Project Name: Windsor Bridge Replacement Project

PROJECT NUMBER: 140604-2

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Test Excavation Report – Aboriginal Heritage

Prepared by AAJV on behalf of NSW Roads and Maritime Services
EXECUTIVE SUMMARY

The NSW Roads and Maritime Service (RMS) is proposing to replace Windsor Bridge at Windsor in NSW. The upgrade includes replacement of the existing Windsor Bridge, with a new structure and various modifications to the approaches and surrounds of the river crossing. The project has been assessed under Part 5.1 of the NSW Environmental Planning and Assessment Act 1979 (State Significant Infrastructure), and was approved in late 2013 (SSI_4951). The Minister's Conditions of Approval (MCoA) for the Windsor Bridge Replacement Project (WBRP) require a range of geomorphological, Aboriginal, historical and maritime archaeological investigations for the southern (condition B3) and northern (condition B4) banks of the Hawkesbury River to be undertaken prior to its construction. This report presents the preliminary findings of the Aboriginal archaeological excavations undertaken to satisfy the MCoA's conditions.

The archaeological program was designed and implemented in accordance with a research design (Appendix 1) approved by the Department of Planning and Environment in consultation with NSW Roads and Maritime Services, Office of Environment and Heritage, and the Registered Aboriginal Parties. The excavation occurred over a 9.5 week field program that extended between 22 August and 17 November 2016, and was undertaken by a core team of four archaeologists, an artefact manager, and seven Aboriginal representatives. Archaeological excavations consisted of supervised mechanically dug test pits across the project area, with all sediment recovered in spits and wet-sieved for cultural material.

The archaeological excavations consisted of a systematic grid of machine dug test pits across the project area to identify and recover any evidence of past Aboriginal activity, and map the sedimentary layers within which they were found. They consisted of 8 test pits (totalling 27.9m²) across the northern project area, and 38 test pits (totalling 74.28m²) across the southern project area. Test pits were dug by mechanical excavator in discrete 5, 10 or 20cm intervals - or spits. The sediment from each interval was wet-sieved through a 3 or 5mm mesh to recover Aboriginal cultural materials (primarily stone artefacts). Overall, some 220 tonnes of sediment was recovered and sieved from the 46 test pits.

Overall, the excavations revealed 10 discrete sedimentary (or geomorphological) layers across the two project areas. Throughout these layers some 1,434 stone artefacts were recovered - 23 from the northern project, and the remainder from the southern project area. The depth of the artefacts was variable, but often deep, ranging between 120-240cm below current surface in the northern project area, and 70-210cm below current surface in the southern project area. From these data, four distinct archaeological landscapes were developed to describe the past Aboriginal occupation and activity of the project area (Figure 16):

- **Ridgeline** – extending across George Street, southern edge of Thompson Square, Macquarie Street, and parts of Old Bridge Street. This landscape reveals a disparate shallow soil profile, often beneath historical overburden. Much of this landscape has been heavily affected by modern and historical activities, with only pockets of soil profile (and any associated stone artefacts) being present across the landscape. The deposit contained discrete concentrations of Aboriginal stone artefacts up to 50/m², which compositionally appeared to represent a mixture of several different phases of use over the last 30,000 years.

- **Source-Bordering Dune** – extending across upper and lower Thompson Square, with truncated and/or discrete patches of the deposit in The Terrace, Old Bridge Street, and George Street. This landscape was composed of two different layers of sand, formed by both river and wind processes over at least the last 82,000 years. The majority of the Aboriginal stone artefacts (995) with the southern project area were recovered from these layers. Compositionally, the artefacts could be divided into three different periods of visitation and/or occupation of the project area, at 27-17,000 years ago, 7-5,000 years ago and early post-European settlement (AD1784-1830s). The majority of the Aboriginal stone artefacts dates to
between 27-17,000 years ago, and provides some of the earliest evidence of populations in the Sydney basin, and importantly thought a major climatic downturn – the Last Glacial Maximum - which saw the abandonment of extensive tracts of Australia. (Therefore finding areas where Aboriginal populations survived and lived through this period are relatively rare). A number of glass artefacts (n=3) were also found in the upper parts of the deposit and demonstrate post-contact interactions between Aboriginal people and early European settlers. Other historical material found in association, and past records of Windsor suggest that the artefacts likely date to between AD1794 and the 1830s.

- River’s Edge Alluvium – encompassing the entire northern project area, and the lower areas of the southern project area, including The Terrace, the wharf area and surrounding carpark. This landscape consisted of thick dark brown sand and clay, and was likely formed through low-energy deposition by the Hawkesbury River, probably in the last 6,500 years, if not much more recently. Aboriginal stone artefacts are found throughout the deposit in low numbers (<5/m²), with many of them potentially re-worked either naturally or via human processes from other nearby archaeological landscapes.

- River’s Edge – Reclaimed/Introduced Fill – disparate pockets of introduced and/or modified natural deposits used to in-fill and landscape areas primarily along the southern bank of the Hawkesbury River. Aboriginal stone artefacts are found throughout the deposit in low numbers (<5/m²), with many of them potentially re-worked either naturally or via human processes from other nearby archaeological landscapes.

Overall, the assessment found nine test pits of very high or high (regional/State) significance, three of moderate significance, and 34 of low or very low significance. All those identified as of high or very high value were situated within the source-bordering dune archaeological landscape. The identification of these areas as of high or very high value was based on the significant age and integrity of the cultural deposit, and its ability to provide information on the behaviour, mobility and populations of Aboriginal people during the earliest occupation and visitation of the southeast Australia, and through the Last Glacial Maximum (24-18ka) - a significant climatic period of drying and cooling. These deposits also contained glass artefacts, and demonstrate post-contact interactions between Aboriginal people and early European settlers, and thereby meeting historical significance thresholds.

A review of the proposed development design indicates that impacts would occur to all four archaeological landscapes present within the project area. Of the four archaeological landscapes, all will be subject to impact, varying from 24 to 38% of the deposits within the project area. Of these, the most significant (source-bordering dune) will be subject to some 1,417m² (or ~22.5% of the identified deposit within the project area) when considering the direct impact corridor of the road, and adding a 4m buffer to address ancillary activities. A management strategy and recommendations to address these impacts has been provided, which includes archaeological salvage of 149m² of the source-bordering dune (equivalent to ~10% of this deposit within the impact corridor) within the lower Thompson Square park. Archaeological salvage is proposed to be undertaken as two open area excavations in the vicinity of SA 8-10, and SA 29.

Based on the findings, the recommendations of the report are:

- The findings of this report should be integrated into the Strategic Conservation Management Plan and other pertinent documents required as part of the project.

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1 The Last Glacial Maximum is a well-documented global event dating to between 24-18,000 years ago. This was the height of the last glacial period, and saw extremely cold and arid conditions across much of Australia.
• The findings of this report should be integrated into the Interpretation Plan to ensure representation of the extensive past Aboriginal visitation and activity within the project area is appropriately expressed following the completion of the project.

• The recommendations of this report should ensure integration with the requirements of the Hawkesbury River Regional Sand Body study to ensure a holistic approach is applied to any future on-site works.

• Consultation with the Registered Aboriginal Parties should continue throughout the project. This will allow stakeholders to continue to have an involvement in the management and interpretation of the Aboriginal cultural heritage issues of the project.

• The planning and execution of the proposed development should address the Aboriginal heritage issues identified in this document, and should avoid and/or minimise Aboriginal heritage impact where possible.

• Subsequent phases of development should address the Aboriginal heritage issues identified in this document, and should avoid and/or minimise Aboriginal heritage impact where possible.

• RMS should advise all relevant personnel and contractors involved in the design, construction and operation of the proposed development, of the relevant heritage issues, and recommendations identified in this report. This should be undertaken as part of the broader site inductions usually required prior to any personal or contractors working on the project.

• Prior to construction, mitigation measures (archaeological salvage) in accordance with the approaches and methods outlined in Section 8.3 of this report should be implemented. No construction or development activities on-site should proceed until the on-site components of these works have been completed.

• The recommended mitigation measures are based on the analysis of the potential impacts as presented in Section 8.2 of this report (see also Figures 18-21). In the event that development or construction activities are required beyond those identified impact corridor (as shown in Figures 18-21), the mitigation measures of this report would need to be re-assessed, and any additional requirements implemented prior to construction/development beginning/resuming.

• The most significant impact is likely to be the construction of the bridge along the eastern edge of Thompson Square, and construction buffer (Figure 18). Given the proximity of significant cultural deposits to this corridor, it is recommended that temporary fencing of the extent of the impact corridor should be installed for the duration of the proposed construction as shown in Figure 18 (as practical given the urban nature of the project area) to avoid inadvertent direct or indirect impacts to the archaeological landscape by the works.

• During construction, mitigation measures (landscape monitoring) in accordance with the approaches and methods outlined in Section 8.3 of this report should be implemented.

• An Aboriginal Site Impact Recording Form must be prepared and submitted to the AHIMS Registrar to outline the findings of the archaeological excavations within the project area.

• A copy of this assessment should be provided to the Registered Aboriginal Parties to review and provide comment on the findings and recommendations prior to the implementation of future archaeological stages.

• Once finalised, a copy of this report should be submitted to OEH AHIMS report library.
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INTRODUCTION

1.1 Background and Context

The NSW Roads and Maritime Service (RMS) is proposing to replace Windsor Bridge, Windsor, NSW. The re-development includes replacement of the existing Windsor Bridge, with a new structure and various modifications to the approaches and surrounds of the river crossing. The project has been assessed under Part 5.1 of the Environmental Planning and Assessment Act 1979 (State Significant Infrastructure), and was approved in late 2013 (SSI 4951). Once all the necessary approvals are received from the Department of Planning and Environment, construction is estimated to begin in 2017. RMS has engaged AAJV (a joint venture of Austral Archaeology and Extent Heritage (formerly AHMS)) to undertake archaeological investigation and provide heritage management services to RMS during the Windsor Bridge Replacement Project (WBRP).

The Minister’s Conditions of Approval (MCoA) for the WBRP require a range of geomorphological, Aboriginal heritage, historical and maritime archaeological investigations for the southern (condition B3) and northern (condition B4) banks of the Hawkesbury River; and if required, a detailed study into the sand bodies of the Hawkesbury region (condition B3f). Specifically, conditions B3 and B4, and the location they are addressed in this report are outlined below:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Location in this Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>B3. The Applicant shall undertake an Archaeological Investigation Program comprising Aboriginal and non-Aboriginal Heritage in the project area on the southern side of the Hawkesbury River, prior to the commencement of preconstruction and construction activities in the southern area. The program shall be conducted to the satisfaction of the Director-General and in accordance with:</td>
<td>Entire report</td>
</tr>
<tr>
<td>a) the Heritage Council’s Archaeological Assessments Guideline (1996) using a methodology prepared, in consultation with the NSW Heritage Council for non-Aboriginal heritage; and</td>
<td>N/A</td>
</tr>
<tr>
<td>b) prepared in consultation with the OEH (Aboriginal heritage) and the Aboriginal stakeholders.</td>
<td>Section 2 and Appendix 1 includes feedback from Aboriginal stakeholders</td>
</tr>
<tr>
<td>The Archaeological Investigation Program is to be undertaken by an archaeological heritage consultant approved by the Director-General in consultation with the NSW Heritage Council and by the OEH (Aboriginal heritage) and by an Excavation Director who shall demonstrate an ability to comply with the Heritage Council’s Criteria for the Assessment of Excavation Directors (July 2011) and in particular must be able to demonstrate compliance with Criterion A.4 that: ‘work under any approvals previously granted by the Heritage Council has been completed in accordance with the conditions of that consent and the final report has been submitted to the NSW Heritage Council.</td>
<td>Section 1.4</td>
</tr>
<tr>
<td>The Archaeological Investigation Program shall include archaeological testing and geophysical investigation, as required for the significance assessment.</td>
<td>Section 5</td>
</tr>
<tr>
<td>The results of the Archaeological Investigation Program are to be detailed in a Historic Archaeological Report and a Detailed Salvage Strategy comprising the non-Aboriginal and Aboriginal heritage findings. These are to be prepared in consultation with the OEH (Heritage Branch and Aboriginal heritage) and to the satisfaction of the Director-General, and shall include, but not necessarily be limited to:</td>
<td></td>
</tr>
</tbody>
</table>
In response to these conditions, AAJV has been engaged by RMS to undertake the Aboriginal archaeological excavations in advance of the bridge replacement. The archaeological investigations were undertaken in accordance with the *Aboriginal Archaeological Research Design and Excavation Methodology* (AAJV, 2016) (hereafter ‘ARD’), which is included in Appendix 1, and summarised in Section 4.

