboriginal sites have been identified within the study area.

[130] Steele 2006

7.4.10 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the Crows Nest Station site.

Due to the landscape context and largely modified nature of Crows Nest Station and surrounding area there are no identified areas of archaeological potential that would be impacted by the proposed works at the Crows Nest Station site.

7.5 Victoria Cross Station

Victoria Cross Station is located in the centre of the North Sydney central business district and has the potential to serve the northern and eastern commercial centres of North Sydney (see Figure 12). The station box would be located under Miller Street between Berry Street and McLaren Street. The station entry would be from Miller Street.

7.5.1 Construction

The northern and southern shafts (site areas A and B respectively) at Victoria Cross Station would be serviced from a suspended working platform over the majority of the shaft area.

The proposed sequencing of the excavation works for the northern and southern shafts of Victoria Cross entails the following:

- Demolition of existing buildings to basement
- Working platforms are formed for piling rigs i.e. backfill pits if necessary
- Piling works – perimeter walls and long piles
- Initial excavation site to allow for the construction of the working platform
- Construction of suspended working platform over shafts, with a shaft opening of at least 15.0m x 20.0m for the removal of spoil and machinery access
- Construction of acoustic shed where necessary and site infrastructure i.e. site office, staff amenities, workshop
- Shaft excavation to required depth.

7.5.2 Environmental context overview

Victoria Cross Station is located on gently undulating terrain on the southern margin of a broad sandstone ridge. The sandstone ridge extends to northwest from North Sydney and is bordered by Lavender Bay to the south. The surface context of Victoria Cross Station has been substantially modified through building and road construction. The closest watercourses are heavily modified unnamed watercourses that flow off the ridgeline into Sydney Harbour, including a heavily developed natural drainage depression starting approximately 300 metres west of Victoria Cross Station that flows into Berrys Bay, and a modified drainage channel 600 metres to the east that flows into Neutral Bay. Local watercourses in the vicinity of Victoria Cross Station would likely have consisted of ephemeral first order tributaries.

Victoria Cross Station is located across the transition between Ashfield Shale and Hawkesbury Sandstone geology. The underlying geology of Site Area B is Ashfield Shale, which is generally

composed of black to dark-grey shale and laminate.[131] Ashfield Shale caps the broad ridge of Hawkesbury Sandstone.[132] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be residual soils developed *in situ.*[133] This includes the residual Blacktown soil landscape.

Generally shallow soils existed across the Hawkesbury Sandstone at Site Area A, with soil developed *in situ* from the underlying sandstone geology. This soil context, called the Gymea soil landscape, consisted generally of sandy soils with high erosion hazard in cleared areas.[134] The upper lens of Hawkesbury sandstone beneath the Gymea soil landscape is likely to be weathered and fractured, resulting in 'floating' bedrock at the soil/bedrock transition.[135]

Archaeological implications of the soil landscape within the subject site are that the residual Blacktown soils represent a moderately deep (<1m) soil with limited erosion characteristics in areas with ground cover.[136] Unless removed or disturbed through commercial/ road / infrastructure development or extreme erosion events, archaeological material is likely to remain relatively *in situ* (subject to bioturbation). The Gymea soil landscape is generally shallow to moderately deep (30-100 cm) with high soil erodibility.[137] Based on the shallow and highly erodible nature of the Gymea soil landscape, it is likely that extensive commercial development has removed or significantly disturbed that context at the Victoria Cross Station site.

7.5.3 Geotechnical information

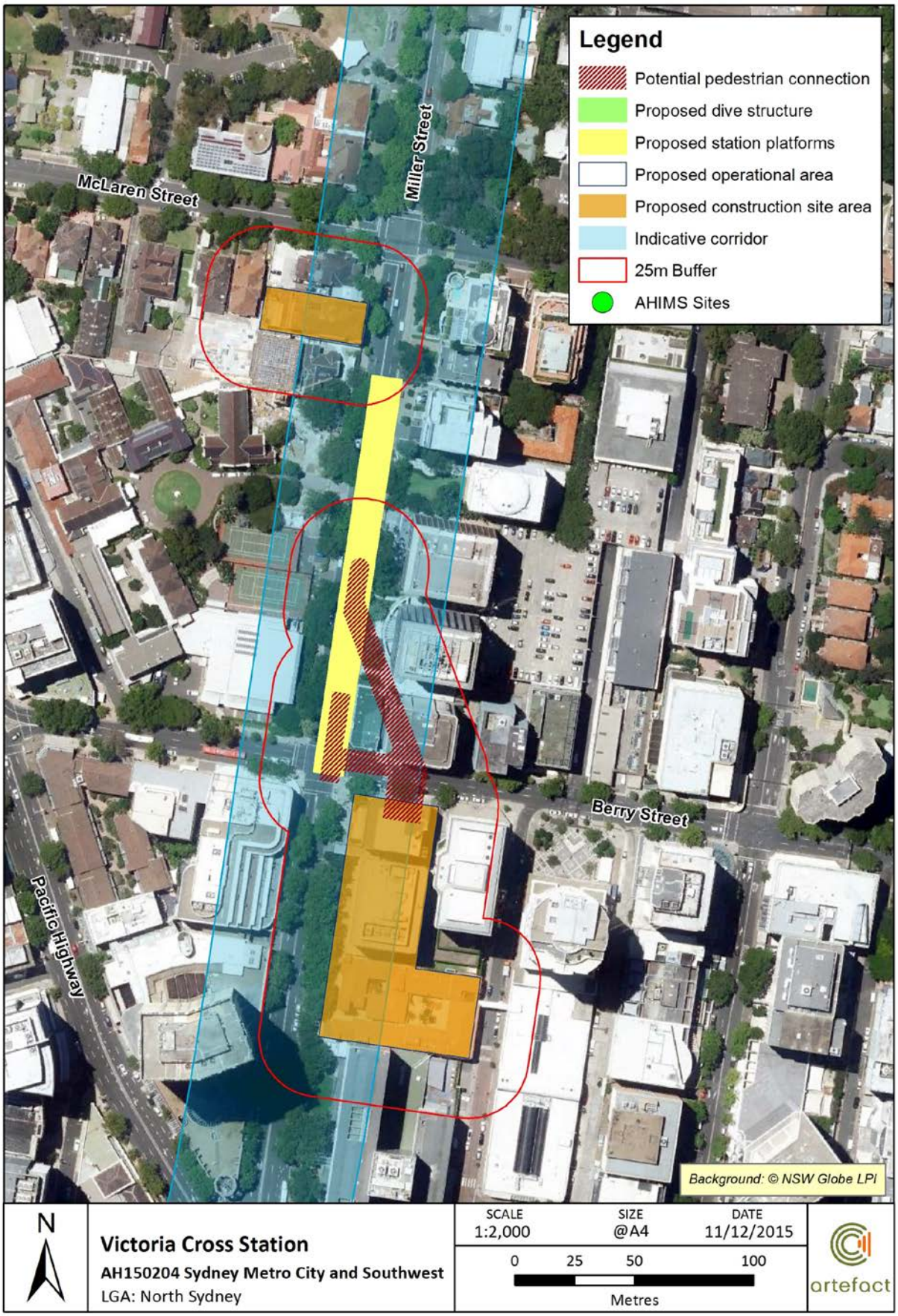
Two boreholes placed on Miller Street indicate up to 1.2 metres of fill overlying up to 4 metres of residual sandy clay to clayey sand associated with weathering Hawkesbury Sandstone. This information suggests that soils are absent at the two borehole locations.

7.5.1 AHIMS

No recorded Aboriginal sites are located within 100 metres of the Victoria Cross Station site (see Figure 12). The closest recorded Aboriginal site is AHIMS site 45-6-2055, an artefact and shell midden site recorded at Lavender Bay 715 metres to the south.

[131] Herbert 1983 p.22
[132] Ibid
[133] Chapman G.A., Murphy, C.L., Tille P.J., Atkinson G. and Morse R.J., 2009 Ed. 4, *Soil Landscapes of the Sydney 1:100,000 Sheet* map, Department of Environment, Climate Change and Water, Sydney
[134] Chapman and Murphy 1989
[135] Lawrie 1999 p.70
[136] Lawrie 1999 p.22
[137] Chapman and Murphy 2009 pg. 71

Figure 12: Location of the Victoria Cross Station site



7.5.2 Archaeological context overview

The Victoria Cross Station site location has been significantly altered through construction of commercial and residential structures, road construction and service installation. The results of the AHIMS site register search demonstrate the predominance of recorded Aboriginal sites in the area are associated with the Sydney Harbour foreshore. The predominance of recorded Aboriginal sites in that context is likely to be the result of:

- The higher survivability of natural contexts along the harbour foreshore in the North Sydney area. Portions of the harbour foreshore have been preserved in natural reserves or in discrete areas that have not been impacted.
- The sandstone geology of the area results in natural flat outcrops and overhangs. Some flat outcrops were utilised for engravings, whilst overhang formations may have been used for shelter, art, manufacture of tools and other subsistence activities. Any natural sandstone outcrops and overhangs that may have occurred further away from the shoreline and in the vicinity of Victoria Cross Station are likely to have been destroyed.
- The predominance of marine and estuarine subsistence resources around the foreshore zone.

Archaeological salvage excavation in a similar sandstone crest setting on the southern side of Sydney Harbour in the Rocks was conducted by Attenbrow in 1992 on Cumberland Street south of Millers Point.[138] The midden assemblage was carbon dated to around 340 years prior to the European settlement of Sydney Cove. The assemblage included bones of Snapper (*Pagrus auratus*) and Bream (*Acanthopagrus australis*), and shells of Rock Oyster (*Saccostrea cucullata*) and Hairy Mussel (*Trichomya hirsuta*).[139]

The setting and results of that excavation demonstrate the fact that shell midden material may not be confined to the shoreline settings, but may also be found in the vicinity at higher elevations. It should be noted that the land-use at Victoria Cross includes construction of large office towers that are likely to have had a more significant impact on the extant ground surface than 19th century residential and commercial dwellings on Cumberland Street.

7.5.3 Site inspection results

The Victoria Cross Station site is located across a built environment. The station site is situated across a moderate to gentle slope down to the south. No areas of surface visibility or intact ground surface were observed.

Underground car park entrances were observed associated with 155-167 Miller Street, 189 Miller Street, 55-69 Berry Street and 194 Berry Street.

Discussion and analysis of site inspection results

Underground car parks indicate the likely removal of natural deposits and consequently archaeological potential at those locations. The heavily built environment and multiple underground services across the remainder of the area indicates the likely removal of natural deposits and archaeological potential within sections of the project station site area.

[138] Attenbrow 1992
[139] Ibid

Plate 6: View southeast across Miller Street towards the proposed southern section of Victoria Cross Station

Plate 7: View north across Berry Street towards the Rag and Famish Hotel

Plate 8: View south across Berry Street towards the northwestern corner of the southern section of Victoria Cross Station

Plate 9: View northwest towards the proposed northern section of Victoria Cross Station at 194 Miller Street

7.5.4 Assessment of archaeological potential

Limited archaeological investigation has occurred at North Sydney in the vicinity of Victoria Cross Station. The majority of recorded Aboriginal sites in the local area are associated with the Harbour foreshore zone, approximately 600 metres to the south. The Aboriginal heritage assessment conducted for the Royal North Shore Hospital in a similar crest landform context to Victoria Cross Station[140] identified that due to large-scale disturbance there was no assessed archaeological potential across that area.

The construction of commercial buildings, roads and underground services are likely to have impacted upon or removed archaeological deposits. The relatively shallow soils associated with Ashfield Shale and the crest context Hawkesbury Sandstone suggest that even minor surface disturbance associated with building or road construction is likely to have a significant impact or result in the removal of natural A horizon contexts.

[140] Steele 2006

Limited basement information available for preparation of this report suggests that a basement covers the majority of the lot located at 194 Miller Street (Lot 1 DP1183173), in the northernmost study area. The property has two basement levels, with Basement 2 (the lowest) ranging between 4.94 metres below ground level fronting Miller Street and 8.94 metres below ground level towards the rear of the property (74.16 metres AHD). It can be assumed that any archaeological resource in this location has been removed.

The predictive model (Section 6.6) indicates that more frequently visited areas likely to demonstrate evidence of repeated and overlapping activities are likely to occur in close proximity to high order watercourses, raw material resources, or salient features in the landscape. Victoria Cross Station is located on a crest landform context away from major watercourses, suggesting that the overall archaeological potential of Victoria Cross Station is likely to be low.

7.5.5 Significance assessment

The archaeological significance of the Victoria Cross Station site is assessed as low due to its low archaeological potential resulting from high levels of ground disturbance that would have impacted any surface or subsurface Aboriginal sites. No Aboriginal sites have been identified within the study area.

7.5.6 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at Victoria Cross Station.

Due to the largely modified nature of Victoria Cross Station and surrounding area there are no identified areas of archaeological potential that would be impacted by the proposed works at Victoria Cross Station.

7.6 Blues Point temporary site

The temporary site at Blues Point is proposed for the retrieval of the cutter heads from the TBMs coming from Chatswood and Barangaroo (see Figure 13).

7.6.1 Construction

The Blues Point temporary site would be about 2,100 square metres and would be located within Blues Point Reserve at the end of Blues Point Road. The site currently contains public open space and a public road.

Construction works at this site would involve the excavation of a shaft to the tunnels below resulting in around 8,000 cubic metres of spoil being removed through the site. The cutter heads and shield of the TBMs from Chatswood and Barangaroo would be retrieved through this shaft. During retrieval of the TBM components, this site would expand to encompass the current car parking on Blue Point Road adjacent to the reserve and the end of Blues Point Road.

Access and egress to and from the site would be left in from Blues Point Road and left out to Henry Lawson Drive.

7.6.2 Environmental context overview

Blues Point temporary site is located on the northern shore of Sydney Harbour at the base of a large sandstone ridgeline that extends north/northwest to include Victoria Cross, Crows Nest, Artarmon substation and the northern construction site. Although the Blues Point temporary site is located on the margin of Sydney Harbour and in a context rich with estuarine resources frequently utilised by Aboriginal people, the site is likely to have been significantly impacted by use throughout the 20th century as a wharf and ship launching area. Aerial photos of the site from 1930 and 1943 show wharves, boat ramp, structures and substantial excavation/ landform modification at the site.