This document presents the findings of the archaeological testing program to provide information on the cultural deposits present within the project area, their significance, potential impacts, and future mitigation strategies. The Aboriginal archaeological excavation findings outlined in this document is a companion document to the historical archaeological test excavation, maritime heritage investigations and a Sand Body Study. Collectively, these works seek to provide an integrated and holistic approach to the identification, assessment and management of the cultural values within the WBRP project area. The results of the assessments will be used to inform the development of a Strategic Conservation Management Plan (SCMP) for the project.

### 1.2 Location

The WBRP project area is located at Windsor, within the Hawkesbury Local Government Area (LGA), approximately 57 kilometres north-west of Sydney. The town is situated on the southern bank of the Hawkesbury River, close to the foothills of the Blue Mountains.

The WBRP project area incorporates the existing and proposed replacement bridge sites and associated road works. It extends from the intersection of Freemans Reach Road and Wilberforce Road in the north to the intersection of Bridge Street and Macquarie Street in the south of the township (Figure 1).
1.3 Limitations

The report includes predictions regarding the potential for sub-surface archaeological materials to exist within certain landforms/landscapes in the subject area. The predictions are based on evidence from surface indications, environmental contexts, and the limited archaeological test excavation undertaken as part of the current assessment. As such, it is noted that sub-surface archaeological material may survive in particular areas despite surface/sub-surface evidence suggesting that they do not. The converse also applies.

The test excavation revealed that the soil profile across much of the southern project area was in excess of 2m in depth, with the upper 50-100cm composed of historical or modern deposits. This meant that the cultural deposits of interest to this study frequently extended >1.5m in depth. Due to Health Safety and Environment (HSE) reasons, entry/exit of test pits >1.5m was not permitted, and this severely restricted the level of high resolution sampling and recording of test pits, especially at their lowest depths.

1.4 Authors

Dr. Alan Williams FSA MAACAI, Aboriginal Heritage Team Leader wrote this report, with assistance from Laressa Berehowyj, Dr. Tessa Bryant and Tom Sapienza, Heritage Advisors. The report was reviewed for quality assurance by Dr. MacLaren North, NSW Director of Extent Heritage Pty Ltd and Justin McCarthy, Director of Austral Archaeology Pty Ltd.

Approval of the heritage consultant team was provided by DPE on 22 March 2016.
Figure 1. Map of the WBRP project area.

Study Area
2 ABORIGINAL CONSULTATION

Aboriginal consultation is being undertaken for the WBRP project in accordance with OEH’s (2010) *Aboriginal Cultural Heritage Consultation Requirements for Proponents* and RMS’ (2011) *Procedures for Aboriginal Cultural Heritage Consultation and Investigation*. The primary purpose of the consultation work is to identify and document the cultural values the WBRP area to the Aboriginal community so that those values can be considered in development of future management and impact mitigation measures in the Strategic Conservation Management Plan (SCMP).

Consultation is ongoing, including regular distribution of documentation and focus group meetings. Currently, consultation is being undertaken with the Aboriginal stakeholders and organisations involved in earlier stages of the project, and including:

- Deerubbin LALC.
- Darug Custodian Aboriginal Corporation.
- Darug Aboriginal Cultural Heritage Assessments.
- Darug Land Observations.
- Darug Tribal Aboriginal Corporation.
- Tocomwall Cultural Heritage Consultants (formerly Yarrawalk).
- Darug Aboriginal Landcare Inc.
- Gunjeewong Cultural Heritage Aboriginal Corporation.

With specific reference to the archaeological investigations, Aboriginal stakeholders were consulted and provided input into the ARD and eventual field program (*Appendix 1*). In addition, representatives of the Aboriginal stakeholders participated in the field program. Specifically, up to seven representatives participated each day of the ten week field program, which ran between 22 August and 17 November 2016. Activities included manual excavation, machine monitoring and wet-sieving, along with a range of other archaeological activities through the program. Frequent and ongoing discussion was undertaken with the Aboriginal stakeholders throughout the field program in relation to any excavation changes, cultural material findings, and significance, as the work progressed.

Aboriginal participation is proposed to continue through AFG meetings and workshops being undertaken by the AAJV to identify cultural values specific to the WBRP and local area. Any feedback will be documented in a consultation log that would be included in the SCMP, and discussed in the main report, with appropriate changes/recommendations made. In addition, further formal exhibition period undertaken once the final SCMP has been developed.
3 BACKGROUND

3.1 Key Findings

Previous investigations in the Sydney region and at Windsor indicate:

- The colonisation of the Sydney Basin may have occurred as early as 40,000 years BP (in the Pleistocene), with reliable evidence for occupation along major river corridors and a focus on local resources and raw material, from about 35,000 BP.

- These areas remained occupied, and use intensified during the Last Glacial Maximum (LGM) – a period of extreme aridity – with recent models highlighting the Sydney Basin as a likely refuge.

- In-filling and intensification of the Sydney Basin, including along lesser creeklines, occurred in the late Holocene (from about 5,000 BP to the present) – with the vast majority of the 12,000 or so sites recorded indicative of this period.

- Our understanding of the post-LGM period remains poor, with archaeological deposits continuing to show refugia-like behaviour despite improving climatic and resource conditions. Further characterisation of deposits from this temporal period is essential to improve our understanding of past society behaviour; and currently the best known of these deposits are along the Hawkesbury River corridor.

- Occupation of the region over the last 8,000 or so years is also yet to be definitively understood, with several sites suggesting a possible abandonment of the region in the mid Holocene (8-5,000 years BP) despite climatic amelioration. This was followed by significant re-colonisation and intense use of the region in the last few thousand years. The high quantities of silcrete during this later period are strongly indicative of close links and/or regular movement to other parts of northwest Sydney, such as Plumpton Ridge and Riverstone.

- The previous studies undertaken by Kelleher Nightingale Consulting in the WBRP area indicate the presence of high densities of cultural deposits within the WBRP area and the presence of a sand body. Previous investigations at Windsor Museum and Pitt Town indicate similar sand body landforms have potential to contain deep cultural sequences extending from the Late Holocene back into the Pleistocene period.

3.2 Regional Studies

The Sydney Basin has been subject to over 70 years of archaeological investigation through both academic and cultural resource management. Some of the earliest investigations were undertaken on the Hawkesbury River corridor at Lapstone and Shaw’s Creek, and included the seminal works of McCarthy (1948) in his attempt to disentangle the Aboriginal stone typology; and the excavations of KII rockshelter by Kohen et al. (1984) which aimed to characterise the colonisation of the basin. Other notable investigations include the works of Stockton and Holland (1974) in the Blue Mountains, and Lampert (1966, 1971), Megaw (1965, 1968), Moore (1970, 1981) and Nanson et al. (1987), which all aimed to understand the history and behaviour of past Aboriginal use and occupation in the region. These studies collectively identified early colonisation of the Sydney Basin may commence c. 40,000 years BP with a significant increase in evidence for occupation in the last few thousand years.
Over the intervening years there has been a large number of development-driven archaeological investigations across the Cumberland Plain to the west of the Sydney CBD. This has resulted in a large data set that has helped flesh out the patterns of past occupation and use of the region. A number of key studies undertaken on the major river systems of the Sydney Basin, including the Parramatta River, Georges River, Hawkesbury-Nepean and Hunter River/Wollombi Brook have demonstrated the presence of Pleistocene, and often Last Glacial Maximum (LGM) occupation (AHMS, 2015; Hughes et al., 2014; McDonald, 2008). Investigation of the wider Cumberland Plain has been extensive with the notable studies by McDonald (1995) at Rouse Hill Infrastructure Project, providing the first large-scale systematic study of lesser creeklines, including Second Ponds Creek and Killarney Chain of Ponds, and demonstrating the intensification of occupation during the last few thousand years. A subsequent study using a similar methodology was undertaken by Extent Heritage (then AHMS) (2015) which investigated the banks of Eastern Creek, First Ponds Creek and Cattai Creek as part of water infrastructure installation, and found similar results. This assisted in further characterising the nature of the archaeological assemblage.

These studies, as well as hundreds of others, have provided us with a more accurate fine-grained understanding of the archaeological resource and past human behaviour within the Sydney Basin. The most reliable information currently indicates that small bands of Aboriginal hunter-gatherers likely visited and colonised the Sydney Basin only around 35,000 years BP, with sites such as PT 12 (Williams et al., 2014), SGCD 16 (Fal Brook Site) (Koettig, 1987) and the Parramatta Sand Sheet (McDonald, 2008) all showing activation at this time. Occupation appears to have been constrained to the major river corridors, with a focus on local resources and raw materials, with the archaeological record dominated by relatively basic stone tools composed of primarily tuff and volcanic river cobbles. These areas remained occupied, and use intensified during the LGM – a period of extreme aridity – with recent models highlighting the Sydney Basin as a likely refuge during this time (Williams et al., 2013). Williams et al. (2014) suggests that people remained highly mobile within the refuge, with the major river systems likely forming a series of locales on a point-to-point subsistence strategy.

Our understanding of the post-LGM period remains poor, with archaeological deposits continuing to indicate refugia-like behaviour despite improving climatic and resource conditions. Similarly, the early and mid-Holocene (10-5,000 years BP) also appears highly variable in the archaeological record, although a number of sites now suggest the expansion of populations along lesser river corridors such as Eastern Creek and Cattai Creek (AHMS, 2014, 2015). Finally, the late Holocene (5,000-0 years BP) sees extensive occupation and in-filling of the Cumberland Plain with the vast majority of the 12,000 or so sites recorded indicative of this period. This is a pattern that was also identified by Attenbrow (2010) in her detailed study of temporal changes in settlement patterns within the Mangrove Creek Catchment to the north of Sydney. While material culture is found on all landforms and locations, there remains a propensity for occupation and activity along riverine corridors, and focussed upon large silcrete raw material resources, such as Plumpton Ridge (West Schofields).

It has recently been hypothesised that climate amelioration in the early Holocene resulted in demographic growth, which was followed by a period of climate downturn in the late Holocene which resulted in pressures that pushed populations into a wider range of resource zones and drove technological innovation (Williams et al. 2015) – a story that correlates well with the archaeological record of the Cumberland Plain.

However, while there is a general understanding of the archaeological record of the Sydney Basin, there remain a number of unresolved questions. Specifically:

- **What is the earliest occupation of the Sydney Basin?** Currently, the findings at Cranebrook Terrace remain unsubstantiated, and the earliest occupation is therefore ~36,000 years BP at PT 12 (Williams et al., 2014) – see Section 3.2. However, there are a range of earlier archaeological dates in the southeast corner of Australia, and it seems likely that the Hawkesbury River would have formed an attractive resource during the original colonisation of
the continent; and as such earlier dates are expected in this region, and especially along the river corridor.

- **What were Aboriginal populations doing between the LGM and early Holocene?** Historically, archaeological research has focussed on the LGM and late Holocene, and for this reason the temporal period in between is poorly understood. PT 12 at Pitt Town forms a snapshot into this period, and shows a range of unexpected behaviours during this time, with populations maintaining a refuge-like state despite improved climatic conditions. Further characterisation of deposits from this temporal period is essential to improve our understanding of past behaviour; currently the best known of these deposits are along the Hawkesbury River corridor.

- **Why was the river less attractive to Aboriginal populations in the Holocene?** Despite evidence for demographic growth during the Holocene, occupation appears to have been more intermittent along the Hawkesbury River during the Holocene. Given the significant resources present along the river, it is unclear why there is evidence of abandonment at PT-12 in the mid-Holocene and at the Windsor Museum during the late Holocene. Further investigations along the corridor are necessary to identify if this was part of a larger abandonment of the river system – and if so, why – or if it was part of a broader change in land use during these times.

### 3.3 The Hawkesbury River Corridor

Studies undertaken elsewhere in the local area at the Windsor Museum (Austral Archaeology, 2011) and Pitt Town (Extent Heritage (then AHMS), 2011; Williams et al., 2012, 2014), have demonstrated that deep sand profiles exist in localised areas along the Hawkesbury River. The investigations have identified significant Aboriginal cultural deposits within these sand profiles, providing evidence for occupation and use extending well back into the Pleistocene.

#### 3.3.1 Pitt Town

Extent Heritage (then AHMS) undertook extensive archaeological investigations in advance of residential development at Pitt Town (AHMS, 2006, 2011, 2012; Williams et al., 2012, 2014). These investigations consisted of several phases of archaeological investigation for a series of residential housing developments situated along Bathurst and Hall Streets on the edge of a ridge elevated above (~25m AHD), and some 200m from the river (or its associated tributaries). The works consisted of ~200m² of investigation and salvage across the ridge-top, with the most significant finds being recovered from a large open area excavation (75m²) near the Pitt Town Anglican Church. The investigations revealed a deep Kandosol soil profile, characterised as a 1-2m deep fine to medium loamy sand (varying in colour from deep red to brown) situated above the Pitt Town Sands and/or Londonderry Clay (both culturally sterile). The investigations found the sand body was deposited through fluvial processes (i.e. flooding by the river) around 120,000 years ago. The upper 1-1.3m of the Kandosol exhibited aeolian (wind-blown) re-working and formed within the last 40,000 years. Test excavations for the ‘Thornton’ residential precinct (situated on a sharp bend of Hall Street and loosely encompassed by Paul Street and Cattai Road), demonstrated the Kandosol soil profile extended ~400m from the ridge’s edge, and was in fact part of a small dune-field covering much of Pitt Town township (AHMS, 2011).

The AHMS excavations at Pitt Town recovered some of the most significant material culture in the Sydney Basin (Williams et al., 2014). Some 10,000 Aboriginal stone artefacts were recovered at depths of up to 1.3m below the surface, and demonstrated largely continuous occupation of the river from 36,000 years ago – making it one of the earliest sites in Australia. The archaeological assemblage could be divided into two distinct periods of occupation: i) a lower assemblage dating to between 36-8,000 years ago, and composed of large worked tuff, volcanic and quartzite cobbles extracted by Aboriginal
populations from the river bed; and ii) an upper assemblage dating to the last 5,000 years and characterised by smaller silcrete and quartz stone artefacts, frequently modified to more complex tools than found in the earlier assemblage

3.3.2 WINDSOR MUSEUM

Closer to the WBRP project area, Austral Archaeology undertook extensive archaeological investigations of a sand deposit within the Windsor township, for the proposed expansion of the Windsor Museum site. The Museum site was located on Baker Street, on an elevated (~20m AHD), moderately steep ridge some 100m from the Hawkesbury River. The investigation revealed a deep soil profile, characterised as a >1.5m deep, fine to medium grained, dull orange to bright reddish brown sand overlying Londonderry Clay, and may have begun forming as many as 150,000 years ago (Austral Archaeology, 2011:152; Groundtruth Consulting, 2011). This sand body was formed as a source bordering dune or sand sheet with the origin of the sand being from the floodplain and channel of the adjacent Hawkesbury River. The sand body appeared to extend along the high ground which now consists of George Street, and tapered off to the south east along Macquarie Street above the South Creek valley.

As many as 12,000 Aboriginal objects were recovered from an area of 26m², and were found to be concentrated between depths of 0.5-0.8m, but occurred as deep as 1.5m below ground surface. A representative sample (two adjacent 1m² pits containing 1,670 artefacts) was subjected to further lithic analysis, and demonstrated prolonged, continuous occupation of the river from the mid Holocene through to the late Pleistocene; as many as 34,000 years ago. The assemblage demonstrated a slight increase in the use of materials approximately 15,000 years ago; however, considering the depth of the deposit and lack of identification of backed artefacts, this likely represents a continual pattern of site use possibly lasting up to European occupation of the area.

3.3.3 THE WINDSOR BRIDGE REPLACEMENT PROGRAM

Kelleher-Nightingale Consulting (KNC) (2012) undertook Aboriginal archaeological test excavation as part of the Environmental Impact Statement (EIS) for the WBRP. These excavations consisted of nine test pits distributed sporadically across the study area. Five test pits were situated in the southern project area, primarily on the edges of Thompson Square and within Old Bridge Street. The remaining four test pits were excavated in conjunction with geotechnical investigations within the northern project area.

The results from the southern project area indicated the presence of highly variable subsurface stratigraphy, with some test pits containing deep sand profiles exceeding a depth of 1m below current ground and others displaying clear evidence for complete truncation of original surface deposits that may have once contained Aboriginal cultural deposits. A total of 185 Aboriginal artefacts were recovered from the archaeological testing in the southern area, the majority of which came from a test pit in close proximity to the George Street/Windsor Road roundabout (n=114). The majority of the assemblage was composed of tuff raw materials, which in this region is strongly indicative of Pleistocene (>10,000 year ago) occupation, based on previous dating of stratified deposits found in rockshelter sites and excavations on Pleistocene sand sheets such as those investigated at Pitt Town by AHMS and on the Parramatta Sand Sheet by Jo McDonald CHM and others. No dating of the soil profile was undertaken as part of these works to verify the age of the soil deposits. The description of the sand deposits in the KNC report indicates they may be similar to those found at Pitt Town and Windsor Museum, and have the potential to be of Pleistocene or early Holocene age. However, to date, the available information is insufficient to form any definitive conclusions regarding the age of the sand deposits.

The results from the northern project area identified a homogenous soil profile, which was considered to have low potential to contain significant Aboriginal cultural materials. KNC argued the regular flooding
of the Hawkesbury River, which may have discouraged occupation within the flood zone and / or stripped and scoured evidence of occupation during periodic flooding events. Excavations were undertaken to an approximate depth of 1m, with some six Aboriginal objects (stone artefacts) recovered in the upper 0.6m. No dating of the soil profile was undertaken as part of the testing works to verify the age or significance of these artefacts, or the sequence in general.

The KNC excavation program identified six Aboriginal sites within the Windsor Bridge study area (Figure 2). Five Aboriginal archaeological sites were located on the northern bank: W-NP (#45-5-3580); W1 (#45-5-3582); W2 (#45-5-3583); W3 (#45-5-3584); and W4 (#45-5-3585). Aboriginal archaeological site W-SP (45-5-3581) was located on the southern bank. Details of these Aboriginal sites identified within the study area and the scientific significance assigned by KNC (2012) are provided below in Table 1. All sites identified were assessed as having low (scientific) significance with the exception of South Bank Pad W-SP (#45-5-3581), which was assessed as having high (scientific) significance.

Elevated portions of South Bank Pad W-SP contained at least partially intact cultural deposits. Specifically, the fine grained sand deposit encountered in this part of the site contained an intact cultural layer which visually appears similar to deposits at Pitt Town and Windsor Museum, and hints at the potential for Pleistocene material culture in the WBRP. The presence of backed artefacts, a hatchet fragment and shell midden material found during the KNC test excavations indicates the WBRP area has potential to provide new valuable information regarding Aboriginal occupation of the area.

### Table 1. Aboriginal sites identified by KNC (2012: Table 5) within the WBRP.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site Type</th>
<th>Description</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Bank PAD</td>
<td>Artefact Scatter (former PAD now site)</td>
<td>Site is located on the south bank of the Hawkesbury River. Portions of the site are above the 1:100 flood zone within Thompson Square at the corner of George and Bridge Street. This portion of the site contains fine grained sand layers and high artefact densities. A second more disturbed portion of the site is located below the 1:100 flood zone between Bridge Street, Old Bridge Street and the wharf car park. This portion of the site contains moderate artefact densities including displaced midden material.</td>
<td>High</td>
</tr>
<tr>
<td>PAD W-SP (#45-5-3581)</td>
<td></td>
<td>Site located on north bank of Hawkesbury River within flood prone terrace. Deep homogenised soils display no buried soils.</td>
<td>Low</td>
</tr>
<tr>
<td>North Bank PAD</td>
<td>Artefact Scatter (former PAD now site)</td>
<td>Site located on north bank of Hawkesbury River within flood prone terrace. Deep homogenised soils display no buried soils.</td>
<td>Low</td>
</tr>
<tr>
<td>PAD W-NP (#45-5-3580)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1 (#45-5-3582)</td>
<td>Isolated find</td>
<td>Site located on north bank of Hawkesbury River within flood prone terrace. Deep homogenised soils display no buried soils.</td>
<td>Low</td>
</tr>
<tr>
<td>W2 (#45-5-3583)</td>
<td>Isolated find</td>
<td>Site located on north bank of Hawkesbury River within flood prone terrace. Deep homogenised soils display no buried soils.</td>
<td>Low</td>
</tr>
<tr>
<td>W3 (#45-5-3584)</td>
<td>Isolated find</td>
<td>Site located on north bank of Hawkesbury River within flood prone terrace. Deep homogenised soils display no buried soils.</td>
<td>Low</td>
</tr>
<tr>
<td>W4 (#45-5-3585)</td>
<td>Isolated find</td>
<td>Site located on north bank of Hawkesbury River within flood prone terrace. Deep homogenised soils display no buried soils.</td>
<td>Low</td>
</tr>
</tbody>
</table>

### 3.4 Comparison of Previous Studies with WBRP Area

The previous investigations carried out at Windsor Museum and Pitt Town (Section 3) identified buried cultural deposits on elevated ridgelines containing deep sand profiles on landforms overlooking the river. In the case of Pitt Town, the cultural assemblage was routinely found at 1.2 to 1.4m below the
surface, and between 22 to 25m AHD. Windsor Museum similarly contained cultural deposits at depths of greater than 1m deep, but at elevations of closer to 20m AHD. The elevation and landform characteristics of the southern WBRP area are similar to those encountered at Windsor Museum suggesting the southern project area has high potential to contain stratigraphically deep, culturally significant deposits at depth. The area of highest potential to contain these deposits extends from approximately 10m north of the Macquarie Street/Windsor Road junction across the entire project area to approximately 30m north of George Street (Figure 3).

There are also two additional areas situated at lower elevations within the WBRP area that also warrant further investigation:

- An identified site documented by KNC (2012) as South Bank PAD WSP #45-5-3581, located below 11m AHD and in close proximity to the river, but containing a sand profile deposit; and

- Areas immediately along the banks of Windsor River that would be subject to some of the most significant impacts of the development, and that were not investigated as part of the Environmental Impact Statement works.