The underlying geology of the Blues Point temporary site is Hawkesbury Sandstone. Soil landscapes generally associated with the area include the Hawkesbury soil landscape, which is generally a very shallow (<50cm) soil landscape with high erodibility located across steep landform contexts.[141]

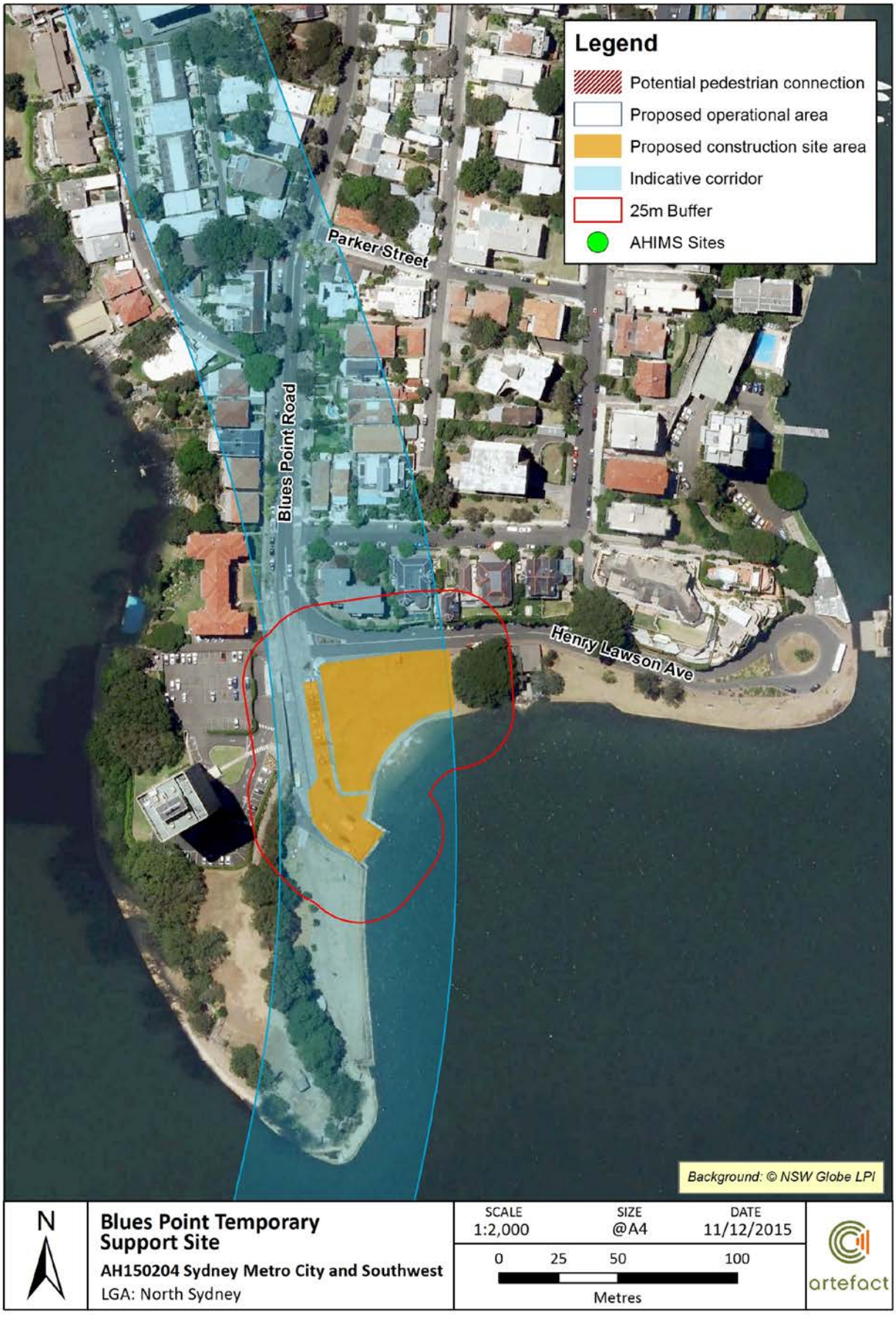
7.6.3 Geotechnical information

One borehole was placed approximately 35 metres north of the southern tip of Blues Point and approximately 70 metres south of the Blues Point temporary construction site. Geotechnical information indicates reclamation material to a level of -3.6 m Australian Height Datum (AHD). The reclamation material overlies Hawkesbury sandstone.

This information supports the information presented in Section 7.6.2 that portions of Blues Point are likely to have undergone extensive disturbance.

[141] Chapman and Murphy 2009 p.46

Figure 13: Location of the Blues Point temporary site



7.6.4 AHIMS

No recorded Aboriginal sites are located within 100 metres of the Blues Point temporary site (see Figure 13). The closest recorded Aboriginal site is AHIMS site 45-6-1267, an artefact and shell midden site recorded at Balls Head approximately 560 metres to the west.

7.6.5 Archaeological context overview

The original landscape context of Blues Point is likely to have consisted of a rocky shoreline context. The shoreline would have provided important subsistence resources, including cockle (*Anadara trapezia*). Although the area has been significantly altered, significant archaeological resources have been identified in discrete areas that have been preserved beneath areas of historical development.

Although there are no identified Aboriginal sites or previous archaeological investigations in the vicinity of Blues Point, due to the similarities in landform context, previous archaeological investigations in the vicinity of Millers Point are likely to provide some insight into the archaeological potential of the Sydney Harbour foreshore.

At Millers Point, Lampert and Truscott excavated beneath the rubble floor of the Bond Store at Moore's Wharf in 1984 after Aboriginal midden material was identified at the site.[142] This site is recorded as AHIMS site 45-6-0519.

The excavation identified ten centimetres of shell midden overlay approximately 30 centimetres of compact grey sand with stone artefacts. The shells recovered included Rock and Mud Oyster (*Saccostrea* and *Ostrea*), cockle (*Anadara trapezia*), whelk (*Pyrazus ebininus*) and mussel (*Trichomya*). Approximately 392 stone artefacts were recovered. The assemblage included cores, used flakes and fabricators. There was also evidence for the use of unusually small pebbles and bipolar flaking. Raw materials included silcrete, quartz, quartzite and chert. It was concluded that the artefacts were typical of the post-Bondaian (most recent) phase of Aboriginal culture in the area. Evidence for continued Aboriginal use of the site into the historic period was found in the small number of European ceramic fragments recovered from the grey sand.

Archaeological salvage excavation of an Aboriginal site was conducted by Attenbrow in 1992 on Cumberland Street and across the crest of the main sandstone ridge south of Millers Point.[143] The midden assemblage was carbon dated to around 340 years prior to the European settlement of Sydney Cove. The assemblage included bones of Snapper (*Pagrus auratus*) and Bream (*Acanthopagrus australis*), and shells of Rock Oyster (*Saccostrea cucullata*) and Hairy Mussel (*Trichomya hirsuta*).[144]

As with the foreshore in the vicinity of Millers Point and Barangaroo, where there has been significant landform disturbance or removal, there are limited opportunities for the identification of intact contexts where Aboriginal objects remain in surface or sub-surface contexts.

7.6.6 Site inspection results

The proposed site consists of a gentle slope bordering the northern foreshore of Sydney Harbour. Surface visibility is limited due to dense grass cover. Occasional patches of visibility were observed in small clearings general measuring less than 300 mm across. The foreshore is delineated by a sandstone retaining wall.

[142] Lampert and Truscott 1984
[143] Attenbrow 1992
[144] Ibid

Discussion and analysis of site inspection results

During the site walkover with Jay Daley (MLALC), differences were observed in the nature of material across the ground surface at Blues Point. The visible surface sediments across most of the site and bordering the sandstone retaining wall appeared mixed and indicative of fill or disturbed material.

The proposed site consists of a gently sloping grassed slope bordering the northern foreshore of Sydney Harbour. There is no surface visibility across the area due to dense grass cover. The foreshore is delineated by a sandstone block retaining wall. This area correlates with the excavated area visible around the foreshore on the 1943 aerial photo.

The sediments observed across areas of surface visibility in the northwest corner of the site did not appear as mixed or indicative of fill as the remainder of the site. Sediments observed in the northwest corner were more uniform in nature and comprised of silty sand. No shell material was observed.

Plate 10: Example of historical material observed on ground surface in southern portion of Blues Point Temporary Site – metal, crushed gravel, mixed sandy silt deposit

Plate 11: View west across the proposed TBM extraction location in the northwest corner of the Blues Point Temporary Site

Plate 12: View southwest across the Blues Point Temporary Site. The area to the south of the park benches was a large cut filled with structures until the Second World War, and has now been back-filled.

Plate 13: View north across the Blues Point Temporary site.

7.6.7 Assessment of archaeological potential

Although the shoreline context of the Blues Point temporary construction site would likely have been frequently utilised area by Aboriginal people, subsequent use of the location for wharf and boat launching infrastructure may have removed or significantly altered the original landform context of that area.

Historical aerial imagery and historical photographs show the original context of Blues Point as a steep-sided rocky point (Figure 15). A large amount of sandstone was quarried and removed from the area during the Nineteenth and early Twentieth Centuries as part of opening transport and development access to Blues Point and presumably also for procurement of sandstone building material.

Any remaining intact natural context at the Blues Point Temporary Site may have been truncated during the process of sandstone removal and residential/industrial construction stages at Blues Point.

Although the shoreline context of the Blues Point temporary site would likely have been a frequently utilised area by Aboriginal people, subsequent use of the location for wharf and boat launching infrastructure may have removed or significantly altered significant portions of the original ground surface within the Blues Point Temporary site. There is some evidence of a possibly truncated natural context in the northwest portion of the site and as such the Blues Point Temporary Site is assessed as demonstrating moderate archaeological potential.

Figure 14: Wharves and building within the Blues Point Temporary Site as shown on the North Sydney Water Board Maps, North Sydney Sheet 16, 11 December 1891 (http://www.photosau.com.au/StantonMaps/scripts/home.asp. (Approximate study area marked in red)

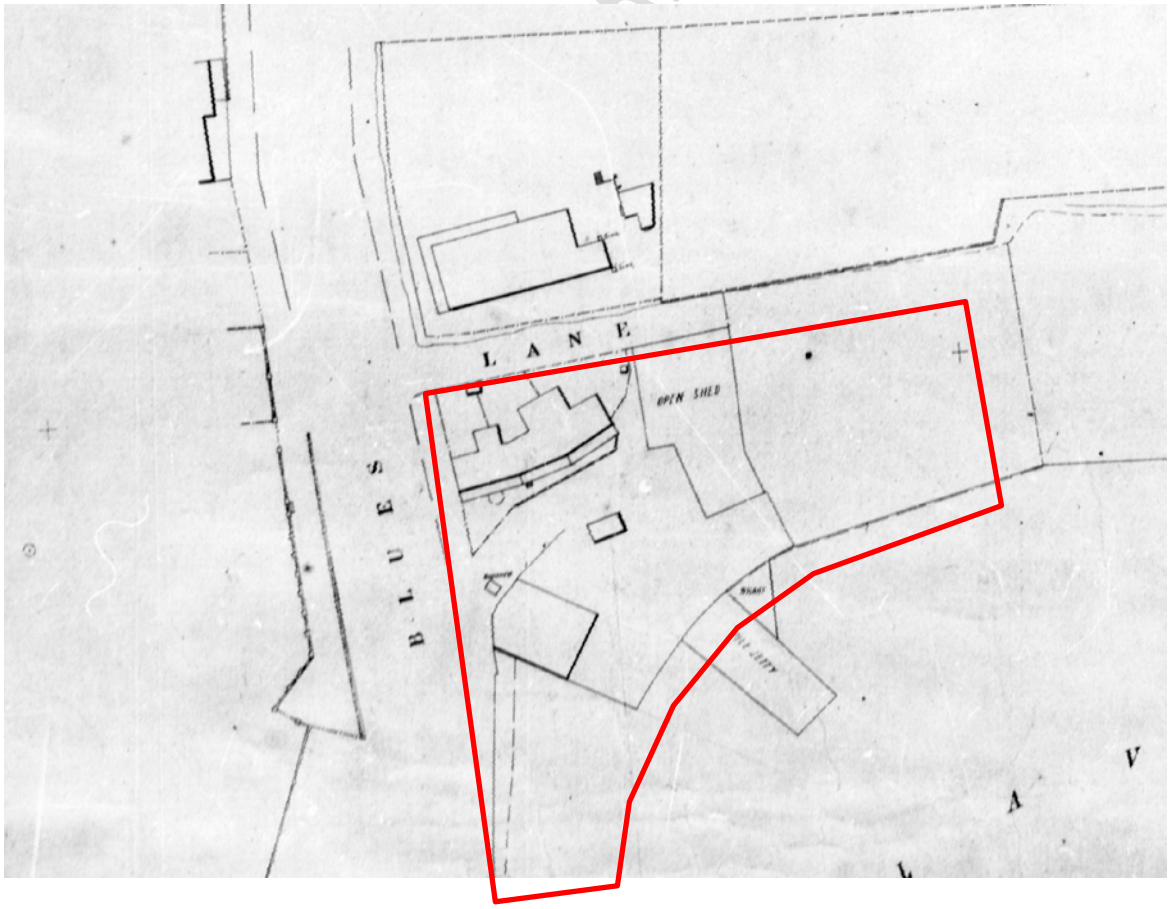


Figure 15: View west across Blues Point, image captured in 1858-1859, showing the area prior to extensive quarrying and more expansive reclamation (State Library of NSW SPF 799)

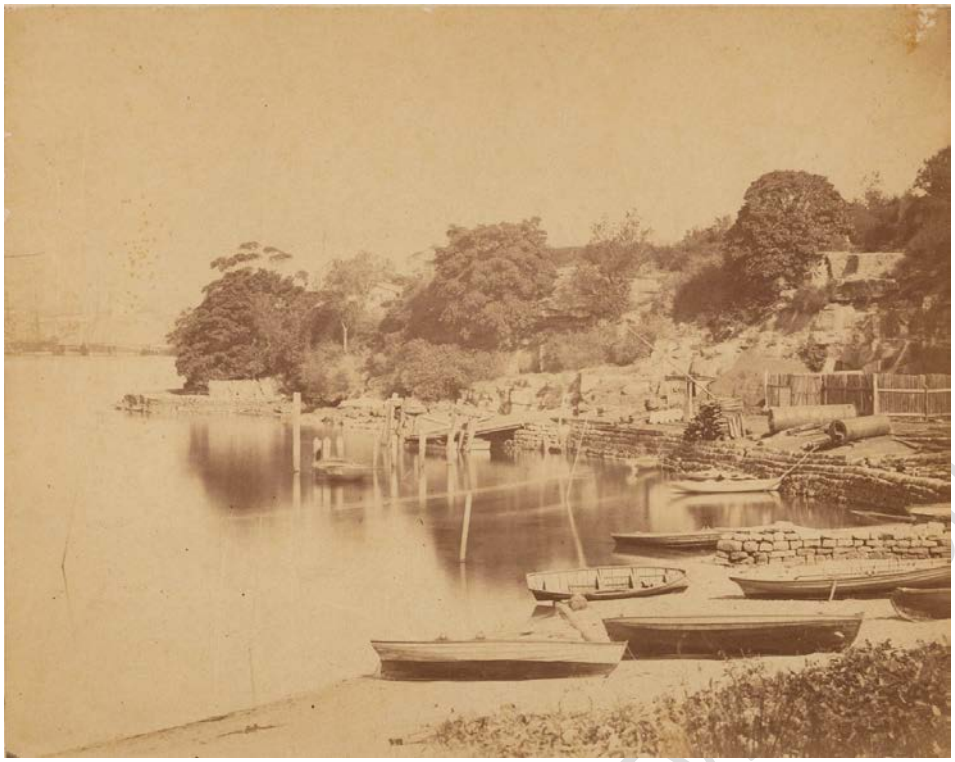


Figure 16: View southwest across Blues Point showing small dwelling in the study area and overgrown steep sandstone sided point to the west/ southwest. Date of image ca. early 1870s (State Library of NSW SPF 933)

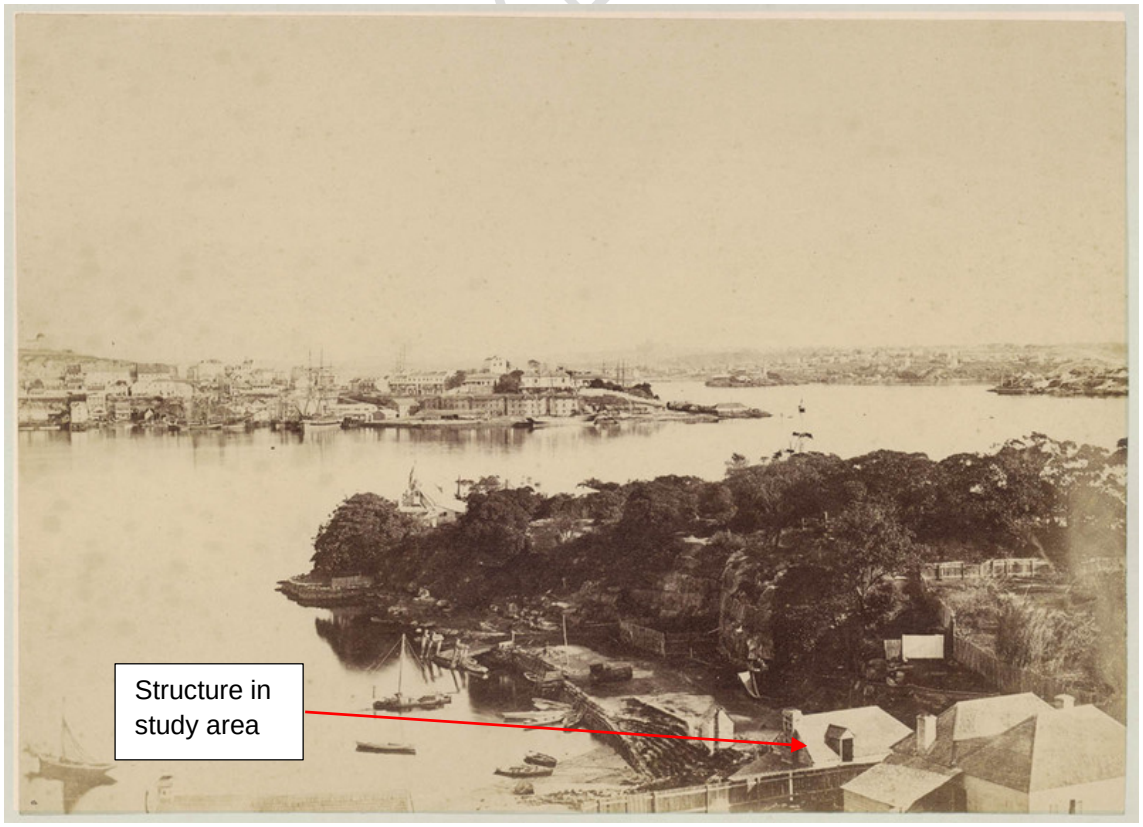


Figure 17: View southwest over Blues Point. In comparison to Figure 16, this image shows extension of structure within study area, vegetation clearance across Blues Point, formalisation of wharfage and shoreline, quarrying activity. Date of image ca. 1890s (State Library of NSW SPF 935).

Figure 18: View southwest across Blues Point. In comparison to Figures 16 and 17 shows extension of dwelling that was located overlooking Cliff Lane (subsequently demolished when Cliff Lane was widened to accommodate a tram line to McMahons Point). Building within the study area is only just discernible above roofline of dwelling in foreground. Access track to Blues Point has been formalised with sandstone retaining wall, which is extant. Date of image 1900-1910 (State Library of NSW ON2 474)

Figure 19: 1 July 1924 view across the southern portion of the Blues Point Temporary Site, showing structure built in excavated area to the east of Blues Point Road (subsequently demolished and back-filled following the Second World War) and punt access (City of Sydney Archives 079\079847)

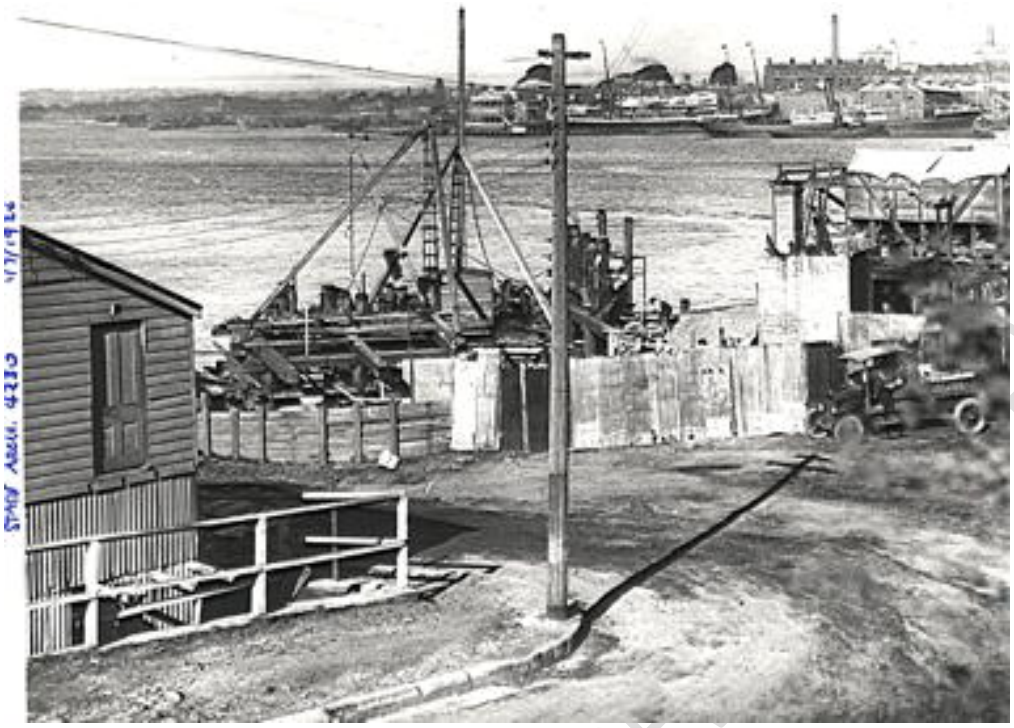
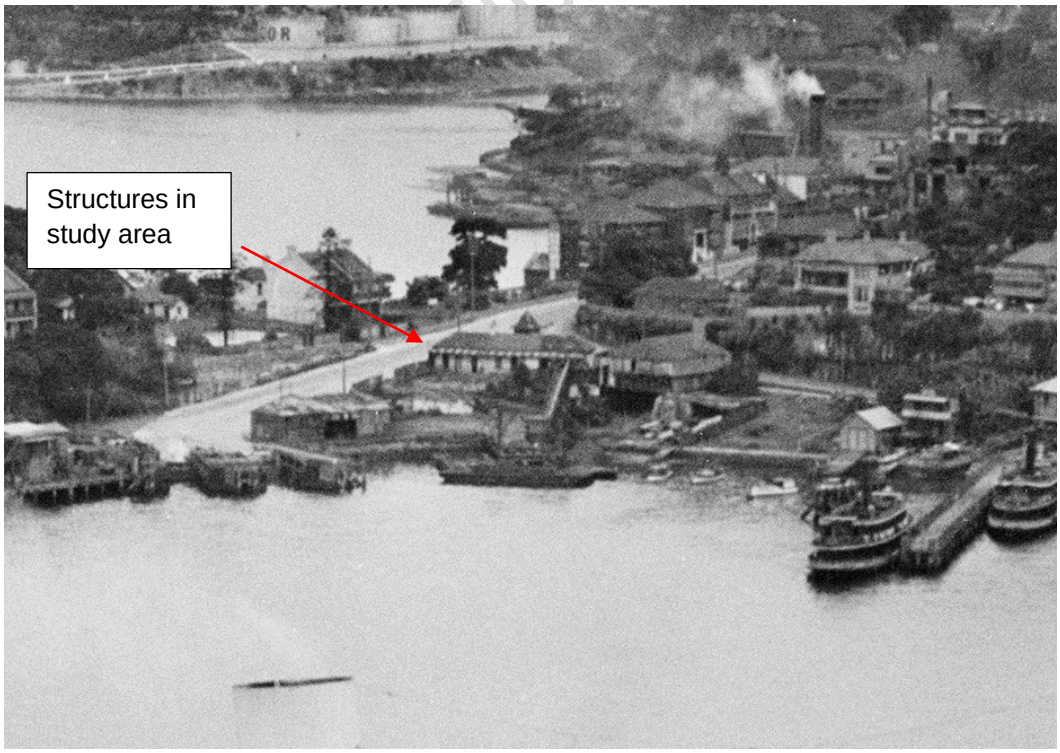


Figure 20: Image assumed to have been taken early Second World War of the SS Stratheden passing Blues Point. Structures within the Blues Point Temporary site visible in the background (Australian War Memorial ID P00172.001)



7.6.8 Significance assessment

Although the majority of the Blues Point temporary site may have been significantly disturbed, where natural profiles containing Aboriginal archaeological deposits are identified those contexts in the local area are rare and would be of high research significance.

7.6.9 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the Blues Point Temporary Site.

A potentially truncated natural landform context was identified in the northwest corner of the site during the site inspection would be impacted the temporary site.

7.6.1 Further archaeological investigation

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where intact natural landform contexts containing Aboriginal objects is identified.

7.7 Barangaroo Station

7.7.1 Proposed scope of works

The proposed Barangaroo Metro station would be located on Hickson Road next to the Barangaroo precinct on the west side of the Sydney CBD.

7.7.2 Construction

The Barangaroo Station construction site would cover about 13,800 square metres within the road reserve of Hickson Road and the adjacent Barangaroo development area (Figure 21). The site would be used to:

- Launch and support the tunnel boring machine for the Sydney Harbour crossing drive to Blues Point
- Retrieve the cutter heads and shields of the two tunnel boring machines driven from the Marrickville dive site
- Carry out the excavation and construction of the future Barangaroo Station.
- Access to and egress from the Barangaroo site would be via Hickson Road.

7.7.3 Environmental context overview

Barangaroo Station would be located across the original shoreline of Darling Harbour. Early historical maps of the area from 1837 and an overlay of twentieth century shipping platforms and the original shoreline demonstrate the shoreline context of Barangaroo Station (Figure 22 and 23).

Barangaroo Station would be located at the base of the Hawkesbury Sandstone rise that forms the elevated area of The Rocks. Large portions of the western margin of the Hawkesbury sandstone ridge have been removed, with the contemporary alignment of Hickson Road located at the base of a large sandstone cutting.

Due to the location of Barrangaroo Station near the base of the original sandstone slope, it is possible that not all of the original sandstone shoreline was removed during quarrying along the current alignment of Hickson Road.

7.7.4 Geotechnical information

Two boreholes were placed to the west of Hickson Road within the reclaimed area for the former container terminal. The geotechnical results indicate up to 0.5 metres of road fill overling up to 6.5 metres of reclaimation material.

Based on historical plans for the area, the boreholes were placed immediately to the west of the former Cockle Bay shoreline. This supposition is supported by the deep reclaimation fill encountered in that area.

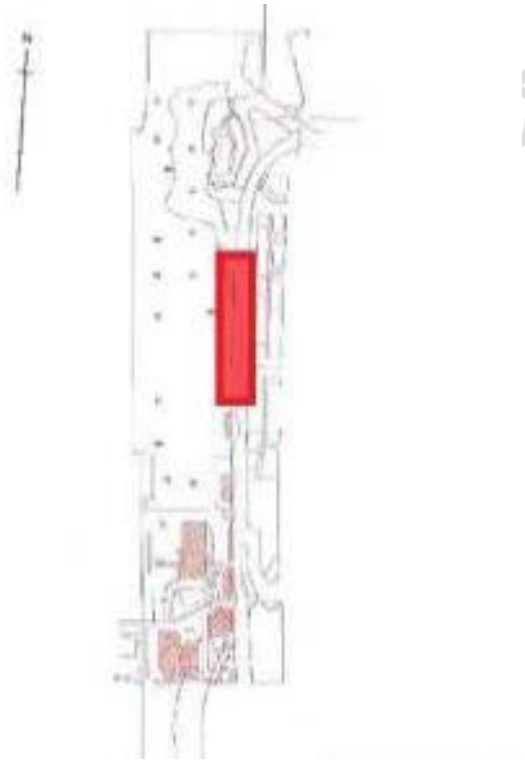
Figure 21: Location of the Barangaroo Station site

This map showing the location of Aboriginal sites has been removed from the public version of this document

Figure 22: 1837 map showing location of recorded Aboriginal sites and approximate location of Barangaroo Station in relation to the original shoreline.[145]

This map showing the location of Aboriginal sites has been removed from the public version of this document

Figure 23: Approximate location of Barangaroo Station overlaid onto map showing original shoreline and 20th century shipping platform[146]



[145] NSW Six Maps
[146] Austral 2010 'Barangaroo Archaeological Assessment and Management Plan' Report prepared for Barangaroo Delivery Authority.

7.7.5 AHIMS

No recorded Aboriginal sites are located within 100 metres of the proposed location of Barangaroo Station (see Figure 21). Two Aboriginal sites have previously been recorded in the vicinity of Barangaroo Station, including an open camp site at Moore's Wharf, approximately 300 metres to the north (AHIMS site 45-6-0519). The site was identified during a historical archaeological excavation at the site of the 19th century Mort Bond Store on Moore's Wharf.

AHIMS site 45-6-1939 consists of a rock engraving near the site of the Maritime Services Board tower, around 180 metres north of Barangaroo Station.

7.7.6 Archaeological context overview

The original landscape at the Barangaroo Station site is likely to have consisted of a rocky shoreline context. The shoreline is likely to have been the source of important subsistence resources, including cockle (*Anadara trapezia*). Although the area has been highly altered, significant archaeological resources have been identified in discrete areas that have been preserved beneath areas of historical development.