As discussed in Section 3, KNC’s (2012) investigation for the EIS were limited in scope and were restricted to maximum c.1m depth of excavation in the north. In the absence of chronological control it is unknown whether the top 1m of the soil profile represents the entire archaeological record or simply the post-Contact period (20th Century relics were recovered to these depths based on the historical heritage report for the same area). While the upper 3.7m of the soil profile appeared similar and homogenous, there are numerous studies along the Hawkesbury River that demonstrate cultural materials can occur even deeper than this. Works at Cranebrook Terrace recovered artefacts from over 8m depth, while recent excavations by Extent Heritage (then AHMS) at Peachtree Creek retrieved Aboriginal objects at 4m depth (dated to only 8,000 years BP).

To the south, excavations were similarly constrained to ~1m below surface. However, these depths typically appeared to reach Londonderry clay or other geological units pre-dating Aboriginal colonisation of Australia. Of interest, however, is the visual appearance of the deposits recovered to the south, which while shallow in some areas, appear similar to those discussed at Pitt Town and Windsor Museum in Section 3.2, and strongly suggest Pleistocene deposits are present within the WBRP.
Figure 3. WBRP project area showing elevation. Note elevated areas in south focussed on junction of Windsor Road and George Street.
4 METHODOLOGY

4.1 Objectives and Aims

The project aims and objectives were defined in the ARD (Appendix 1), and propose to improve our understanding of Aboriginal cultural heritage within the WBRP, tells us about past populations and societies, and to assess the impact of the development upon this resource. The investigation aimed to:

- Identify, map and characterise the nature, age, extent, integrity and significance of the Aboriginal cultural material within the WBRP development footprint;
- To answer (or contribute to answers) to research questions outlined in Section 4.1.1;
- Inform the Strategic Conservation Management Plan (SCMP) currently in preparation for the WBRP;
- Better assess the significance and historical meaning of the cultural materials that exist within the WBRP so that future archaeological investigation can advance our understanding of past Aboriginal cultural behaviour and environmental adaptation; and
- Direct future heritage activities and mitigation measures (if required) for the WBRP.

The research design and associated methods were designed to achieve broad-scale investigation of the material culture within the WBRP, with finer resolution excavation and/or conservation ex situ measures that may be warranted forming subsequent recommendations and requirements that would be integrated into the SCMP. In addition to the over-arching aims outlined above, the study has also been developed to integrate with the other studies required under Conditions B3 and B4, namely the historical and geomorphological (sand body) investigations within the study area.

4.1.1 RESEARCH QUESTIONS

Based on the project aims (Section 4.1), and our existing knowledge of the local environment (Section 3), a number of research questions can be identified to improve our understanding of the archaeological resource within the WBRP, determine its significance, understand the potential impacts by the development, and direct planning and research into the future. In addition, there are a range of larger questions around the timing, demography and behaviour of Aboriginal hunter-gatherers in the region that form a broad framework for exploration and resolution. These include:

- What is the spatial and stratigraphic extent of Aboriginal sites and/or material culture within the WBRP?
- What is the age, integrity and significance of Aboriginal sites and/or material culture within the WBRP?
- What are the environmental characteristics associated with the distribution of Aboriginal cultural heritage within the WBRP? Can the formative processes of the stratigraphic profile provide information on the nature and/or survivability of the archaeological resources? Are there other key factors in the distribution and extent of the material culture within the WBRP?
• How do the cultural materials compare with other Pleistocene sites nearby? What can the material culture tell us about the populations and behaviour of Aboriginal hunter-gatherers during the last 30,000 years?

• Is there any evidence for contact period archaeology between the local Aboriginal people and Europeans within the WBRP?

• What are the cultural, social and public values associated with the Aboriginal archaeological resource in the southern project area?

• How should the Aboriginal sites in the region be conserved and managed in future?

Further details and discussion of these questions are provided in Appendix 1.

4.2 The Archaeological Program

4.2.1 SCOPE AND RATIONALE

The archaeological test excavation methodology outlined below was developed to fulfil the aims, objectives and research questions outlined in Section 4.1. At the heart of the aims and objectives was the need to understand the spatial and stratigraphic distribution of cultural materials across the WBRP. This has been achieved through:

• The application of a closely spaced systematic grid of test pits across the WBRP to ensure all parts of the development study area are investigated for cultural materials;

• The investigation of the soil profile in controlled intervals to understand the depth and stratigraphic position of cultural materials. This includes the use of mechanical excavators to allow investigation of deep deposits thought to be present within some parts of the WBRP;

• The identification and recovery of cultural materials through wet-sieving of sediments;

• The recovery of environmental and chronological samples from multiple test pits to understand the formative history of the soil and cultural deposits; and

• Detailed documentation and recording of the archaeological program.

4.2.2 PROPOSED PROGRAM

The proposed archaeological program is outlined in detail in the ARD (Appendix 1). In summary, the archaeological program was proposed to consist of:

• Southern project area – Test excavations of a grid of 37 test pits situated across the entirety of the project area at ~20m spacing (Figure 4). Test pits were proposed to be
~1.2m$^2$ and excavated mechanically in 10cm spits. All sediment was to be collected, weighed, and wet-sieved through a 3mm mesh to recover cultural material where present.

- Northern project area – Test excavations of a grid of 8 test pits situated across the entirety of the project area at 40m spacing (Figure 5). Test pits were proposed to be ~3m$^2$ and excavated mechanically in 20cm spits. All sediment was collected, weighed, and wet-sieved through a 5mm mesh to recover cultural material where present.

Further details of the archaeological techniques employed are provided in subsequent sections.

4.2.3 AMENDED PROGRAM

The field program proposed in Section 4.2.2 and Appendix 1 was followed with some minor modifications and/or amendments. These included:

- Southern project area –
  - The majority of the test pits required some minor movement from their original proposed locations due to the presence of underground services, or being in problematic areas (e.g. directly adjacent a tree trunk, partially situated on a road kerb, in areas considered too dangerous to undertake works, etc) (Figure 4). In most cases, these revisions happened before the finalisation of the ARD, but a number still needed minor relocation throughout the field program.
  - Excavations in this part of the project area proved deeper than expected, often >2m. Due to the limitations of the mechanical excavator boom, this resulted in the need to enlarge test pits from 1.44m$^2$ to 2 x 1.2m or 3 x 1.2m in size. This proved especially the case in those test pits in closer proximity to the river and within the park areas.
  - Following the identification of a potential sand body in a historical test pit (SH3), an additional test pit was undertaken in Thompson Square (SA11). This test pit was excavated in accordance with the same techniques approved for other test pits within the square, but was an addition to the original program, and resulted in 38 test pits being dug overall.
  - Two test pits had to be discontinued during their excavation, SA 6 and SA 37. SA 6 was discontinued due to its proximity with a precariously balanced tree adjacent Bridge Street. Support roots from this tree extended throughout the test pit, and could not be removed, resulting in its abandonment. In the case of SA37, contaminated fill materials (including asbestos) was found throughout the upper 1.5m, and it was considered unsafe to proceed.
  - The occurrence of historical features/structures/deposits within a number of test pits (SA17, 18, 25, 27 and 29) resulted in their discontinuance, and/or modifications in their excavation methods. This was in contrast to the ARD that allowed removal of such features/deposits to access any under-lying cultural

\[2\] There were two exceptions to this, with two test pits within Thompson Square proposed to be 1m$^2$ and excavated manually in 5cm spits.
materials, but was undertaken at the direction of the Historical Excavation Director.

- Northern project area –
  - The majority of the test pits required some minor movement from their original proposed locations due to the presence of underground services, or being in problematic areas (e.g. in areas considered too dangerous to undertake works, etc) (Figure 5). In most cases, these revisions happened before the finalisation of the ARD, but a number still needed minor relocation throughout the field program.
  - One test pit had to be discontinued during the excavation, NA 2. This test pit contained asbestos, and was considered unsafe to proceed.

All changes to the methodology were permitted under the ARD at the discretion of the Excavation Director in consultation with RMS and the Aboriginal stakeholders on site. This occurred in all instances listed above. Notification of test pit expansion requirements, significant test pit relocation and/or mechanical excavator size changes were also submitted to the Department of Planning and Environment (DPE) for approval.
Figure 4. The proposed and actual test pit locations for the southern project area.
Figure 5. The proposed and actual test pit locations for the northern project area.
4.3 Excavation Methods

The field program methods are outlined in detail in ARD (Appendix 1). With the exception of those modifications outlined in Section 4.2.3, all works were undertaken in accordance with the ARD. These are summarised below.

4.3.1 SOUTHERN PROJECT AREA

Due to the presence of most test pits in a highly urban area and active road corridor, with frequent bitumen, packing layers and overburden, all excavations were undertaken using a mechanical excavator,\(^3\) supervised by a team of archaeologists and Aboriginal stakeholders (Section 4.4). Excavations consisted of 38 test pits distributed in a ~20m spaced grid across the project area.

Excavation of these test pits used the following approach:

- All excavations involved machine clearance of bitumen and overburden to expose any underlying deposits containing historical relics. These were removed and archaeologically recorded (as per the requirements of the Historical Archaeological Research Design), until natural soil deposits were identified. Once reached, Aboriginal archaeological investigations began. Where overburden was shown to have potential to contain cultural materials, which were typically the early-mid 18\(^{th}\) Century deposits, the excavation methods presented here were adopted. Cultural material from both the overburden and the natural soil deposits was therefore captured through the works.

- Each test pit was between 1.44m\(^2\) (1.2 x 1.2m) and 3.2m\(^2\) (3 x 1.2m) depending on the depth needing to be reached. The vast majority of test pits (n=23) were 2.4m\(^2\) (2 x 1.2m) in size. With three exceptions, all test pits were excavated by machine in controlled horizontal (or angled to sloping stratigraphy if required) spits. Spit depths were set at ~10cm to ensure that the vertical distribution of archaeological material was accurately monitored and recorded. Reduced levels of the top and bottom of the test pit were documented using a dumpy level against surveyed locations across the project area (frequently the corners of each test pit). Other levels were taken as required.

- Three test pits within Thompson Square (SA11, SA12 and SA13) were excavated using manual techniques. Specifically, each test pits was 1m\(^2\) (1 x 1m) and dug in 5cm spits using shovels, trowels, and other hand tools. Reduced levels of the top and bottom of the test pit were documented using a dumpy level against surveyed locations across the project area (frequently the corners of each test pit). Other levels were taken as required.

- During excavation, recording of each test pit was conducted from a suitable location at the ground surface level, including the nature of the soil profile, the amount of material recovered per spit, and any disturbance or features noted.

- Excavations were undertaken to Londonderry Clay (B2 horizon)\(^4\) when this could be reached by the mechanical excavator (i.e. <2.5m below surface). Where Londonderry Clay proved deeper than this, excavations continued to the limits of the mechanical excavator,

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\(^3\) Two mechanical excavators were mainly used for this, one 3.5 tonne in size, the other 5 tonnes. Due to the extreme depth being required for test pits along the river’s edge, a 15 tonne excavator was also used periodically to excavate SA 31, 33, and 35.

\(^4\) Londonderry Clay is a Tertiary (66-2.6 million years ago) deposit, and is considered to pre-date the arrival of Aboriginals to Australia. It can therefore be considered a basal layer at which to stop archaeological investigation.
which was between 2.2 and 2.8m below surface depending on conditions. (This depth extended to >3.5m below surface where the 15 tonne excavator was available).

- All excavated sediment was collected into large bulk soil bags, and transported across the bridge to the site compound on the northern side of the river for processing. Each bag was weighed using a mechanical crane, and then transferred onto large 3mm gauge sieves for processing. 100% of the deposit was wet-sieved for artefact recovery.

- Artefacts were collected from the sieves, appropriately labelled and bagged according to excavation pit and spit provenance. A finds bag was retained for each spit even if no artefacts were recovered to ensure each excavation unit was accounted for. Any non-Aboriginal cultural material (post-1788) was also collected from the sieve to document disturbance through the deposit.

- All test pits were documented using photographic records, written descriptions and scaled drawings.

- A range of samples for chronological dating, soil, and/or palaeo-climatic information were also taken in areas of undisturbed soils and/or deep sand to fulfil the aims, objectives and research questions outlined in Section 4.1. Where sandy deposits were identified, additional samples in accordance with the Hawkesbury Regional Sand Body Study Research Design and Action Plan (AAJV, 2016) were also taken.

- It must be highlighted, however, that where test pits were of great depth, detailed recording and sampling could only be undertaken in the upper 1.5m below surface for HSE reasons. Below this, investigation was constrained to visual observations and sample recovery only from the sediments being recovered by the mechanical excavator as part of the works.

4.3.2 NORTHERN PROJECT AREA

Due to the requirement for deep excavation in this area (>3.7m below surface), all excavations were undertaken using a mechanical excavator (15 tonne), supervised by a team of archaeologists and Aboriginal stakeholders (Section 4.4). Excavations consisted of 8 test pits distributed in a ~40m spaced grid across the project area.

Excavation of these test pits used the following approach:

- All excavations involved machine clearance of bitumen and overburden to expose any underlying deposits containing historical relics. These were removed and archaeologically recorded (as per the requirements of the historical archaeological research design), until natural soil deposits were identified. Once reached, Aboriginal archaeological investigations began. In most cases, this was within 20cm of the surface, with past development in this area being minimal.

- Each test pit was ~3.2m² (3 x 1.2m) in size. NA 1 and 4 were 3.6m² (3 x 1.5m) to allow a shoring system to be installed. All test pits were excavated by machine in controlled horizontal (or angled to sloping stratigraphy if required) spits. Spit depths were set at ~20cm to ensure that the vertical distribution of archaeological material was accurately monitored and recorded. Reduced levels of the top and bottom of the test pit were
documented using a dumpy level against surveyed locations across the project area (frequently the corners of each test pit). Other levels were taken as required.

- During excavation, recording of each test pit was conducted from a suitable location at the ground surface level, including the nature of the soil profile, the amount of material recovered per spit, and any disturbance or features noted.

- Excavations were undertaken to Londonderry Clay (B2 horizon) when this could be reached by the mechanical excavator (i.e. <3.5m below surface). Where Londonderry Clay proved deeper than this, excavations continued to the limits of the mechanical excavator, which was between 3.5 and 4m below surface depending on conditions.

- All excavated sediment was collected into large bulk soil bags, and transported across the bridge to the site compound on the northern side of the river for processing. Each bag was weighed using a mechanical crane, and then transferred onto large 5mm gauge sieves for processing. 25% of the deposit was initially wet-sieved for artefact recovery, where Aboriginal objects were recovered the remaining 75% was then wet-sieved.

- Artefacts were collected from the sieves, appropriately labelled and bagged according to excavation pit and spit provenance. A finds bag was retained for each spit even if no artefacts were recovered to ensure each excavation unit was accounted for. Any non-Aboriginal cultural material (post-1788) was also collected from the sieve to document disturbance through the deposit.

- All test pits were documented using photographic records, written descriptions and scaled drawings.

- A range of samples for chronological dating, soil, and/or palaeo-climatic information were also taken in areas of undisturbed soils and/or deep sand to fulfil the aims, objectives and research questions outlined in Section 4.1.

- It must be highlighted, however, that where test pits were of great depth, detailed recording and sampling could only be undertaken in the upper 1.5m below surface for HSE reasons. Below this, investigation was constrained to visual observations and sample recovery only from the sediments being recovered by the mechanical excavator as part of the works. There were two exceptions to this, NA 1 and NA 4, where a shoring system was obtained and access to the lower deposits could be undertaken.

4.4 Excavation Team and Timing

All test excavation was undertaken mechanically using an excavator (varying between 3.5, 5 and 15 tonne in size) with a flat bladed bucket and rubberised tracks. Excavation was undertaken under the careful supervision of a core team of four archaeologists and seven Aboriginal representatives. An Artefact Manager was also on-site to ensure the collection, analysis and appropriate storage of all artefacts.

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5 This number varied throughout the project with some Aboriginal stakeholder organisations being unable to provide a representative each day of the nine week program. Aboriginal representatives included Deerubbin LALC, Darug Custodian Aboriginal Corporation, Darug Aboriginal Cultural Heritage Assessments, Darug Land Observations, Darug Tribal Aboriginal Corporation, Darug Aboriginal Landcare Inc, and Tocomwall.
cultural material recovered. A historical archaeological team, directed by Anita Yousif, was also present on-site throughout the excavations, and assisted in the works where needed.

The excavation consisted of a 9.5 week field program that extended between 22 August and 17 November 2016. The northern project area was undertaken between 22 August and 8 September 2016 (2.5 weeks), and the southern project area between 9 September and 17 November 2016 (7 weeks). Note that there was two breaks within the wider field program due to logistical issues between 1-17 October 2016 and 9-14 November 2016.

The long excavation program was primarily the result of three factors:

- many of the test pits were situated within the active road corridor and the licences allowing these works to occur restricted working hours to 10am-3pm (5 hours). This time included the logistical requirements of establishing and shutting down the excavations in the road corridors each day, generally leaving only 3 hours for archaeological works.

- many of the test pits were situated within the active road corridor and surrounding car parks, and it was therefore necessary to provide temporary re-instatement of them each night and weekend (resulting in shorter working times). There was also a need to re-establish test pits as the program progresses for the safety of road-users, and this also resulted in reduced archaeological working hours each day.

- to minimise disruption to the general public, only two to three test pits (including historical excavations) were allowed to be active at any one time. With the depth of excavations, and the re-instatement/re-establishment requirements outlined above, this often restricted the field program to the completion of one test pit every 1-2 days.

4.5 Artefact Storage

During excavation works, artefacts were cleaned and catalogued in the site compound in the northern project area. Artefacts were then transferred to a secure off-site storage locker near the site compound each evening. Following excavation works the artefacts have been relocated to the Extent Heritage office for detailed analysis. While at the Extent Heritage office, the artefacts are stored in a compactus within a locked storage area. Periodic auditing of the assemblage is undertaken by Extent Heritage’s artefact specialist to ensure their safe-keeping.

A long-term curation policy and Care and Control Agreement for the Aboriginal cultural material will be developed in consultation with the RMS, registered Aboriginal stakeholders and relevant State and Government agencies at the completion of the field program and post-excavation analysis and reporting. Three potential options have been discussed, and are presented in preferential order below. The preferred option will be determined once the nature of the archaeological assemblage is known.

1. Deposit the recovered material with a relevant museum, such as the Australian Museum or the local Windsor Museum.
2. Repatriate (rebury) recovered material in a location close to the study area, taking care to accurately record the location (Eastings and Northings, GDA 1994 MGA Zone 56) and ensure its preservation in perpetuity;
3. Deposit the recovered material in a designated keeping place, such as with the Local Aboriginal Land Council or a traditional owner group.
5 SUMMARY OF RESULTS

5.1 Key Findings

- Archaeological excavations consisted of 46 test pits across the northern (n=8, totalling 27.9m²) and southern (n=38, totalling 74.28m²) project areas. These test pits ranged in depth from <30cm and >4.9m below current surface (\(\bar{x} = 2.13m\)), and were excavated in 5-20cm spits depending on location. Some 774 spits were recovered, of which 440 equivalent to ~220 tonnes) were in historical and/or natural deposits, and wet-sieved through a 3 or 5mm mesh for cultural material.

- The excavations recovered 1,434 Aboriginal objects (stone artefacts). 23 were recovered from the northern project area (equivalent to 0.81 lithics/m² or 0.0005 lithics/kg) in depths ranging from 120-240cm below current surface. 1,324 were recovered from the southern project area (equivalent to 18.26 lithics/m² or 0.0325/kg) found throughout the soil profile, but predominantly between 70 and 210cm below current surface. 87 unmodified river pebbles and cobbles were also recovered from the southern project area, and considered likely to represent manuports.

- The excavations identified ten geomorphological (or stratigraphic) units characterising the project area, which along with the cultural materials, could be divided into four archaeological landscapes. Of note are two sand units that were encompassed within Thompson Square (either side of Bridge Street), and which contained the majority of the cultural assemblage (n=995/75% equating to 56 lithics/m² or 0.05 lihics/kg). The lower unit was formed by fluvial processes (e.g. terrace, levee), and the upper layer through wind-blown processes, and likely the remnants of a source-bordering dune. OSL ages of these deposits indicate that they contain cultural materials dating primarily between 27-17ka in age. These deposits are visually and compositionally similar to the nearby Windsor Museum archaeological site, which contained cultural deposits dating to between 33 and 8ka. In places, an early- to mid-Holocene (>5ka) assemblage is also present.

- The cultural assemblage from the source-bordering dune deposits revealed that they formed a key locale for Aboriginal populations prior to, and during, the Last Glacial Maximum (24-18ka), with evidence of prolonged occupation and/or repeat visitation, most likely to exploit the resources of the river – especially stone raw materials exposed during entrenchment of the river, as a result of lower sea-levels at this time.

- OSL ages indicate that parts of the source-bordering dune have been truncated in Thompson Square either just prior to, or immediately following European settlement.

- The remaining archaeological landscapes all appear younger, <6.5ka, and often disturbed and/or truncated by historical and/or modern activities. With the exception of SA12, also within Thompson Square, cultural deposits were generally sparse, and have either been reworked by natural (i.e. fluvial/alluvial) or human (i.e. reclamation/earthworks) processes.

- A number of glass artefacts (n=3) were found in the lower portion of Thompson Square (east of Bridge Street) and demonstrate post-contact interactions between Aboriginal people and early European settlers. Other historical material found in association, and past records of Windsor suggest that the artefacts likely date to between AD1794 and the 1830s.

5.2 General
Overall, the excavations followed the research design (Appendix 1) with minor amendments outlined in Section 4.2. Across the project area, excavations consisted of 46 test pits, totalling 102m², and ranging in depths from <30cm to >4.9m below current land-surface (x = 2.13m) (Figures 6-8, Appendix 2-4). From a logistical perspective, these excavations consisted of 774 spits, and investigated some 220 tonnes of sediment (Tables 2 and 3; Appendix 4). Overall, 1,434 artefacts were recovered, of which 1,347 have cultural modification, with the remaining 87 including manuports and/or heat shattered stone fragments (Tables 2 and 3). Of these, 23 artefacts were recovered from the northern project area, specifically from NA 1 (n=1), NA 5 (n=1), NA 6 (n=14), NA7 (n=3), and NA 8 (n=4), providing an average artefact density of 0.81/m² or 0.0005/kg of sediment sieved. These artefacts were recovered primarily from a single stratigraphic unit (9 in Figure 8) between depths of 120-240cm below surface (~8.8 – 7.6 m AHD). The remaining 1,324 artefacts were recovered from the southern project area (Table 3), equating to 18.26/m² or 0.0325/kg of sediment sieved. These were primarily recovered (n=995/75% equating to 56 lithics/m²) from two stratigraphic units (3 and 4 in Figures 7 and 8) that extended across the undeveloped park areas either side of Bridge Street (see below for further discussion) (Figure 9). The depth of the artefact-bearing deposits was variable, since the southern project area is characterised by a steep slope, but the main concentrations typically occurred between 70 and 210cm below the current land surface (Figure 9).