Approximately 300 metres to the north of Barangaroo Station at Millers Point, Lampert and Truscott excavated beneath the rubble floor of the Bond Store at Moore's Wharf in 1984 after Aboriginal midden material was identified at the site.[147] This site is recorded as AHIMS site 45-6-0519 (the northernmost site on Figure 21).

The excavation identified ten centimetres of shell midden overlay approximately 30 centimetres of compact grey sand with stone artefacts. The shells recovered included Rock and Mud Oyster (*Saccostrea* and *Ostrea*), cockle (*Anadara trapezia*), whelk (*Pyrazus ebininus*) and mussel (*Trichomya*). Approximately 392 stone artefacts were recovered. The assemblage included cores, used flakes and fabricators. There was also evidence for the use of unusually small pebbles and bipolar flaking. Raw materials included silcrete, quartz, quartzite and chert. It was concluded that the artefacts were typical of the post-Bondaian (most recent) phase of Aboriginal culture in the area. Evidence for continued Aboriginal use of the site into the historic period was found in the small number of European ceramic fragments recovered from the grey sand.

Archaeological salvage excavation of an Aboriginal site was conducted by Attenbrow in 1992 approximately 300 metres to the east of Barangarro Station, on Cumberland Street and across the crest of the main sandstone ridge.[148] The midden assemblage was carbon dated to around 340 years prior to the European settlement of Sydney Cove. The assemblage included bones of Snapper (*Pagrus auratus*) and Bream (*Acanthopagrus australis*), and shells of Rock Oyster (*Saccostrea cucullata*) and Hairy Mussel (*Trichomya hirsuta*).[149]

Historical archaeological excavation at Barangaroo South did not identify any Aboriginal objects. Reporting on excavation at Barangaroo North has not yet been completed, although no recorded Aboriginal sites in those areas have been recorded on the AHIMS site register. Aboriginal artefacts were retrieved during archaeological excavations on the Wynyard Walk project (AHIMS site 45-6-3116), approximately 600 metres south of Barangaroo Station.

[147] Lampert and Truscott 1984
[148] Attenbrow 1992
[149] Ibid

7.7.7 Site inspection results

The Barangaroo Station site is located across a hardstand area associated with Hickson Road and includes portions of the Barangaroo redevelopment area. The eastern boundary of the proposed station site is delineated by a steep sandstone cutting and upper concrete retaining wall. To the west of Hickson Road is the large flat hardstand area associated with reclaimed land for a former shipping terminal.

The northern section of the proposed station site is located beneath the deep sandstone cutting associated with the Argyle Place and Windmill Street overpasses. There is no evidence in this portion of the proposed station site of any remaining natural ground surface at the Hickson Street level.

Discussion and analysis of site inspection results

There is no visible evidence of the location of former ground surfaces across the Barangaroo Station site. Hickson Road and adjacent Barangaroo redevelopment area are covered by either concrete or bitumen, whilst the eastern and northwestern boundaries of the road are bordered by steep sandstone cuttings.

There is no visible evidence of where the former Cockle Bay shoreline is located.

Plate 14: View south along Hickson Road from the Argyle Place overpass

Plate 15: View southwest across Hickson Road, the New Bond Stores, and the Barangaroo redevelopment area in the background

Plate 16: View north along Hickson Road from High Street

Plate 17: View north onto Hickson Road from Argyle Place, showing the deep cutting and Windmill Street overpass

7.7.8 Assessment of archaeological potential

The survivability of Aboriginal archaeological deposit on sites in inner Sydney depends largely on the extent and nature of subsequent phases of historical construction activities. Large-scale landform modification has occurred at the Barangaroo Station site, including quarrying of the former Hawkesbury Sandstone slope that originally bordered Darling Harbour. The removal of sandstone from the eastern margin of Hickson Road indicates the original landform context in that area has been removed and there is no archaeological potential.

The lower original shoreline along the western side of Hickson Road may not have been as affected by sandstone quarrying. Other activities may have affected that area, including construction of the pier wharves that were present across that area in the twentieth century, construction of Hickson Road, and large-scale reclamation and construction of the container terminal. Other historical activities, including lime burning, may also have affected the survivability of Aboriginal objects and removed midden material.

Although the western portion of the Hickson Road station footprint has undergone significant alteration and impact during the historical period, archaeological excavations in the area have demonstrated that discrete archaeological deposits containing Aboriginal objects can occur beneath historical period structures. The identification at AHIMS site 45-6-1939 of Aboriginal shell midden material and artefacts in a similar shoreline context to Hickson Road Station indicates that pockets of shell midden and/or original shoreline soil/sediment contexts may survive in areas that have undergone extensive modification.

There is moderate-high archaeological potential for Aboriginal objects in sub-surface contexts where shell midden and/or original shoreline sand/silt contexts occur in the western portion of the Barangaroo Station footprint. This archaeological potential relates to the possible survivability of buried shell midden deposits associated with the original shoreline of Darling Harbour.

The eastern portion of the Barangaroo Station footprint does not demonstrate archaeological potential due to the large-scale removal of the original sandstone context, as demonstrated by the large sandstone cutting bordering the eastern margin of Hickson Road.

7.7.9 Significance assessment

The preliminary assessment of archaeological potential indicates the possible survival of shell midden deposits in the eastern portion of the Barangaroo Station footprint and associated with the former shoreline of Darling Harbour.

Intact Aboriginal archaeological deposits within the Sydney CBD area are extremely rare and would be of high research significance. It is also possible that out of context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not be likely to demonstrate high archaeological significance as they would not have the potential to provide accurate information or answers to relevant research questions.

7.7.10 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the Barangaroo Station site.

An area of archaeological potential in areas that are likely to contain surviving natural shoreline context(s) has been identified associated with the former shoreline of Darling Harbour along the western side of the Barangaroo Station site. That area would be impacted by the construction of Barangaroo Station.

7.7.11 Further archaeological investigation

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where the possibility of surviving shoreline context(s) is identified at the Barangaroo Station site.

7.8 Martin Place Station

Martin Place is a major urban public open space within the Sydney Central Business District, and it provides an important pedestrian connection between George Street and Macquarie Street (see Figure 24). Martin Place has an existing station that serves the primary business district of the city.

7.8.1 Construction

The cut and cover construction of the proposed southern entrance/service building shaft link across the top of the existing ESR tunnels would necessitate temporary closure of the existing open plaza and diversion of pedestrian traffic to the south. The proposed construction of the southern shaft / cavern / adits entails the following:

- Demolition of Prudential Building to Ground Floor.
- Establish a re-routed pedestrian traffic route from Martin Place Plaza over the demolished Prudential Building.
- Close Martin Place Plaza.
- Demolish Existing Plaza and subway structures.
- Construct metro concourse structure and new pedestrian subway structure.
- Install new pedestrian subway building services and systems.
- Reopen Plaza and pedestrian subway to traffic, decommission alternative route.
- Demolish remaining basement structure in Prudential Building (if necessary).
- Form working platforms for piling rigs (backfilling pits if necessary) over Prudential Building footprint.
- Piling works – short and long piles.
- Initial excavations to allow for the construction of working platform.
- Construction of working platform.
- Construction of acoustic shed where necessary and site infrastructure i.e. site office, staff amenities, workshop.
- Shaft excavation to required depth.
- Establish road headers in base of shaft.
- Excavate top headings, followed by removal of benches.

Figure 24: Location of the Martin Place Station site

This map showing the location of Aboriginal sites has been removed from the public version of this document

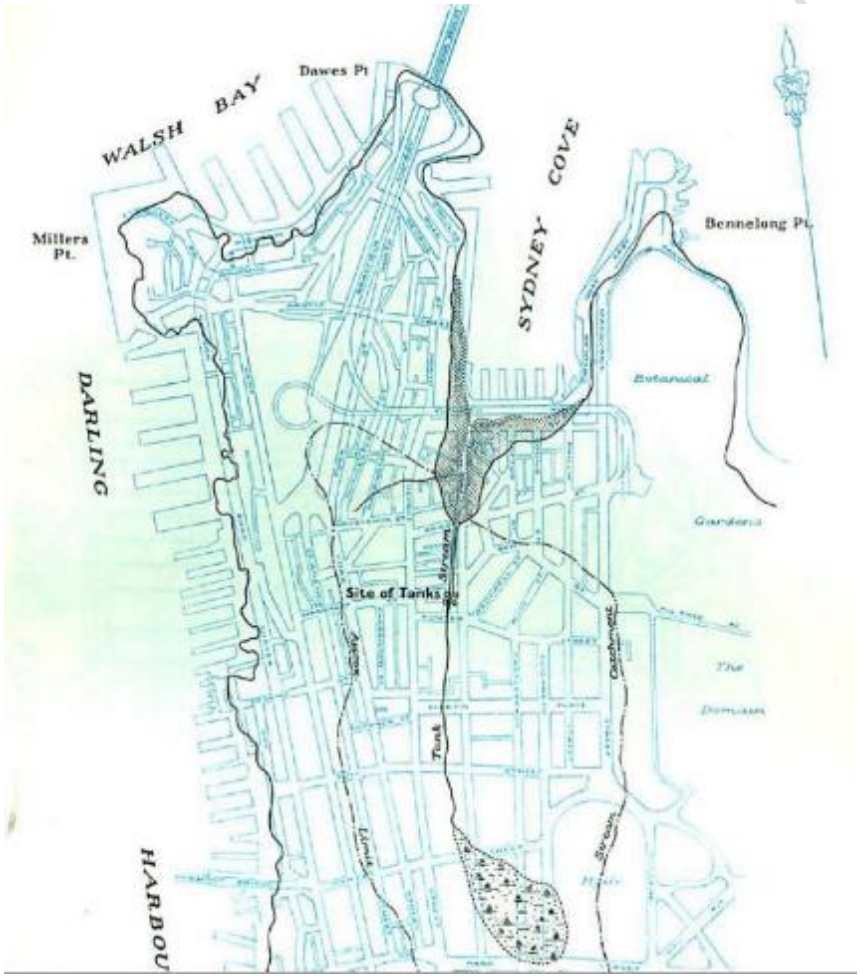
7.8.2 Environmental context overview

The underlying geology of Martin Place Station consists of Hawkesbury Sandstone, which comprises medium to coarse-grained sandstone, very minor shale, and laminate lenses. [150]

Generally shallow soils existed across the Hawkesbury Sandstone to the south of the shoreline, with soil developed *in situ* from the underlying sandstone geology. This soil context, called the Gymea soil landscape, consisted generally of sandy soils with high erosion hazard in cleared areas.[151] The upper lens of Hawkesbury sandstone beneath the Gymea soil landscape was likely to be weathered and fractured, resulting in 'floating' bedrock at the soil/bedrock transition.[152]

The natural drainage catchment within the inner Sydney area included a watercourse called the Tank Stream that flowed north from a swampy area stretching between Market Street and Park Street (see Figure 25). The watercourse flowed between the current alignments of Pitt Street and George Street, with the mouth of the creek originally a tidally influenced estuarine flat covering the area north from Bridge Street, east from Pitt Street and west from Loftus Street. The alignment of Tank Stream is approximately 240 metres west of Martin Place Station.

Figure 25: Location of the Tank Stream and original shoreline overlaid on twentieth century plan of Sydney CBD.[153]



[150] Herbert 1983
[151] Chapman and Murphy 1989
[152] Lawrie 1999 p.70
[153] Aird 1961

7.8.1 Geotechnical information

Geotechnical information from boreholes on Pitt Street and Castlereagh Street indicate that there is up to 2.3 metres of fill overlying residual clayey sand.

This information suggests that any remnant A horizon has been removed from the two borehole locations. This also provides an indication of the type of residual soil removal expected in a significantly built environment with basements, underground car parks and services.

7.8.2 AHIMS

One recorded Aboriginal site is located within 100 metres of the proposed location of Martin Place Station. That site consists of AHIMS site 45-6-2581, a sub-surface archaeological deposit associated with Angel Place and the recorded location of the site is 75 metres to the north (see Figure 24). It is likely that the AHIMS coordinates for the site are incorrect and that the site location is 200 metres west at Angel Place.

The recorded Aboriginal site at Angel Place indicates the potential for surviving archaeological deposits in sub-surface contexts within the CBD, specifically at those locations where there are not deep sub-surface basement carparks where there is non-Indigenous archaeological potential.

7.8.3 Archaeological context overview

The original landscape context of Martin Place Station is likely to have consisted of a slope landform within the Tank Stream catchment area. A number of Aboriginal sites have been recorded within the Sydney CBD. These include three areas of PAD, two artefact sites, one site with an artefact and PAD, two art sites at Millers Point and Dawes Point, and one site with shell, artefact. Taking in to consideration the fact that AHIMS site 45-6-2581 is not recorded on the AHIMS site register in the correct location, no recorded sites are located within 100 metres of Martin Place Station.

A significant demonstration of the potential for the survivability of Aboriginal objects in sub-surface contexts includes the results of excavation at Angel Place, approximately 200 metres west of Martin Place Station, [154] and at William Street, approximately 750 metres southeast of Martin Place Station.

The Aboriginal and non-Aboriginal archaeological deposit at Angel Place and William Street had been preserved to a certain extent by the large deposits of fill placed over those sites prior to subsequent phases of building construction. Additionally, none of the later buildings constructed on those sites involved deep excavations for a basement. Aboriginal archaeological deposit was identified in those parts of the site that had survived the various phases of building construction.

7.8.4 Site inspection results

The Martin Place Station site is located across a built environment on a gentle slope down to the west. No areas of surface visibility or intact ground surface were observed. The southern portion of the project station site includes the existing access to Martin Place Station.

Discussion and analysis of site inspection results

The heavily built environment, existing underground access to Martin Place Station and multiple underground services indicates the likely removal of natural deposits and archaeological potential within sections of the proposed station site area.

[154] Godden Mackay 1997

Plate 18: View east across Martin Place and existing entrance to Martin Place station

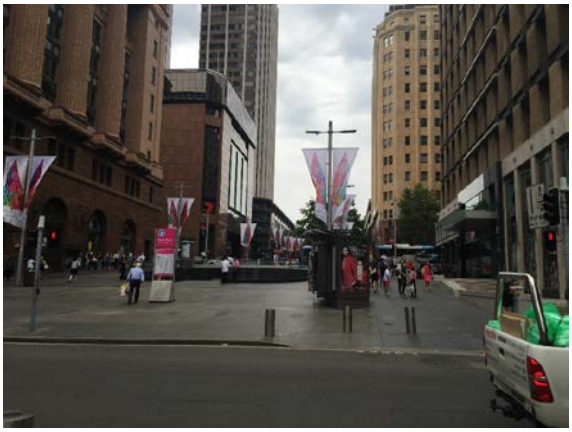


Plate 19: View northwest across Castlereagh Street to proposed northern station entrance

7.8.5 Assessment of archaeological potential

The survivability of Aboriginal archaeological deposit on sites in inner Sydney depends largely on the extent and nature of subsequent phases of historical construction activities. As demonstrated at Angel Place, discrete portions of surviving archaeological deposit containing Aboriginal objects may occur in very small areas. Excavation at William Street demonstrated the increase in survivability of sub-surface archaeological deposit in areas where existing structures do not have basement or underground car park levels, and where some degree of fill has been placed over an area.