The upper portion of all test pits contained evidence of overlying historical and/or modern sedimentary units. While often undulating, these upper ‘fill’ units were clearly identifiable and suggest a sharp truncation or compaction of under-lying archaeological deposits, rather than any strong evidence for inter-mixing.

### Table 2. Summary of test excavations in the northern project area.

<table>
<thead>
<tr>
<th>Test pit</th>
<th>Height at Surface (m)</th>
<th>Height at Base (m)</th>
<th>Depth of Test Pit (m)</th>
<th>Spits (n)</th>
<th>Area (m²)</th>
<th>Artefacts (n)</th>
<th>Total Weight Sieved (kg)</th>
<th>Artefact Density (x/m²)</th>
<th>Artefact Density (x/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA1</td>
<td>8.60</td>
<td>3.70</td>
<td>4.90</td>
<td>25</td>
<td>3.6</td>
<td>1</td>
<td>6,806.75</td>
<td>0.28</td>
<td>0.0001</td>
</tr>
<tr>
<td>NA2*</td>
<td>9.10</td>
<td>8.70</td>
<td>0.40</td>
<td>2</td>
<td>3.6</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>-</td>
</tr>
<tr>
<td>NA3</td>
<td>9.25</td>
<td>5.25</td>
<td>4.00</td>
<td>20</td>
<td>3.6</td>
<td>0</td>
<td>7,074.81</td>
<td>0.00</td>
<td>0.0000</td>
</tr>
<tr>
<td>NA4</td>
<td>9.99</td>
<td>6.19</td>
<td>3.80</td>
<td>19</td>
<td>3.6</td>
<td>0</td>
<td>5,517.00</td>
<td>0.00</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

---

6 Due to the upper soil profile generally being composed of historical and/or modern fill materials, these were usually removed by the historical archaeologist as per the excavation methods outlined in Section 4.2. This resulted in 440 spits being recovered and investigated for cultural materials as part of the Aboriginal archaeological program.

7 These items are highly likely to be of cultural origin given their raw material composition, and proximity to other archaeological materials. However, since they exhibit no specific diagnostic features of modification, they are not included in artefact counts presented in this section.
### Table 3. Summary of test excavations in the southern project area.

<table>
<thead>
<tr>
<th>Test pit</th>
<th>Height at Surface (m AHD)</th>
<th>Height at Base (m AHD)</th>
<th>Depth of Test Pit (m)</th>
<th>Spits (n)</th>
<th>Area (m²)</th>
<th>Artefacts (n)</th>
<th>Total Weight Sieved (kg)</th>
<th>Artefact Density (x/m²)</th>
<th>Artefact Density (x/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA5</td>
<td>10.55</td>
<td>6.55</td>
<td>4.00</td>
<td>20</td>
<td>2.7^</td>
<td>1</td>
<td>4,480.25</td>
<td>0.37</td>
<td>0.0002</td>
</tr>
<tr>
<td>NA6</td>
<td>9.95</td>
<td>5.95</td>
<td>4.00</td>
<td>20</td>
<td>3.6</td>
<td>14</td>
<td>10,243.25</td>
<td>3.89</td>
<td>0.0014</td>
</tr>
<tr>
<td>NA7</td>
<td>10.25</td>
<td>6.25</td>
<td>4.00</td>
<td>20</td>
<td>3.6</td>
<td>3</td>
<td>4,785.00</td>
<td>0.83</td>
<td>0.0006</td>
</tr>
<tr>
<td>NA8</td>
<td>10.30</td>
<td>6.30</td>
<td>4.00</td>
<td>20</td>
<td>3.6</td>
<td>4</td>
<td>3,048.25</td>
<td>1.11</td>
<td>0.0013</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>10.00</td>
<td>6.04</td>
<td>3.64</td>
<td>18.19</td>
<td>3.49</td>
<td>2.88</td>
<td>5,244.41</td>
<td>0.81</td>
<td>0.0005</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41,955.31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Test pit abandoned due to asbestos being found.

^Test pit was 3 x 0.9m in size to avoid a number of surrounding services in the vicinity.
<table>
<thead>
<tr>
<th>Test pit</th>
<th>Height at Surface (m AHD)</th>
<th>Height at Base (m AHD)</th>
<th>Depth of Test Pit (m)</th>
<th>Spits (n)</th>
<th>Area (m²)</th>
<th>Artefacts (n)</th>
<th>Total Weight Sieved (kg)</th>
<th>Artefact Density (x/m²)</th>
<th>Artefact Density (x/kg)</th>
</tr>
</thead>
<tbody>
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<td>SA7</td>
<td>7.35</td>
<td>4.85</td>
<td>2.50</td>
<td>25</td>
<td>2.4</td>
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<td>5,977</td>
<td>0.00</td>
<td>0.0000</td>
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<tr>
<td>SA8</td>
<td>11.22</td>
<td>8.42</td>
<td>2.80</td>
<td>27</td>
<td>2.4</td>
<td>204</td>
<td>9,408</td>
<td>85.004</td>
<td>0.0217</td>
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<td>SA9</td>
<td>13.25</td>
<td>10.15</td>
<td>3.10</td>
<td>25</td>
<td>2.4</td>
<td>153</td>
<td>8,135</td>
<td>63.75</td>
<td>0.0188</td>
</tr>
<tr>
<td>SA10</td>
<td>15.30</td>
<td>12.60</td>
<td>2.70</td>
<td>26</td>
<td>2.4</td>
<td>70</td>
<td>5,740</td>
<td>29.17</td>
<td>0.0122</td>
</tr>
<tr>
<td>SA11</td>
<td>17.12Σ</td>
<td>15.62</td>
<td>1.50</td>
<td>30*</td>
<td>1</td>
<td>155</td>
<td>2,581</td>
<td>155.00</td>
<td>0.0601</td>
</tr>
<tr>
<td>SA12</td>
<td>20.55</td>
<td>19.50</td>
<td>1.05</td>
<td>3*</td>
<td>1</td>
<td>42</td>
<td>143</td>
<td>42.00</td>
<td>0.2937</td>
</tr>
<tr>
<td>SA13</td>
<td>20.39</td>
<td>19.79</td>
<td>0.60</td>
<td>6*</td>
<td>1</td>
<td>3</td>
<td>756</td>
<td>3.00</td>
<td>0.0040</td>
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<tr>
<td>SA14</td>
<td>20.72</td>
<td>20.02</td>
<td>0.70</td>
<td>7</td>
<td>1.8</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SA15</td>
<td>20.75</td>
<td>19.65</td>
<td>1.10</td>
<td>11</td>
<td>1.8</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>SA16</td>
<td>21.06</td>
<td>20.16</td>
<td>0.90</td>
<td>9</td>
<td>1.8</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SA17</td>
<td>19.37</td>
<td>19.07</td>
<td>0.30</td>
<td>3</td>
<td>1.4</td>
<td>0</td>
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<td>-</td>
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<td>17.10</td>
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<td>1.4</td>
<td>1</td>
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<td>15.76</td>
<td>0.80</td>
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<td>0.80</td>
<td>8</td>
<td>1.4</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
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<td>18.82</td>
<td>17.72</td>
<td>1.10</td>
<td>11</td>
<td>1.4</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SA22†</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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</tr>
<tr>
<td>SA23†</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>SA24</td>
<td>20.02</td>
<td>18.52</td>
<td>1.50</td>
<td>15</td>
<td>2.4</td>
<td>16</td>
<td>6,535</td>
<td>6.67</td>
<td>0.0024</td>
</tr>
<tr>
<td>Test pit</td>
<td>Height at Surface (m AHD)</td>
<td>Height at Base (m AHD)</td>
<td>Depth of Test Pit (m)</td>
<td>Spits (n)</td>
<td>Area (m²)</td>
<td>Artefacts (n)</td>
<td>Total Weight Seived (kg)</td>
<td>Artefact Density (x/m²)</td>
<td>Artefact Density (x/kg)</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>----------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------------------</td>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>SA25</td>
<td>20.15</td>
<td>19.35</td>
<td>0.80</td>
<td>8</td>
<td>2.4</td>
<td>113</td>
<td>378</td>
<td>47.08</td>
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<td>17.75</td>
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<td>3</td>
<td>1.4</td>
<td>0</td>
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<td>16.75</td>
<td>16.15</td>
<td>0.60</td>
<td>6</td>
<td>1.4</td>
<td>0</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
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<td>13.75</td>
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<td>23</td>
<td>2.4</td>
<td>70</td>
<td>5,851</td>
<td>29.17</td>
<td>0.0120</td>
</tr>
<tr>
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<td>10.40</td>
<td>1.40</td>
<td>9</td>
<td>2.4</td>
<td>124</td>
<td>2,960</td>
<td>51.67</td>
<td>0.0419</td>
</tr>
<tr>
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<td>8.55</td>
<td>6.25</td>
<td>2.30</td>
<td>22</td>
<td>2.4</td>
<td>75</td>
<td>10,585</td>
<td>31.2</td>
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<td>3.60</td>
<td>21</td>
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<td>6</td>
<td>10,499</td>
<td>2.50</td>
<td>0.0006</td>
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<td>22</td>
<td>2.4</td>
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<td>7,276</td>
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<td>0.0008</td>
</tr>
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<td>19</td>
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<td>4</td>
<td>13,247</td>
<td>1.67</td>
<td>0.0003</td>
</tr>
<tr>
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<td>4.99</td>
<td>2.90</td>
<td>16</td>
<td>1.8</td>
<td>9</td>
<td>3,545</td>
<td>5.00</td>
<td>0.0025</td>
</tr>
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<td>SA35</td>
<td>7.87</td>
<td>3.87</td>
<td>4.00</td>
<td>40</td>
<td>3.6</td>
<td>57</td>
<td>17,715</td>
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<td>0.0032</td>
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<td>SA36</td>
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<td>5.22</td>
<td>3.00</td>
<td>24</td>
<td>2.4</td>
<td>7</td>
<td>9,580</td>
<td>2.92</td>
<td>0.0007</td>
</tr>
<tr>
<td>SA37</td>
<td>7.72</td>
<td>6.42</td>
<td>1.30</td>
<td>13</td>
<td>2.4</td>
<td>0</td>
<td>6,361</td>
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<td>-</td>
</tr>
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<td>5.97</td>
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<td>2.30</td>
<td>23</td>
<td>2.4</td>
<td>32</td>
<td>8,459</td>
<td>13.33</td>
<td>0.0038</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>1.79</td>
<td>16.51</td>
<td>1.95</td>
<td>34.47</td>
<td>7,135.24</td>
<td>27.22</td>
<td>0.03</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>628</td>
<td>74.28</td>
<td>1,304Δ</td>
<td>178,381</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* These test pits were undertaken in 5cm spits.

^ Test pit abandoned due to asbestos being found.

† Excavations undertaken by historical archaeological program and stopped once historical features and/or culturally sterile deposits found. Therefore, no data available.

Σ This test pit was excavated at the base of a historical test pit (SH3). This value is the top of the Aboriginal test pit, but 80cm must be added to calculate the height of the current ground surface.
These test pits were either dominated by modern fill materials, and/or had no soil profile (i.e. road surfaces onto Londonderry Clay) and were therefore not sieved for cultural material.

Note this value excludes artefacts recovered out of historical test pits (n=20).
Figure 6. Summary of the stratigraphy identified within test pits NA 1 - 8.
Figure 7.

Summary of the stratigraphy identified within test pits SA 1-20.
Figure 8. Summary of the stratigraphy identified within test pits SA 21-38.
Figure 9. Summary of the cultural assemblage in key test pits in the southern project area.
5.3 Stratigraphy

The excavations identified 10 discrete stratigraphic units across the project area (Figures 7-9), which included residual soil profiles, alluvial, fluvial and wind-blown deposits (see Appendix 2 for further detail). Despite the substantial size and width of the Hawkesbury River, correlations in the stratigraphic record were found between the northern and southern project areas. These stratigraphic units can be divided into the following chronological sequence (oldest to youngest):

i. At the base of the sequence was Londonderry Clay (2 in Figures 6-8), a Tertiary deposit (>1.8 million years in age), which pre-dates the archaeological evidence for colonisation of Australia (and can therefore be considered culturally sterile). This deposit was found in most parts of the study area, generally immediately underlying the overburden and/or road surfaces on the ridgeline in the southern project area (e.g. SA 12-23 inclusive, SA 26 and SA27), increasing to depths of 2.5+m downslope towards the river. In the northern project area, Londonderry Clay was not reached, and is likely >4m in depth if present.

ii. Above (i) was a coarse and medium sand fluvial deposit, likely deposited by the Hawkesbury River as a levee or terrace >82±7ka (GL16055) (Section 5.4). This deposit was present from ~4.75 to 15.75m AHD, and was found across the study area, most evident in SA 2, SA 4, SA 28, SA 32 and SA 33. While compositionally, a single unit, visually the deposit consists of two different layers, an upper one coloured strong brown, and a reddish yellow one below (4 and 8, respectively in Figures 6-8; Plate 1). The change in colour of the lower layer reflects the long-term illuviation of clay particles from (i) upslope of the deposit (as well as possibly inter-mixing with under-lying (i) below), and was culturally sterile. While the deposit appears to be older than the accepted ages of Aboriginal colonisation of Australia, the presence of cultural materials within the upper layer (evident in SA 4, SA28 and SA32) suggest that parts of this deposit remained on the surface over the last 50,000 years, and upon which Aboriginal populations lived and discarded stone artefacts. An OSL age was processed to identify the latest age of exposure for this deposit to have been on the surface (and occupied by hunter-gatherers), however given the extremely young age (GL16120 – 0.19±0.02ka) more likely reflects when it was truncated by European activities in Thompson Square. Based on the cultural assemblage, the surface of stratigraphic unit 4 in several areas was likely exposed on the surface during the onset and peak of the LGM, and correlates well with the assemblage found in (iii) below.

iii. Above (ii) was a wind-blown light yellowish brown fine to medium sand, interpreted to be part of a source-bordering dune (3 and 5 in Figures 6-8; Plates 2 and 3). This deposit was situated across the upper and lower parts of Thompson Square (being present in SA 8-11 inclusive and SA 29), between 9.25 and 17.25m AHD (Figure 10); and a thin isolated patch was also found on the ridgeline within SA 24 and SA25 at 19-20m AHD. Generally, the deposit was between 50-150cm thick (Figure 8-10). A suite of ages show that this deposit began forming at ~82±7ka (GL16055), and was most active through the onset of the LGM (27-18ka), and continuing into the Holocene with the uppermost age (either reflecting the end of formation or truncation) being GL 16116 (5.7±0.6ka). Given the large gap in some of the ages, it is highly likely that this deposit reflects disparate phases of deposition and/or erosion over the last 80,000 years. The majority of the cultural assemblage was recovered from this deposit, and suggests the study area formed a key focus of occupation for Aboriginal populations prior to, and during the Last Glacial Maximum (21±3ka). (This deposit is of a similar elevation and composition to the Windsor

8 ka = abbreviation for thousand years ago.
Museum cultural deposit discussed in Section 3.3.2. A later phase of occupation near the surface and dating to ~>5ka was also present.

iv. Underlying (v), and younger but not overlying (ii) and (iii) in any of the test pits excavated was a brown clayey fine sand alluvium (9 in Figures 6-8). This deposit was prevalent in the lower elevations of both the northern and southern project area (between 4 and 8m AHD), and likely reflects the active floodplain extending out from the river (notably to the north). It was present in NA1-8 inclusive, SA36 and SA38. OSL ages from the lower part of NA 4 returned ages of 6.5±0.7ka (GL16056), 4.7±0.5ka (GL16117) (and a probable erroneous age of 11±2ka (GL16057)), and suggest the entire deposit is <7ka.

v. Over-lying (v), (ii) and (iii) was a dark brown silty loam alluvium (1 in Figures 6-8). This deposit was prevalent across the lower elevations of both the northern and southern project area (between 5 and 8m AHD), and likely reflects the active floodplain extending out from the river (notably to the north). It was present in NA 1-8 inclusive, SA 1, SA 3, SA 8, SA 30, SA 34-36 inclusive. GL16119 taken at the interface of (v) and the under-lying (iii) in test pit SA8 provided a date of only ~400 years, and suggests that this unit may have been deposited very recently, shortly before European settlement. However, it may more conservatively be considered of late Holocene age based on its position above (v), and the presence of an edge-ground axe fragment (an artefact type only introduced into southeast Australia at <3.5ka in age) in SA 34 at 100cm below current land surface. Much of the remaining cultural assemblage from this deposit is also more characteristic of the last 5,000 years.

vi. Over-lying and abutting (v), as well as other stratigraphic units, was a mixture of reclaimed and/or introduced fill materials. These are most evident in SA 5, SA7, SA 30, SA 31 and SA 37, and suggest that historical activities were undertaken along the river’s edge to smooth out and level the natural undulations and irregular bank edge likely present during, and after European arrival. The archaeological excavations indicate that much of the present day wharf access, and areas immediately around the bridge entrance were reclaimed in the 19th Century.

In addition to above, a shallow (<50cm) duplex soil profile was found in several of the test pits across the ridgeline in the southern project area (SA 12, SA 13, SA 16, and SA 19). This deposit consisted of a very dark yellowish brown silty clay (A1 horizon) over-lying a light yellowish brown silty clay (A2 horizon) (5 and 7 in Figures 6-8), and was frequently truncated or disturbed from overburden and over-lying road surfaces. The deposit is best represented in SA 12 and SA 13, within Thompson Square where impacts have been minimal, and where artefact densities of up to 46/m² were recovered. (A similar finding was made in test pit 057E560N of KNC’s (2012) investigations nearby). This soil profile was not found in association with the other stratigraphic units, and its relationship to them or its depositional age can, therefore, not be determined. However, the presence of a significant portion of IMTC (Indurated Mudstone/Tuff/Chert) artefacts, more commonly found in 10+ka cultural assemblages, intermixed with more recent cultural material suggests parts of it may be fairly old.

5.3.1 SEDIMENTOLOGY

In addition to visual observations in the field, soil samples from SA9 (4 samples from spits 10-13 inclusive), SA11 (n=75 at 2cm intervals) and SA4 (17 samples between spits 11-29 inclusive) were processed for more detailed particle size analysis (Appendix 5). Despite being in different locations, overall, these samples provide a complete composite record of the sand body deposit (stratigraphic units 3,4 and 8) (Figure 11).
In general, the data demonstrates that the lower parts of the sand body (stratigraphic units 4 and 8), contain a parent material dominated by fine to very coarse sand. These larger fractions are indicative of a fluvial or alluvial method of deposition originally, and likely prior to the last interglacial (>82ka) based on OSL ages. The upper part of the sand body shows increasing fine components of clay, silt and fine sand, and suggests deposition or reworking of the deposit more likely occurred through aeolian processes. This finding is similar to the previous works at Pitt Town, which found windier conditions in the Last Glacial Maximum led to re-working of the upper portion of the (primarily alluvial) deposit (Williams et al., 2012, 2014). A sharp peak in several of the size fractions at 107cm below surface (spit 22) in test pits SA 11 may reflect the start of these windier conditions. The significant age difference between OSL ages above (~27ka) and below (~82ka) this point strongly suggests a stratigraphic disconformity, perhaps as a result of the change in environmental conditions. With the exception of large undulations at the upper part of test pit SA11, likely associated with historical activities and/or animal burrows near the surface, there is no other sharp changes in the particle size within stratigraphic units 3 and 4, and suggests there are no other disconformities present. There are several undulations within stratigraphic unit 8, which may similarly reflect disconformities, but based on OSL ages these will be >82ka, and unlikely to be relevant to the cultural assemblage recovered.

The limited sample points within test pits SA9 makes comparison with other particle size values problematic (Appendix 5). However, test pit SA 9 typically contains higher values of coarser materials (very coarse sand, coarse sand and fine sand totalling ~70%) than finer characteristics, and is comparable with the lower depths of stratigraphic unit 3 within test pit SA11. This correlates well with the OSL ages, and suggest that at least a portion of the sand body unit has been truncated within test pit SA9. A finding that is also evident in test pits SA8 and SA28 where OSL ages show substantial re-working at, or just before, European settlement.

Plate 1. SA 28, looking north. Beneath a thick layer of overburden was coarse to medium sand fluvial deposit (evident here as the lowest metre of the test pit). This consisted of two different colours, a strong brown at the top, and a reddish yellow at the base.
Plate 2. SA 9, looking south. SA 9 contained one of the best preserved portions of the sand sheet, evident here as a thick black band (probably a remnant A1 horizon) halfway down the section, and the pale fine sand deposit under-lying it. The sondage at the base of the test pit is investigating a layer that proved to be culturally sterile (6 in Figures 8-10).

Plate 3. SA 11, looking north. SA 11 was contained one of the most extensive portions of the sand sheet deposit, encompassing most of the section shown here. The under-lying fluvial sands (4 in Figures 8-10) is present in the bottom 10cm of the test pit.
Figure 10. Stratigraphic transect of the cultural deposits from the southwest corner of Thompson Square to the wharf in the northeast. The pink shading indicates the distribution of the sand sheet, while the green shows the residual soil profile found on the top of the ridge.
Figure 11. Particle size analysis of test pits SA4 and SA11 showing the main soil characteristics. Size fractions are based on Gale and Hoare (2012).
To provide a chronology of the deposits, a large number of samples were collected for Optically Stimulated Luminescence (OSL) dating. Within budgetary constraints, 11 samples were processed using a combination of multi-aliquot and single grain techniques. These samples were selected strategically to provide a general understanding of the stratigraphic units, as well as provide a higher resolution of dating through key sequences, which contained significant cultural materials.

All sampled were processed by Dr. Phil Toms at the University of Gloucestershire (UK), and are reported upon in detail in Appendix 6. The samples were processed using two main techniques:

- **Multi-aliquot method** – the age is calculated from a large number of quartz grains grouped onto small discs, and measured as a single bulk sample. This is the most common approach to OSL dating, and provides an average (or central) age for all sand grains measured. However, since it is an averaging technique, it can attenuate or subdue variations amongst the sand grains that may affect the eventual age produced.

- **Single-grain method** – the age is calculated from a large number of quartz grains, each of which is individually measured to determine their age. This method presents a large number of individual ages for a sample that can then be interrogated to determine which is the most suitable based on a range of factors. Typically, the approach will provide a minimum age, incorporating the youngest sand grains in a given sample, a central age as per the multi-aliquot approach above, and a finite mixture model that use statistical techniques to identify discrete age populations within the sample that may be more suitable than the other methods. This approach is more time-intensive, and has a range of limitations, but is often adopted in academic and/or research projects.

The results of the OSL ages are presented in Table 4 and Figures 8-10. Eight of these were focussed on the main cultural-bearing deposits (3, 4 and 5 in Figures 8-10) within the two parks either side of Bridge Street. The rationale for these samples were the presence of a cultural assemblage that visually appeared similar to the nearby Windsor Museum deposits (Section 3.3.2), and therefore had the potential to be some of the earliest evidence of Aboriginal people in the Sydney Basin. The samples were undertaken both across several different test pits to provide a broad chronology of the deposit, as well as provide a higher chronological resolution for SA11 where a significant portion of the cultural assemblage was recovered. The remaining three OSL samples were focussed on the thick alluvium on the northern side of the river (1 and 9 in Figure 6). These were taken since no work has previously occurred to the north of the river, and the age of the deposits were completely unknown. They, therefore, provided a series of range-findings ages with which to tie the deposits into the wider stratigraphic picture of the area.