The location of Martin Place Station within the Tank Stream catchment area and within 250 metres of that watercourse suggest potential for Aboriginal objects beneath the ground surface in areas that have not been significantly impacted or excavated.

The existing structure at the proposed location of the southern cut and cover box dates to the second half of the twentieth century. Potential survivability of archaeological deposit in that area would largely depend on whether that structure has a basement or underground car park area. There would be archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts.

Available basement depth and extent information indicates that A horizon soil contexts are likely to have been removed from a number of the properties within the proposed station site excavation areas.

The works to the existing Martin Place Station entrance would largely be contained to an area that has been significantly impacted and excavated. There would be archaeological potential for Aboriginal objects in sub-surface contexts in any areas bordering the existing Martin Place Station access way that have not been significantly impacted.

The existing structures at the proposed location of the northern cut and cover box date from different periods. Potential survivability of archaeological deposit in that area would largely depend on whether that structure has a basement or underground car park area. There would be archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts.

There is moderate-high archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts.

7.8.6 Significance assessment

The preliminary assessment of archaeological potential indicates the possible survival of Aboriginal objects in sub-surface contexts in those areas that have not been impacted by construction of basements and underground car parks.

Intact Aboriginal archaeological deposits within the Sydney CBD area are extremely rare and would be of high research significance. It is also possible that out of context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not be likely to demonstrate high archaeological significance as they would not have the potential to provide accurate information or answers to relevant research questions.

7.8.7 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at Martin Place Station.

There is demonstrable archaeological potential associated with any A horizon context that may remain beneath current structures at the proposed Martin Place Station site.

7.8.8 Further archaeological investigation

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where the possibility of surviving A horizon soils is identified at the Martin Place Station site.

7.9 Pitt Street Station

Pitt Street Station is located within the midtown precinct of the Sydney CBD, with a strong retail focus, as well as a mix of commercial, residential and civic buildings (see Figure 26). The local area includes a number of listed heritage items, including Sydney Town Hall, the Queen Victoria Building and St Andrews Cathedral. It is also near open spaces such as Hyde Park and Pitt Street Mall.

7.9.1 Construction

The design involves a binocular station cavern arrangement with both platforms at the same level under Pitt and Castlereagh Streets. It has two separated entrances with the southern entry on Bathurst Street and the northern entry on the corner of Pitt and Park Street with the entry off Park Street.

Following the shaft excavation works, roadheaders are proposed to be launched from the northern shaft to excavate the station caverns and adits.

Site specific features of the proposed works for Pitt Street include;

- Contiguous piles encompassing cut and cover boxes extending into competent rock
- Northern open shaft minimum of 15.0 x 20.0m and southern mucking opening minimum of 8.0 x 8.0 metre for the removal of spoil and mobilization of machinery.
- Road headers launched from northern shaft to maximise site area at the southern site.
- Shafts excavated to required depth and backfilled for the launch/recovery of roadheaders to enable top heading, followed by bench excavation (when necessary for sequencing).

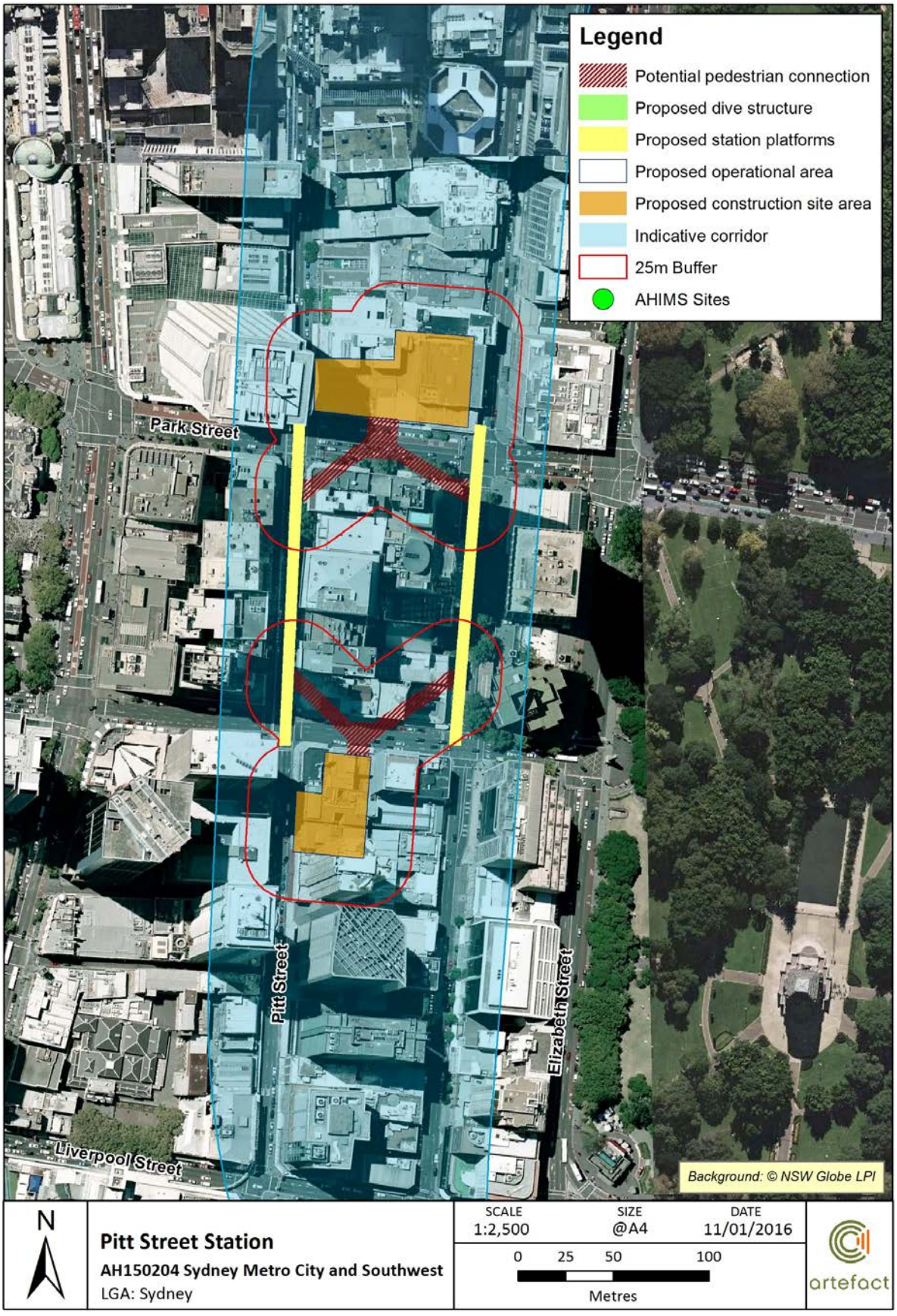
7.9.2 Environmental context overview

The underlying geology of Pitt Street Station consists of Ashfield Shale which is generally composed of black to dark-grey shale and laminate (Herbert 1983a) that caps the underling Hawkesbury Sandstone.[155] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be residual soils developed *in situ*.[156]

The natural drainage catchment within the inner Sydney area included a watercourse called the Tank Stream that flowed north from a swampy area stretching between Market Street and Park Street in the northern portion of Pitt Street Station (see Figure 26). The watercourse flowed between the current alignments of Pitt Street and George Street, with the mouth of the creek originally a tidally influenced estuarine flat covering the area north from Bridge Street, east from Pitt Street and west from Loftus Street.

[155] Herbert 1983 p.22
[156] Chapman and Murphy 1989

Figure 26: Location of the Pitt Street Station site



7.9.3 Geotechnical information

Geotechnical information from boreholes on Pitt Street and Castlereagh Street indicate that there is around two metres of fill overlying residual clays. The geotechnical report suggests that the deep fill layers encountered beneath the street contexts are associated with underground service installation.

This information suggests that A horizon soil contexts have been removed at the two borehole locations. Due to the variability of surface impacts in an urban environment, impacts to A horizon contexts across the remainder of the site will vary. This provides an indication of the type of residual soil removal expected in a significantly built environment with basements, underground car parks and services.

7.9.4 AHIMS

No recorded Aboriginal sites are located within 100 metres of the proposed location of Pitt Street Station (see Figure 26). The closest recorded Aboriginal sites are AHIMS site 45-6-2838 approximately 380 metres to the northwest and AHIMS site 45-6-2637 approximately 380 metres to the southwest (see Figure 6). AHIMS site 45-6-2838 consists of a PAD identified by Dr Tim Owen at 420 George Street, whilst AHIMS site 45-6-2637 consists of a sub-surface archaeological deposit identified further to the south on George Street.

7.9.5 Archaeological context overview

The original landscape context of Pitt Street Station is likely to have consisted of a low-lying gently sloping area associated with a swampy area at the headwaters of the Tank Stream.

A number of Aboriginal sites have been recorded within the Sydney CBD. These include three areas of PAD, two artefact sites, one site with an artefact and PAD, two art sites at Millers Point and Dawes Point, and one site with shell, artefact. There are no recorded Aboriginal sites within 100 metres of Pitt Street Station.

A significant demonstration of the potential for the survivability of Aboriginal objects in sub-surface contexts includes the results of excavation at Angel Place, approximately 630 metres north of Pitt Street Station, [157] and at William Street, approximately 530 metres east of Pitt Street Station.

The archaeological deposit at Angel Place and William Street had been preserved to a certain extent by the large deposits of fill placed over those sites prior to subsequent phases of building construction. Additionally, none of the later buildings constructed on those sites involved deep excavations for an underground car park. Aboriginal archaeological deposit was identified in those parts of the site that had survived the various phases of building construction.

7.9.6 Site inspection results

The Pitt Street Station site is located across a built environment on a flat to gentle slope. No areas of surface visibility or intact ground surface were observed.

Discussion and analysis of site inspection results

The heavily built environment and multiple underground services indicate the likely removal of natural deposits and archaeological potential within sections of the project station site area.

[157] Godden Mackay 1997

Plate 20: View southwest across proposed southern station entrance on Bathurst Street

Plate 21: View northeast across proposed northern station entrance on Park Street

7.9.7 Assessment of archaeological potential

The survivability of Aboriginal archaeological deposit on sites in inner Sydney depends largely on the extent and nature of subsequent phases of historical construction activities. As demonstrated at Angel Place, discrete portions of surviving archaeological deposit containing Aboriginal objects may occur in very small areas. Excavation at William Street demonstrated the increase in survivability of sub-surface archaeological deposit in areas where existing structures do not have basement or underground car park levels, and where some degree of fill has been placed over an area.

The location of Pitt Street Station in a low-lying and gently sloping area around the headwaters of the Tank Stream suggests potential for Aboriginal objects beneath the ground surface in areas that have not been significantly impacted or excavated.

The existing structures at the proposed location of the southern and northern cut and cover boxes date from different periods. Potential survivability of archaeological deposit in that area would largely depend on whether that structure has a basement or underground car park area. There would be archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts.

The limited basement information that was available for this report indicates that a basement covers the majority of the lot located at 48-49a Park Street (Lot 1 DP74367), the easternmost portion of the northern study area. The basement floor ranges between 1.74 to 2.78 metres below current ground level (21.22-21.26 metres AHD). It can be assumed that any archaeological resource in this location has been removed.

There is moderate-high archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts (with the exception of Lot 1 DP74367).

7.9.8 Significance assessment

The preliminary assessment of archaeological potential indicates the possible survival of Aboriginal objects in sub-surface contexts in those areas that have not been impacted by construction of basements and underground car parks.

Intact Aboriginal archaeological deposits within the Sydney CBD area are extremely rare and would be of high research significance. It is also possible that out of context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not be likely to demonstrate

high archaeological significance as they would not have the potential to provide accurate information or answers to relevant research questions.

7.9.9 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at Pitt Street Station.

There is demonstrable archaeological potential associated with any A horizon context that may remain beneath current structures at the proposed Pitt Street Station site.

7.9.10 Further archaeological investigation

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where the possibility of surviving A horizon soil is identified at the Pitt Street Station site.

7.10 Central Station

7.10.1 Proposed scope of works

Construction of the new metro platforms at Central Station would require the use of multiple construction sites, primarily to provide feasible solutions for construction access and egress (materials delivery and spoil removal). The primary works at Central Station would include a new station constructed using the cut-and-cover technique beneath Platforms 13 and 14 and the proposed Sydney Yard access bridge to the southwest.

Figure 27: Detailed location of Central Station construction site area

This map showing the location of Aboriginal sites has been removed from the public version of this document

7.10.2 Environmental context overview

The underlying geology of Central Station is Ashfield Shale, which is generally composed of black to dark-grey shale and laminate.[158] Ashfield Shale caps the underlying Hawkesbury Sandstone.[159] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be residual soils developed *in situ*[160] and includes the residual Blacktown soil landscape at the Central Station site.

Portions of Central Station are located across the northwestern portion of a large Quaternary sand sheet. It is likely that this sand sheet overlies Ashfield Shale in some area. The majority of the Eastern Suburbs from Central Station east to the ocean coastline and south to Botany Bay was originally an undulating series of sand dunes. GML indicated that the area is 'underlain by Quaternary marine sands, deposited by marine and Aeolian actions during the Holocene, and are associated with sea level changes since the last Ice Age'. [161]

Large sand hills once covered the area, some of which still remain in the Moore Park area to the east of the Waterloo Station site. Large, extant sand hills are located approximately 1.5 kilometres southeast of the Central Station project area at the Sydney Golf Course.

Historical records indicate that the sand sheet at Moore Park was subject to extensive deflation and erosion from vegetation clearance combined with wind and water erosion.[162] This provides an example of what may have occurred in similar contexts across the sand sheet, such as at Central Station, when vegetation clearance initially occurred in the area.

Archaeological implications of the soil landscape within the subject site are that the residual Blacktown soils represent a moderately deep (<1m) soil with limited erosion characteristics in areas with ground cover.[163] Unless removed or disturbed through commercial/ road / infrastructure development or extreme erosion events, archaeological material is likely to remain relatively *in situ* (subject to bioturbation). Although the contexts associated with the Botany sand sheet are likely to provide deeper contexts more likely to preserve sub-surface archaeological deposits, the A1 horizon of the sand sheet is also very susceptible to disturbance and removal due to exposure or construction/ landform modification activities.

The natural drainage in the vicinity of Central Station would have flowed north onto estuarine flats bordering the southern side of Cockle Bay.

7.10.3 Geotechnical information

Two boreholes were placed within the rail corridor above the proposed station box beneath Platforms 14 and 15. The borehole logs indicate a layer of fill between 1 to 1.5 metres deep overlying a layer of sand up to 2 metres thick. The geotechnical report suggests that this sand may be associated with the Quaternary sands that characterise the area east of Central Station. The sand layer overlies a variable thick residual layer of clay associated with Ashfield Shale geology.

This information indicates that the Quaternary sand layer extends west across the proposed station box location and overlies the Ashfield Shale geology.

[158] Herbert 1983 p.22
[159] Herbert 1983 p.22
[160] Chapman *et al* 2009
[161] GML 2013 p.134
[162] Central Parklands Trust 2014
[163] Ibid p.22

7.10.4 AHIMS

No recorded Aboriginal sites are located within 100 metres of the proposed Central Station work site (see Figure 27). The closest recorded Aboriginal site is AHIMS site 45-6-2987, an artefact site recorded by Biosis 330 metres to the northwest (see Figure 7).

7.10.5 Archaeological context overview

The original landscape context of Central Station is likely to have consisted of a low-lying gently sloping area associated with well-drained land on the southern margin of flats associated with Cockle Bay.

A number of Aboriginal sites have been recorded to the west and northwest of Central Station at locations where Aboriginal objects have been identified or may be located in sub-surface contexts beneath historical period structures.

A significant demonstration of the potential for the survivability of Aboriginal objects in sub-surface contexts in the Sydney CBD area includes the results of excavation at Angel Place, approximately 1.7 km north of Central Station. [164]

Excavation at Broadway, approximately 530 metres west of Central Station, retrieved Aboriginal objects from archaeological deposit revealed during extensive historical archaeological investigations across the site.[165] The area had formerly been located bordering the estuarine environment of Blackwattle Bay. At Angel Place in the Sydney CBD, intact Aboriginal archaeological deposit was also identified during the course of non-Aboriginal (historical) archaeological investigations. [166]

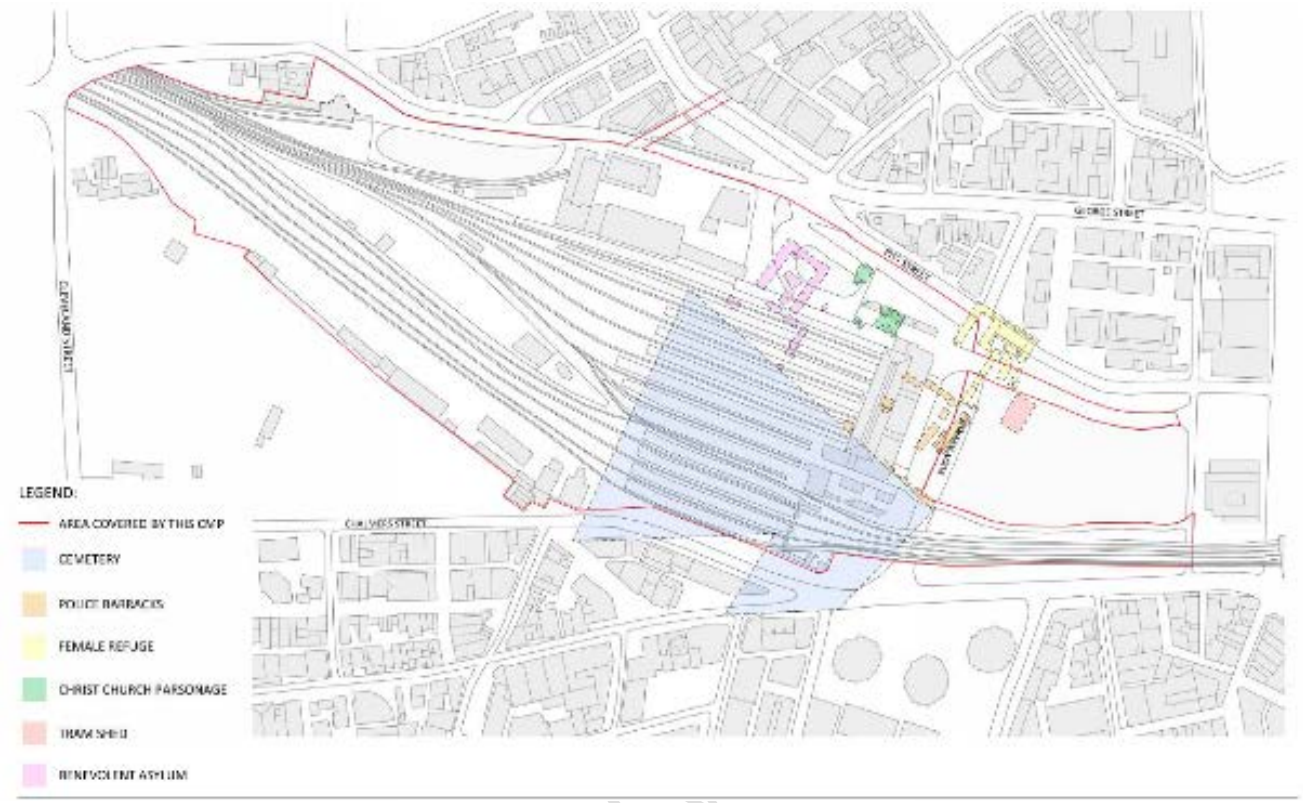
The archaeological context at Broadway had been preserved to a certain extent by the large deposits of fill placed over that site prior to subsequent phases of building construction.

The Central Station Conservation Management Plan indicates that although the site has undergone a range of uses and different construction phases that there are areas with archaeological potential for historical relics. Those areas are indicated in Figure 28. Where there is demonstrated potential for earlier phases of historical occupation there is generally a corresponding potential for deposits containing Aboriginal objects.

With regards to the underlying sand sheet associated with portions of the Central Station site, Archaeological excavations within the Eastern Suburbs sand sheet system at Rose Bay[167], Prince of Wales Hospital Randwick[168], Long Bay[169], Prince of Wales Medical Research Institute,[170] Moore Park and Discovery Point Tempe[171] have located evidence of Aboriginal occupation. The Aboriginal sites located during those archaeological excavations are some of the oldest so far recorded in the Sydney Basin with dates for Discovery Point at around 10,000 years before present, and human remains at Rose Bay dated to approximately 3,000 years before present.

[164] Godden Mackay 1997
[165] Steele and Czastka 2003
[166] Steele and Barton 1998
[167] JMcD CHM 2010
[168] Godden *et al*1997
[169] MDCA 2008
[170] Ibid
[171] JMcD CHM 2005

Figure 28: Areas of historical period archaeological potential from the Central Station CMP



7.10.6 Site inspection results

The rail corridor portion of the Central Station site was not accessed for the survey.

The portion of the Central Station site bordering Regent Street consists of built structures. No areas of surface visibility of natural ground surface were observed in that area.

The majority of the Central Station site consists of a built environment, including an active rail corridor.

7.10.7 Assessment of archaeological potential

The location of Central Station on a raised, well-drained area in close proximity to estuarine resources at Cockle Bay suggests potential for Aboriginal objects beneath the ground surface in areas that have not been significantly impacted or excavated.

The survivability of Aboriginal archaeological deposit on sites in inner Sydney depends largely on the extent and nature of subsequent phases of historical construction activities. Geotechnical information is available for the area around the proposed station box and not for Regent Street.

Geotechnical information indicates that an intact Quaternary sand layer is present beneath overlying layers of fill and disturbance in the vicinity of Platforms 14 and 15. This information indicates potential for significant intact sand deposits beneath those portions of the Central Station site.

Information relating to the survivability of natural ground surface beneath the Regent Street portion of the Central Station site is unknown.

7.10.8 Significance assessment

Intact Aboriginal archaeological deposits in the local area are extremely rare and would be of high research significance. It is also possible that out of context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not be likely to demonstrate high archaeological significance as they would not have the potential to provide accurate information or answers to relevant research questions.

7.10.9 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at Central Station.

There is identified archaeological potential associated with intact Quaternary sands underlying the proposed station box site at Platforms 14 and 15.

Across the remainder of the Central Station site there is potential for Aboriginal objects to occur in sub-surface contexts where natural soil contexts remain.

7.10.10 Further archaeological investigation

Further archaeological investigation, including archaeological test / salvage excavation, is recommended at Central Station. Archaeological excavation of the sand sheet associated with the proposed station box site would need to be conducted following the removal of station and rail infrastructure in that area.

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where the possibility of surviving Quaternary sands or residual soils associated with underlying Ashfield Shale geology is identified across the remainder of the Central Station site.

7.11 Waterloo Station

7.11.1 Proposed scope of works

The Waterloo Station construction site would be located within the block bounded by Raglan Street, Cope Street, Wellington Street and Botany Road. The site currently contains commercial and residential buildings.

Access and egress to and from the site would be to and from Raglan Street, Cope Street, Wellington Street and Botany Road.

The location of Waterloo Station is shown in Figure 29.

7.11.2 Environmental context overview

The Waterloo Station site would be located across the northwestern portion of a large Quaternary sand sheet. The majority of the Eastern Suburbs from Waterloo east to the ocean coastline and south to Botany Bay was originally an undulating series of sand dunes. GML indicated that the area is ‘underlain by Quaternary marine sands, deposited by marine and Aeolian actions during the Holocene, and are associated with sea level changes since the last Ice Age. [172]

[172] GML 2013 p.134

Large sand hills once covered the area, some of which still remain in the Moore Park area to the east of the Waterloo Station site. Large, extant sand hills are located approximately 1.5 km east of the Waterloo Station site at the Sydney Golf Course.

Historical records indicate that the sand sheet at Moore Park was subject to extensive deflation and erosion from vegetation clearance combined with wind and water erosion.[173] This provides an example of what may have occurred in similar contexts across the sand sheet, such as at Waterloo Station, when vegetation clearance initially occurred in the area.

The closest extant drainage channel to the Waterloo Station site is Shea Creek, located approximately 900 metres to the south. It is likely that the sand sheet in the vicinity of the Waterloo Station site would have included other, now destroyed or heavily modified, drainage channels and possibly incorporated swamp areas.

7.11.1 Geotechnical information

Geotechnical information from four locations in the vicinity of the Waterloo Station site indicates a deep layer (up to 10 metres) of Quaternary sand beneath layers of fill.

7.11.2 AHIMS

No recorded Aboriginal sites are located within 100 metres of the proposed Waterloo Station site (see Figure 29). The closest recorded Aboriginal site is AHIMS site 45-6-2597, an artefact and shell midden site located approximately 275 metres to the north.

[173] Central Parklands Trust 2014

Figure 29: Location of Waterloo Station site

This map showing the location of Aboriginal sites has been removed from the public version of this document

7.11.3 Archaeological context overview

Recent excavation by Artefact Heritage on the Botany sand sheet at Moore Park retrieved stone artefacts from portions of the sand sheet that had been buried in the 19th and 20th century with up to 1 metre of introduced fill and rubbish. The investigation found that the greyish sand A1 horizon was absent or very fine, and that underneath the A1 horizon was bleached A2 sands onto B horizon silicified sands (referred to as 'coffee rock'). The results of that excavation demonstrate the fragility of the A1 horizon as it was the main interface between buried sand deposit and surface disturbances associated with vegetation clearance, erosion, fill and rubbish deposition, and in the case of Waterloo Station, construction of several phases of commercial, industrial and residential buildings.

Other archaeological excavations within the Eastern Suburbs sand sheet system at Rose Bay[174], Prince of Wales Hospital Randwick[175], Long Bay[176], Prince of Wales Medical Research Institute[177] and Discovery Point Tempe[178] have located evidence of Aboriginal occupation. The Aboriginal sites located during those archaeological excavations are some of the oldest so far recorded in the Sydney Basin with dates for Discovery Point at around 10,000 years before present, and human remains at Rose Bay dated to approximately 3,000 years before present.

7.11.4 Site inspection results

The Waterloo Station site is located across a generally flat area. No areas of surface visibility or intact ground surface were observed and the area is generally covered by residential and commercial properties interspersed by sealed bitumen roads.

Discussion and analysis of site inspection results

The heavily built environment suggests and associated underground services suggest that there is likely to have been some disturbance of natural ground surface in the area. However, background information indicates that the sand body underlying the area is likely to be relatively deep. There is potential or intact sand layers beneath areas of limited surface disturbance.

Plate 22: View southeast across the corner of Raglan Street and Botany Street

Plate 23: View east across 103-105 Botany Street, Waterloo

174 JMcD CHM 2010
175 Godden *et al*1997
176 MDCA 2008
177 Ibid
178 JMcD CHM 2005

7.11.5 Assessment of archaeological potential

The survivability of Aboriginal archaeological deposits in sites such as Waterloo Station is dependent largely on the extent and nature of subsequent phases of historical construction activities. As demonstrated at archaeological excavations across the Quaternary sand sheet, discrete portions of surviving archaeological deposit containing Aboriginal objects may occur beneath extant buildings and deep layers of introduced fill.

There are likely to have been significant, although not necessarily comprehensive, sub-surface impacts across the Waterloo Station site from 19th and 20th century construction and service installation across the site. The extent of introduced fill and depth of excavation during construction of the extant structures was unknown at the time this report was prepared.

Results from previous archaeological excavations across the Quaternary sand sheet demonstrate the potential for buried Aboriginal sites associated in those contexts. These sites can occur buried beneath areas of surface impact. Results of geotechnical investigations in the vicinity of the Waterloo Station site indicates the presence of buried sand beneath layers of introduced fill overlying Ashfield shale.

There is moderate-high archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts.

7.11.6 Significance assessment

The assessment of archaeological potential indicates the possible survival of Aboriginal objects in sub-surface contexts in those areas that have not been impacted by construction of basements and underground car parks.

Intact Aboriginal archaeological deposits within the region area are extremely rare and would be of high research significance. It is also possible that out of context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not be likely to demonstrate high archaeological significance as they would not have the potential to provide accurate information or answers to relevant research questions.

7.11.7 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at Waterloo Station.

There is potential for Aboriginal objects to occur in the sub-surface archaeological deposits where there are surviving portions of A horizon sands.

7.11.8 Further archaeological investigation

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where surviving Quaternary sands are identified at the Waterloo Station site.

7.12 Marrickville dive site (southern)

7.12.1 Proposed scope of works

The Marrickville dive site would be used to:

- Excavate and construct the dive structure and tunnel portal
- Launch and support two TBMs for the major tunnelling works
- Support tunnel rail systems fit out works
- Support the construction of the southern services facility
- Provide precast segment manufacturing and storage.

The location of the Marrickville dive site is shown in Figure 30.

7.12.2 Environmental context overview

The Marrickville dive site is located on gently sloping terrain on the eastern margin of the Cumberland Plain. The site is on the transition between the Ashfield shale geology to the north and west and the Quaternary peat sediments associated with estuarine areas to the south around Cooks River.

The original context of the Marrickville dive site is likely to have been on the margin of a low-lying drainage channel that may have also been a tidally influenced estuarine area. Over the course of industrial and commercial development in the area the natural water flow through the area was canalised. A concrete canal runs along the western perimeter of the site.

The Marrickville dive site is located on the transition between Ashfield Shale and Quaternary sediments. Ashfield Shale is generally composed of black to dark-grey shale and laminate.[179] Soils associated with the typically gentler slopes of the Ashfield Shale formation tend to be relatively shallow residual soils developed *in situ*.[180] The Quaternary sediments consist of peat, sandy peat and mud, and consist of deep soils (250 centimetres) of the Birrong soil landscape.[181] The Birrong soil landscape is typically comprised of soils that are water-logged and subject to localised flooding, and are a high erosion hazard.[182] Although the soils may have been subject to flooding and possibly even tidally influenced, the identification of Dugong bones and Aboriginal artefacts during construction work at Shea Creek for Alexandra Canal in the 1890s demonstrates the archaeological potential of the deep soils adjacent to estuarine subsistence resources.

7.12.3 Geotechnical information

One borehole was placed in the Murray Street road easement and two in the Edgeware Road easement. Geotechnical information indicates that between 0.7 – 1.3 metres of fill overlies a silty clay alluvium layer 0.6 metres thick, which overlies residual sediments to 7.5 metres depth.

This information supports the environmental context outlined above that indicates deep residual sediments at this site.

[179] Herbert 1983
[180] Chapman and Murphy 1989
[181] Bannerman S.M. and Hazelton P.A., 1990, *Soil Landscapes of the Penrith 1:100,000 Sheet* map and report, Soil Conservation Service of NSW, Sydney p.83
[182] Ibid p.83

7.12.4 AHIMS

No recorded Aboriginal sites are located within 100 metres of the Marrickville dive site (see Figure 30). The closest recorded Aboriginal site is AHIMS site 45-6-2654, a PAD located 350 metres to the west.

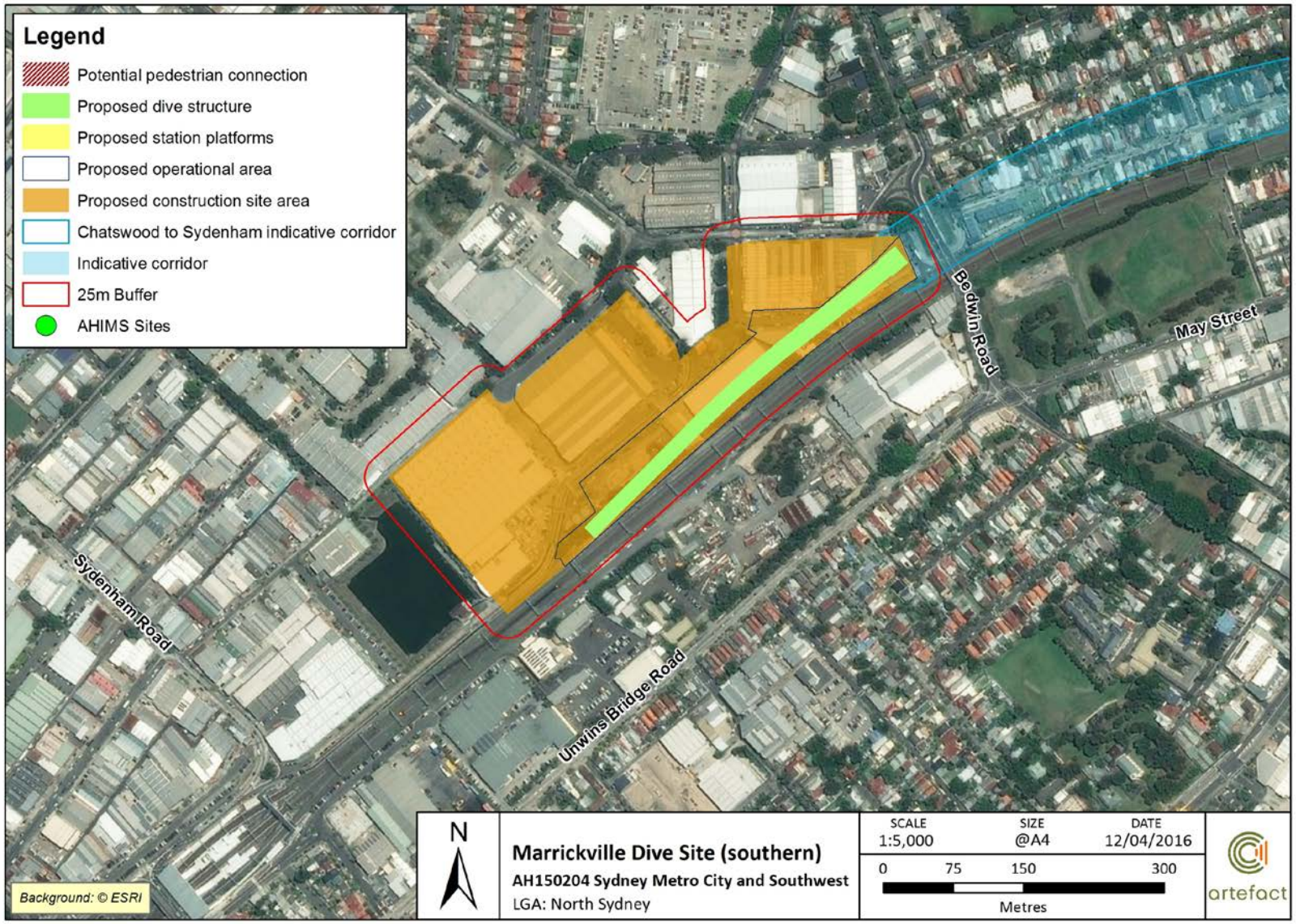
7.12.5 Archaeological context overview

Archaeological excavation in the local area included identification in 1896 of Dugong bones during the canalisation of Shea Creek (Alexandra Canal). Etheridge identified cuts and scars on the bones consistent with the animal being butchered. Two hatchet heads were also retrieved from the same area.[183]

The area was developed into a residential and industrial area in the nineteenth century with corresponding modification of the natural environment. Due to the extensive development of the area, few sub-surface archaeological investigations have occurred, as demonstrated by the sparse locations of recorded Aboriginal sites in Figure 7.

[183] Etheridge 1905

Figure 30: Location of the Marrickville dive site (southern)



7.12.6 Site inspection results

The Marrickville dive site is located across a built environment on a generally flat landform. No areas of surface visibility or intact ground surface were observed. One artificial drainage canal was observed from Sydney Steel Road, as well as the large Sydenham Drainage Pit and Pumping Station off the southeastern end of Saywell Street.

Discussion and analysis of site inspection results

Although the site inspection documented an extensive built environment and corresponding drainage modification, the deep nature of the residual underlying sediments indicates that there is likely to be some remaining archaeological potential at the southern dive site. The extent and location of that archaeological potential would be dependent on the depth and extent of impacts from building and canal construction and installation of underground services.

Plate 24: View southwest of Murray Street showing canal

Plate 25: View south across Sydenham Drainage Pit and Pumping Station

7.12.7 Assessment of archaeological potential

Limited archaeological investigations have occurred in the vicinity of the Marrickville dive site. The area has been significantly modified, including canalisation of the natural watercourse through the area to the Cooks River, construction of large industrial estates, and the large-scale use of the area for brick making and corresponding extraction of A and B horizons. It is assumed that where extraction of materials for brick making occurred at the Marrickville dive site that all archaeological potential would have been removed. Areas surrounding extraction pits area may still contain intact residual sediments and associated soils.

As demonstrated by the identification of Dugong bones and stone artefacts at Alexandra Canal, where there are remaining areas of natural soil there would be archaeological potential. The archaeological potential would relate to the likely use of the estuarine area subsistence resources.

There is moderate-high archaeological potential for Aboriginal objects in sub-surface contexts where there have not been extensive sub-surface impacts.

7.12.8 Significance assessment

The preliminary assessment of archaeological potential indicates the possible survival of Aboriginal objects in sub-surface contexts in those areas that have not been impacted by construction or removal of sediments for brick-making.

Intact Aboriginal archaeological deposits in this area would be extremely rare and would be of high research significance. It is also possible that out of context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not be likely to demonstrate high archaeological significance as they would not have the potential to provide accurate information or answers to relevant research questions.

7.12.9 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the Marrickville dive site.

Geotechnical information indicates that natural sediments are located beneath built structures at the Marrickville dive site. There is potential for Aboriginal objects to occur in the sub-surface archaeological deposits where there are surviving natural contexts.

7.12.1 Further archaeological investigation

Further archaeological investigation, which may include archaeological test / salvage excavation, is recommended where surviving Quaternary sediments or residuals soils associated with underlying Ashfield Shale are identified at the Marrickville dive site.

7.13 Sydney Harbour Tunnel Section

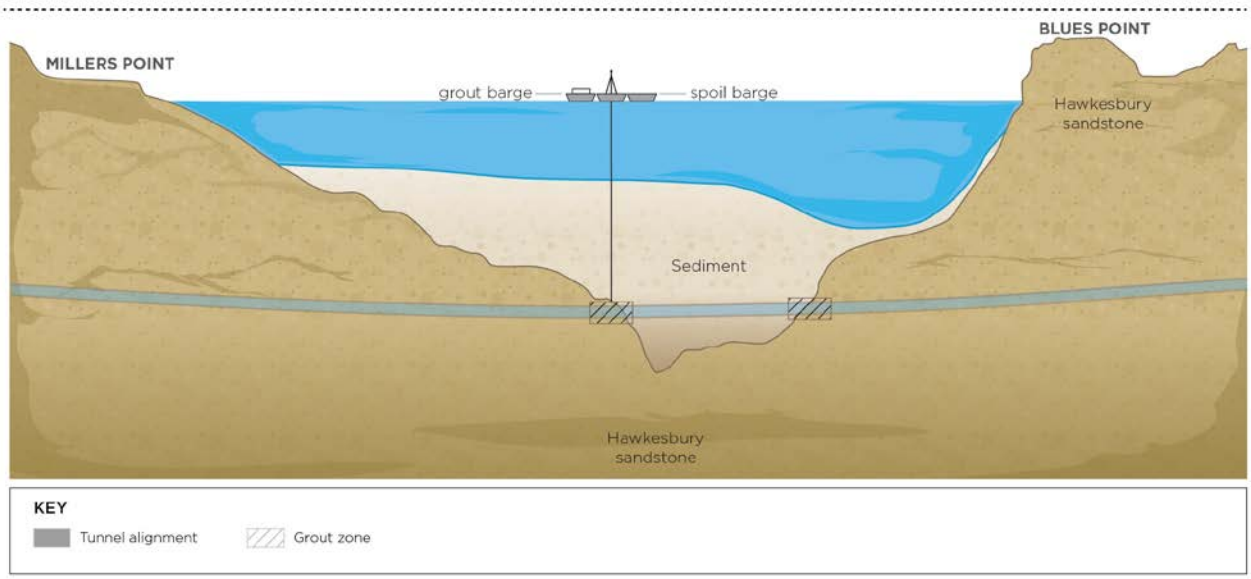
7.13.1 Scope of works

Due to expected ground conditions, ground improvement works may be required at specific locations underneath Sydney Harbour. Ground improvement works may be required at the rock-sediment transition zones (refer Figure 31) to reduce construction risks associated with tunnel boring machine work.

For the purposes of assessment, ground improvement works involve jet grouting which comprises the injection of a cement grout into the harbour bed from barges on the harbour. The grout would be delivered to the barges from an on-shore grout facility and would be injected from the barge via a crane and drilling lead.

Indicatively, ground improvement work could require the establishment of two cement grout blocks (each about 35 metres wide by 20 metres long by 16 metres deep) at the two points where the tunnel alignment passes through a rock-sediment transition zone.

Figure 31: Potential ground improvement scope



7.13.2 Discussion of the Sydney Harbour archaeological context

Sydney Harbour consists of a river valley that was inundated during the last sea level rise. The current sea level stabilised around 6,000 years ago.[184] The deeper parts of Sydney Harbour that would have represented valley floor contexts during periods of low sea-levels are likely to have been buried beneath large amounts of sand deposited by the rising sea levels and sediment from tributary watercourses. The steeper sides of the valley to the south of Blues Point and north of Millers Point would likely have included sandstone outcrops, including overhang formations.

Geotechnical investigations of the base of Sydney Harbour have been conducted for the project to determine the depth of underlying Hawkesbury Sandstone. During that investigation, evidence of the former valley floor prior to sea level inundation was encountered.

Charcoal retrieved from the former valley floor was suggested as representing evidence of a bushfire sometime prior to the last sea level rise. Charcoal retrieved during the geotechnical investigations has been sent for radiocarbon dating. The results of that radiocarbon dating were not available when this report was prepared.

The valley floor context between Blues Point and Millers Point prior to the last sea level rise is likely to have been a key subsistence resources area. Evidence of resource use as part of wider land-use strategies, including stone artefacts and shell material, would likely have been deposited on the valley floor and incorporated over time into sub-surface contexts through bioturbation or sediment deposition from flooding.

The effect on potential archaeological deposits at this location from inundation by rising sea levels and subsequent deposition of sand and silt is unknown. The fact that geotechnical investigations have been able to approximately establish the former valley floor context and identify possible evidence of a bushfire indicates some remaining contextual integrity.

[184] Birch, G. F. 2007. A short geological and environmental history of the Sydney estuary, Australia, pp 217-246. In: Water, Wind, Art and Debate. Ed. G. F. Birch, University of Sydney Press, The University of Sydney, Australia. 433p.

7.13.3 Assessment of archaeological potential

Very few archaeological investigations have been conducted within Sydney Harbour. Based on the preliminary findings of geotechnical investigations there is potential for an intact valley floor dating to the Pleistocene period buried beneath many metres of silty sediment on the base of the Harbour. This demonstrates moderate-high archaeological potential and a potentially unique and rare archaeological deposit.

7.13.4 Significance assessment

The preliminary assessment of archaeological potential indicates the possible survival of Aboriginal objects associated with a buried valley floor dating to the Pleistocene period. Intact Aboriginal archaeological deposits in this context would be extremely rare and would be of high archaeological significance.

7.13.5 Impact assessment

No identified Aboriginal sites would be impacted by the proposed works at the base of Sydney Harbour.

There is potential for Aboriginal objects to occur in the sub-surface archaeological deposits associated with the buried valley floor. A small portion of the buried valley floor underneath Sydney Harbour would be affected by the proposed ground improvement work.

7.13.6 Further investigation

The buried valley floor context is essentially inaccessible to humans and therefore the ability to apply specific mitigation is difficult in these circumstances is limited. Investigation of feasible and reasonable mitigation measures to manage potential impacts at this location would be considered in consultation with Aboriginal stakeholders and the Office of Environment and Heritage.

7.14 Power supply routes

Power supply routes are proposed at the following locations:

- Chatswood (Hampden and Mowbray Roads)
- Crows Nest (Clarke Lane)
- North Sydney (Berry Street)
- Millers Point to Darling Harbour (Hickson Road, Sussex Street, Lime Street, Erskine Street)
- King Street Wharf to Martin Place (Napoleon Street, Margaret Street, Hunter Street)
- Pyrmont to Pitt Street (Pyrmont Street, Western Distributor, Market Street)
- Pitt Street to Surry Hills (Pitt Street, Campbell Street, Mary Street, Albion Street)
- Central (Hay Street, Elizabeth Street, Eddy Avenue)
- Waterloo (Cope Street, Wellington Street, George Street)
- Sydenham (May Street, Council Street, Lord Street, Edinburgh Road).

The majority of the power supply routes would be constructed by trenching within the road reserve. Where major roads are crossed by the route (such as Mowbray Road for the Chatswood dive site power supply), alternative construction methods would be used such as under boring in order to avoid impacts to the road network. Alternative construction methods such as under boring may also be used to avoid other constraints such as services or areas of environmental sensitivity.

Trenches are expected to be around 1 m wide and 1.5 – 2 m deep. It is therefore likely any subsurface archaeological remains existing to this depth below the road treatment and pavement would be impacted. Where previous disturbance, such as utilities installation, has occurred the archaeological potential would be low. Preliminary Aboriginal Heritage Information Management System (AHIMS) searches indicate that no Aboriginal sites are present along the proposed power supply routes.

The proposed Aboriginal cultural heritage assessment report (refer to section 8.1) would address areas of archaeological potential associated with the power supply routes.

7.15 Summary of archaeological potential and significance for each site

Archaeological potential and significance for each site has been discussed throughout Section 7. A summary of that information is presented below in Table 3. A summary of recommended mitigation measures in included in Section 8 (Table 4).

Table 3: Overview of archaeological potential and archaeological significance

Location	Archaeological potential	Archaeological significance
Chatswood dive site (northern)	**Low** – The site is located on a crest away from major watercourses and is likely to contain shallow soils (associated with Ashfield Shale). Construction of commercial buildings, roads and a large rail cutting is likely to have impacted or removed archaeological deposits.	**Low** – The site would have low archaeological significance as high levels of previous ground disturbance would have impacted any surface or subsurface Aboriginal sites. As the site is located on a sandstone ridge and slope landform with shallow soils, any remnant archaeological deposits that may exist are likely to be low density and are unlikely to represent areas of focus for Aboriginal occupation.

Location	Archaeological potential	Archaeological significance
Artarmon substation	**Low** – The site has been subjected to high levels of surface disturbance, including construction and subsequent demolition of a dwelling and construction activities associated with the Gore Hill Freeway. These developments are likely to have impacted or removed archaeological deposits.	**Low** – The site would have low archaeological significance as high levels of previous ground disturbance would have impacted any surface or subsurface Aboriginal sites. As the site is located on a sandstone ridge and slope landform with shallow soils, any remnant archaeological deposits that may exist are likely to be low density and are unlikely to represent areas of focus for Aboriginal occupation.
Crows Nest Station	**Low** – The site is located on a crest away from major watercourses and is likely to contain shallow soils (associated with Ashfield Shale). Construction of commercial buildings, roads and a large rail cutting is likely to have impacted or removed archaeological deposits.	**Low** – The site would have low archaeological significance as high levels of previous ground disturbance would have impacted any surface or subsurface Aboriginal sites. As the site is located on a sandstone ridge and slope landform with shallow soils, any remnant archaeological deposits that may exist are likely to be low density and are unlikely to represent areas of focus for Aboriginal occupation.
Victoria Cross Station	**Low** – The site is located on a crest away from major watercourses and is likely to contain shallow soils (associated with Ashfield Shale and crest landscapes of Hawkesbury Sandstone). Construction of commercial buildings, roads and underground services is likely to have impacted or removed archaeological deposits.	**Low** – The site would have low archaeological significance as high levels of previous ground disturbance would have impacted any surface or subsurface Aboriginal sites. As the site is located on a sandstone ridge and slope landform with shallow soils, any remnant archaeological deposits that may exist are likely to be low density and are unlikely to represent areas of focus for Aboriginal occupation.

Location	Archaeological potential	Archaeological significance
Blues Point temporary site	**Moderate** – Although the site is likely to have been frequently used by Aboriginal people (due to its shoreline location), the development of a wharf and boat launching infrastructure is likely to have removed or significantly altered the original landform of the site. There is however some evidence of a possible natural landform in the northwest portion of the site.	**Potentially moderate to high** – Although the majority of the Blues Point temporary site is likely to have been significantly disturbed, natural profiles containing Aboriginal archaeological deposits are rare and if present would be of high research significance.
Barangaroo Station	**Moderate to high** – Archaeological potential has been identified within the western portion of the Barangaroo Station footprint. This archaeological potential relates to the possible survivability of buried shell midden deposits associated with the original shoreline of Darling Harbour. The eastern portion of the Barangaroo Station footprint does not demonstrate archaeological potential due to the large-scale removal of the original sandstone context.	**Potentially high** – Intact Aboriginal archaeological deposits within the Sydney CBD are extremely rare and would be of high research significance. It is also possible that out-of-context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not likely demonstrate high archaeological significance as they would not have potential to provide accurate information or answers to relevant research questions.
Martin Place Station	**Moderate to high** – Discrete portions of surviving archaeological deposit containing Aboriginal objects may occur in very small areas. The location of Martin Place Station within the Tank Stream catchment and within 250 metres of that watercourse suggests potential for Aboriginal objects below the ground surface in areas that have not been significantly impacted or excavated (for example, during the construction of building basements and / or underground car parks).	**Potentially high** – Intact Aboriginal archaeological deposits within the Sydney CBD are extremely rare and would be of high research significance. It is also possible that out-of-context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not likely demonstrate high archaeological significance as they would not have potential to provide accurate information or answers to relevant research questions.

Location	Archaeological potential	Archaeological significance
Pitt Street Station	**Moderate to high** – The location of Pitt Street Station in a low-lying and gently sloping area around the headwaters of the Tank Stream suggests potential for Aboriginal objects below the ground surface in areas that have not been significantly impacted or excavated (for example, during the construction of building basements and / or underground car parks).	**Potentially high** – Intact Aboriginal archaeological deposits within the Sydney CBD are extremely rare and would be of high research significance. It is also possible that out-of-context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not likely demonstrate high archaeological significance as they would not have potential to provide accurate information or answers to relevant research questions.
Central Station	**Moderate to high** – There are likely to have been significant, although not necessarily comprehensive, sub-surface impacts across the site from construction of the station, including underground excavation for access tunnels, and the establishment and possible landform modifications for laying the extensive network of rail lines to the south of Central Station. The site's location on a raised, well-drained area close to estuarine resources at Cockle Bay indicates potential for Aboriginal objects to be present below the ground surface in areas that have not been significantly impacted or excavated.	**Potentially high** – Intact Aboriginal archaeological deposits within the Sydney CBD are extremely rare and would be of high research significance. It is also possible that out-of-context Aboriginal artefacts may be present in the layers of fill used in the area. Any such artefacts would not likely demonstrate high archaeological significance as they would not have potential to provide accurate information or answers to relevant research questions.
Waterloo Station	**Moderate to high** – There are likely to have been significant, although not necessarily comprehensive, sub-surface impacts across the site from 19th and 20th century construction and installation of services. Notwithstanding, discrete portions of surviving archaeological deposit containing Aboriginal objects may occur beneath buildings and deep layers of introduced fill. There is moderate to high potential for Aboriginal objects to be present in sub-surface contexts where there have not been extensive sub-surface impacts.	**Potentially high** – Intact Aboriginal archaeological deposits within the area are extremely rare and would be of high research significance. It is also possible that out-of-context Aboriginal artefacts may be present in the layers of fill used in the area. However, any such artefacts would not likely demonstrate high archaeological significance as they would not have potential to provide accurate information or answers to relevant research questions.

Location	Archaeological potential	Archaeological significance
Marrickville dive site	**Moderate to high** – The site has been significantly modified by previous developments, including channelisation of the natural watercourse through the area to Cooks River, construction of large industrial estates, and the large-scale use of the area for brick-making (including the extraction of clay soil). These activities are likely to have impacted or removed archaeological deposits. Notwithstanding, a previous archaeological excavation in the local area (Etheridge, 1905) identified Dugong bones and stone artefacts at Alexandria Canal, demonstrating the potential for Aboriginal objects to be present in sub-surface contexts where there have not been extensive sub-surface impacts.	**Potentially high** – Intact Aboriginal archaeological deposits in this area are extremely rare and would be of high research significance. It is also possible that out-of-context Aboriginal artefacts may be present in the layers of fill used in the area. However, any such artefacts would not likely demonstrate high archaeological significance as they would not have potential to provide accurate information or answers to relevant research questions.
Sydney Harbour Tunnel Section	**Moderate to high** – Geotechnical investigation indicates the presence of a buried valley floor dating to the Pleistocene period.	**Potentially high** – Known intact Aboriginal deposits in Sydney Harbour are extremely rare and would be of high research significance. However, only a very small proportion of the buried valley floor underneath Sydney Harbour would be affected by the proposed ground improvement work.

8.0 MITIGATION AND MANAGEMENT MEASURES

The following measures were based on consideration of:

- Statutory requirements under the *National Parks and Wildlife Act 1974* as amended.
- The results of the background research, site survey and assessment.
- Consultation with the Metropolitan Local Aboriginal Land Council (MLALC).

It was found that

- There are no recorded Aboriginal sites within the study area
- There are seven proposed work sites within the study area (Blues Point temporary site, Barangaroo Station, Martin Place Station, Pitt Street Station, Central Station, Waterloo Station and the Marrickville dive site) where further archaeological investigation is recommended in areas of archaeological potential where there is a likelihood of natural soil/sand horizons being present.
- There are four proposed work sites within the study area (Chatswood dive site, Artarmon substation, Crows Nest Station and Victoria Cross Station) where there is low archaeological potential and no further archaeological investigation is recommended.
- Works along the proposed power supply routes would involve trenching to a depth of about two metres. In locations where there has been no previous ground disturbance, these activities could affect areas with archaeological potential. Preliminary Aboriginal Heritage Information Management System (AHIMS) searches indicate that no Aboriginal sites are present along the proposed power supply routes. The Aboriginal cultural heritage assessment report would address areas of archaeological potential associated with the power supply routes.

8.1 Approach to mitigation

8.1.1 Guiding principles

The overall guiding principle for cultural heritage management is that where possible Aboriginal sites would be conserved. If conservation is not practical, measures would be taken to mitigate against impacts to Aboriginal sites.

The nature of mitigation measures recommended is primarily based on an assessment of archaeological significance. The recommendations are also informed by cultural significance, which would be discussed with the MLALC and other registered stakeholders.

8.1.2 Aboriginal cultural heritage assessment report

An Aboriginal cultural heritage assessment report would be prepared in accordance with the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*. The Aboriginal cultural heritage assessment report would include:

- Details of Aboriginal stakeholder consultation
- An assessment of cultural significance for the project area and identification of any specific areas of cultural significance based on consultation with Aboriginal stakeholders
- A methodology for archaeological management including test excavation and salvage (refer to section 8.1.3 below).

8.1.3 Test / salvage excavation

A flexible test / salvage excavation methodology should be incorporated into the Aboriginal cultural heritage assessment report. Where natural contexts that require archaeological test / salvage excavation are identified during further investigation or construction work at those sites identified as demonstrating archaeological potential, test / salvage excavation would take place based on the methodology in the Aboriginal cultural heritage assessment report. The test / salvage excavation methodology would likely specify that the test / salvage excavation would be conducted to the full extent of the archaeological resource, and include guiding principles for interpretation and assessment of possible contact and post-contact period sites.

8.1.4 Unexpected finds

The Aboriginal cultural heritage assessment would provide a method to manage potential heritage constraints and unexpected finds during construction works. This document would include information on any requirements during construction for:

- Protecting any identified Aboriginal heritage sites in the immediate area during construction activities
- A procedure to manage reporting and investigation when unexpected finds are encountered.

The Aboriginal cultural heritage assessment report should also incorporate measures and controls to be applied during construction, including but not limited to contractor training in general Aboriginal cultural heritage awareness, and any on-going opportunities for Aboriginal community engagement.

8.1.5 Discovery of human remains

If suspected human skeletal remains are uncovered at any time throughout undertaking the proposed works, procedures outlined in the Aboriginal cultural heritage assessment report unexpected finds procedure should be implemented.

8.2 Mitigation and management measures – Construction

The measures detailed in Table 4 are proposed to address potential impacts on Aboriginal heritage sites and areas of archaeological potential during construction. They were developed following consideration of:

- Statutory requirements under the *National Parks and Wildlife Act 1974* as amended.
- The results of the background research, site survey and assessment.
- Consultation with the Metropolitan Local Aboriginal Land Council (MLALC).

Table 4: Aboriginal heritage mitigation measures

Ref	Mitigation measure	Applicable site[1]
AH1	Aboriginal stakeholder consultation would be carried out in accordance with the NSW Office of Environment and Heritage's *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*.	All
AH2	An Aboriginal cultural heritage assessment report would be prepared in accordance with the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*. The Aboriginal cultural heritage assessment report would include: • Details of Aboriginal stakeholder consultation conducted in accordance with AH1 • An assessment of cultural significance for the project area and identification of any specific areas of cultural significance based on consultation with Aboriginal stakeholders • A methodology for archaeological management, including test excavation and salvage (refer to AH3).	All
AH3	Archaeological test excavation (and salvage when required) would be carried out where intact natural profiles with the potential to contain significant archaeological deposits are encountered at the Blues Point temporary site, Barangaroo Station, Martin Place Station, Pitt Street Station, Central Station, Waterloo Station and Marrickville dive site. Excavations would be conducted in accordance with the methodology outlined in the Aboriginal cultural heritage assessment report.	BP, BN, MP, PS, CS, WS and MDS
AH4	Appropriate Aboriginal heritage interpretation would be incorporated into the design for the project in consultation with Aboriginal stakeholders.	All
AH5	Feasible and reasonable mitigation at the ground improvement locations would be identified in consultation with the Office of Environment and Heritage.	GI
AH6	The Aboriginal cultural heritage assessment report would address areas of archaeological potential associated with the power supply routes.	PSR

[1] *STW: Surface track works; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement works; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; MDS: Marrickville dive site; Tunnel: Tunnel not related to other sites (e.g. TBM works);PSR; Power supply routes.*

8.3 Mitigation and Management Measures – Operation

No additional mitigation measures for Aboriginal heritage are required.

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artefact

Artefact Heritage

ABN 73 144 973 526
Level 4, Building B
35 Saunders Street
Pyrmont NSW 2009
Australia

+61 2 9518 8411
office@artefact.net.au
www.artefact.net.au