GL16055 dates to the last Interglacial (Marine Isotope Stage (MIS) 5), and provides a useful benchmark for the formation history of several of the deposits. It shows that (ii) above formed during the last Interglacial. Given this deposit appears to have been deposited as part of an active river corridor (e.g. terrace, levee, etc) up to ~14m above the current river’s surface, it strongly suggests that they formed during the end of MIS 5 (~120-71ka) when sea-levels were 4-6m higher than present (Rohling et al. 2007) (and therefore the river would also have been higher as well). While the deposit appears to pre-date the archaeological evidence for arrival of Aboriginal people to Australia, a number of artefacts were found in the upper part of this unit, suggesting parts of it likely remained exposed to the surface for a considerable time after deposition, and upon which visitation and occupation occurred. Additional ages were processed to verify this, but only provide evidence for the latest truncation of this deposit in the last few hundred years, either just prior to and/or immediately after European settlement (see below).

GL16055 also provides a basal age for (iii), which contains the largest proportion of the cultural assemblage. A large gap in the ages between GL16055 and GL16115 despite being only 25cm apart may imply a stratigraphic disconformity in the formation of the deposit, with most of the dates -
GL161115, GL161118, and GL16054 – indicating that this deposit formed primarily throughout the last Glacial (MIS 2-4), and especially during the Last Glacial Maximum (LGM). The LGM is characterised as much drier, cooler and windier (Reeves et al., 2013; Williams et al., 2015) - all conditions that would have resulted in large wind-blown deposits being deposited near sediment sources (in this case the large floodplains surrounding the Hawkesbury River). The prevailing wind in the region coming across the Blue Mountains from the west, would also indicate that such deposits would predominantly occur to the east of the river, as has been found through this study; and similar deposits of similar ages are observed nearby (see Section 3.3.2). The ages strongly suggest that visitation of the region was occurring between ~30 - 17ka. An OSL age was also obtained from the upper portion of stratigraphic unit 3, and indicates that deposit formation was continuing until ~6ka. The cultural assemblage situated just below this age broadly supports this finding with late Holocene technological attributes being prevalent (e.g. backed artefacts, increasing silcrete raw materials, etc). Given the significant age gap between GL 16116 and GL 16054, which are only 25cm apart, it similarly suggests that a disconformity or hiatus is evident during the late Pleistocene/Holocene transition in the upper part of the deposit – a finding also made in similar sand units at Pitt Town (see Williams et al., 2014).

A sample (GL16056) from test pit SA 9 located in the lower park, and a significant distance from SA11 provides a similar age of ~17ka for the upper portion of the source-bordering dune; and a minimum age for the formation of much of the cultural assemblage recovered from this test pit. This provides further confirmation and robustness that the deposit is of an MIS2-4 age. Unfortunately, due to the disturbance and depth of excavation at SA 9, further samples could not be processed to understand the earlier formation of this portion of the deposit. Given this OSL age is near the surface of the deposit, and based on findings in SA 8 and SA 28, it is probable that a portion of the soil profile (and associated cultural assemblage) has been truncated from this area just prior to, or during, European settlement.

Two further ages were undertaken to try and determine the terminus post quem9 of the source-bordering dune deposit (GL16119 in SA 8) and under-lying alluvium (GL16119 in SA 28). In both cases, the ages were significantly younger than the wider findings of the investigations allowed. The ages both being <500 years in age strongly suggests that they are dating the period at which the deposit was truncated and/or modified in more recent times, rather than a time of burial for the unit. This is largely confirmed by the presence of a Holocene assemblage in the top of the source-bordering dune in test pit SA11, which is not evident in any of the test pits of the lower park – indicating that the top 10-20cm of the deposit has been lost. In both cases, the OSL samples were recovered from the upper portion of their respective stratigraphic units, and may have been partially bleached or ‘reset’ as the upper profile was removed or heavily modified. The two ages for the truncation are both relatively similar, and indicate landscape change at around 250-300 years ago. This is likely to be slightly before European settlement, and may indicate a natural phenomenon, such as large flood.

With these ages, an age-depth model has been developed for test pits SA 11 and is presented in Figure 12.

Three OSL ages were recovered from the northern side of the river, GL16056, GL16057 and GL 16117. All ages come from the lower alluvium (stratigraphic unit 9), and suggest that this deposit formed only in the last 6,500 years. GL 16057 provides an older age, but given its location near the top of the unit, and the results of two lower ages, it is considered erroneous. Several other lines of evidence also indicate that the deposit is of Holocene age, including its stratigraphic position to the south above deposits <17ka in age, and the cultural assemblage recovered, which has technological attributes commonly found only in the last 5,000 years. Further, while the evidence is not definitive due to the variation in the soil profiles, stratigraphic unit 1 appears to be situated above GL16119, and may indicate that this deposit is only a few hundred years in age. Indeed, the deposition of this deposit may be the event that truncated the under-lying source-bordering dune layers. Similarly (vi) appears to be largely

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9 A term meaning the point at which the deposit stopped forming.
introduced material, and overlies (v), it is therefore likely to only date to the last 200 years. Historical material found throughout the deposit suggests ages from AD1794 into the 20th Century.
Table 4. Summary of Optical Stimulated Luminescence (OSL) ages. All uncertainties in age are quoted at 1σ confidence and reflect combined systematic and experimental variability. Those that have multiple ages reported were processed using single grain analysis, which provides an indication of the differing ‘populations’ of sand grains within a sample – the preferred age is shown in bold. Further details of this technique are presented in Notes and Appendix 6. MAM = Minimum Age Model; FMM$^{\text{Min}}$ = Finite Mixture Model (Minimum population); FMM$^{\text{Maj}}$ = (Maximum population); CAM = Central Age Model.

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Test Pit</th>
<th>Spit</th>
<th>Depth (cm below surface)</th>
<th>Elevation (m AHD)</th>
<th>Lab Code</th>
<th>MAM Age (ka)</th>
<th>FMM$^{\text{Min}}$ Age (ka)</th>
<th>FMM$^{\text{Maj}}$ Age (ka)</th>
<th>CAM Age (ka)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Project Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>SA11</td>
<td>5$^\circ$</td>
<td>105$^*$</td>
<td>16.95</td>
<td>GL16116</td>
<td>1.6±0.2</td>
<td>1.7±0.2</td>
<td>11.0±0.8</td>
<td>5.7±0.6</td>
<td>The OSL analysis provided no support for which age model should be adopted here, and recommended the use of archaeological data in determining the age. The artefactual assemblage from these depths is characteristic of a pre-Bondaian/early Bondaian transition, which would lend support to a mid-Holocene age. As such the CAM model has been selected.</td>
</tr>
<tr>
<td>9</td>
<td>SA11</td>
<td>10$^*$</td>
<td>130$^*$</td>
<td>16.7</td>
<td>GL16054</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18±2</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>SA11</td>
<td>15$^*$</td>
<td>155$^*$</td>
<td>16.45</td>
<td>GL16118</td>
<td>9.6±1.1</td>
<td>14.9±1.4</td>
<td>24.6±2.2</td>
<td>22.9±2.1</td>
<td>The OSL analysis suggests that the CAM model would be most suitable based on the analysis, with potential microdosimetry (older and younger ages from reworked sediments) suggesting the average of all grains is more reliable.</td>
</tr>
<tr>
<td>11</td>
<td>SA11</td>
<td>20$^*$</td>
<td>180$^*$</td>
<td>16.2</td>
<td>GL16115</td>
<td>7.2±1.3</td>
<td>22.4±2.2</td>
<td>22.4±2.2</td>
<td>27.6±4.4</td>
<td>The OSL analysis suggests that the FMM$^{\text{Maj}}$ or the CAM models would be most suitable based on the age populations. Since stratigraphically, this age must be older than GL16118.</td>
</tr>
<tr>
<td>Sample #</td>
<td>Test Pit</td>
<td>Spit</td>
<td>Depth (cm below surface)</td>
<td>Elevation (m AHD)</td>
<td>Lab Code</td>
<td>MAM Age (ka)</td>
<td>FMM&lt;sub&gt;Min&lt;/sub&gt; Age (ka)</td>
<td>FMM&lt;sub&gt;Maj&lt;/sub&gt; Age (ka)</td>
<td>CAM Age (ka)</td>
<td>Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>------</td>
<td>-------------------------</td>
<td>------------------</td>
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<td>--------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>13</td>
<td>SA11</td>
<td>25^</td>
<td>205*</td>
<td>15.9</td>
<td>GL16055</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>82±7</td>
<td>-</td>
</tr>
<tr>
<td>45</td>
<td>SA28</td>
<td>10</td>
<td>95</td>
<td>12.8</td>
<td>GL16119</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.39±0.06</td>
<td>-</td>
</tr>
<tr>
<td>52</td>
<td>SA9</td>
<td>15</td>
<td>150</td>
<td>11.75</td>
<td>GL16056</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>17±2</td>
<td>-</td>
</tr>
<tr>
<td>55</td>
<td>SA8</td>
<td>17</td>
<td>170</td>
<td>9.7</td>
<td>GL16120</td>
<td>0.19±0.02</td>
<td>0.19±0.02</td>
<td>0.25±0.03</td>
<td>-</td>
<td>All OSL models broadly reflect the same age, FMM&lt;sub&gt;Min&lt;/sub&gt; has been selected at the advice of the OSL report, and since this represents ~AD1826 – a period when European activity was occurring in the project area.</td>
</tr>
</tbody>
</table>

**Northern Project Area**

| 21       | NA4      | 18   | 350                     | 6.5              | GL16056  | -            | -                        | -                        | 6.5±0.7     | -     |
| 23       | NA4      | 12   | 240                     | 6.8              | GL16117  | -            | -                        | -                        | 4.7±0.5     | -     |
| 24       | NA4      | 11   | 210                     | 7.9              | GL16057  | -            | -                        | -                        | 11±2        | -     |

* Note that these depths include the addition of 80cm to account for over-lying fill and other sedimentary layers that were excavated as part of the historical archaeological program.

^ Note SA 11 was excavated in 5cm spits.
Figure 12. Age-depth model for test pit SA11. The model has been developed using a 2nd order polynomial trendline \( y = -10742.85714286x^2 + 56891.42857143x - 39620.57142857 \) and proves highly accurate \( (r^2 = 0.98) \). It has removed GL16055, which is considered to be below a stratigraphic disconformity, and assumes the surface of stratigraphic unit 3 represents AD1788.

5.5 Phytolith Analysis

Phytolith analysis\(^{10}\) was undertaken by Loraine Watson-Fox (University of Queensland). The full report of the analysis is provided in Appendix 7. Overall 10 samples were processed from every 15cm down the soil profile of test pit SA11 (Table 5).

In summary, the analysis found that, vegetation has been relatively consistent over the last 80+ka, dominated by a variety of grasses and sedges, with the presence of herbaceous and/or arboreal taxa. The high proportions of grass and sedges are to be expected along a river corridor where intermittent flooding and a high-water table was likely present through much of the last 80+ka.

There has been variation in the nature of this community over time, with a mixed grass-arboreal-herbaceous vegetation community prior to and after the LGM, giving way to an *Araucaria* sp. dominated community during the LGM. The concentration of phytoliths, while possibly an artefact of taphonomy in some samples, indicate that vegetation was relatively sparse prior to, and during, the LGM, before increasing in abundance in the Holocene (10-0ka). While it is perhaps a paradox that the LGM - known to be extremely dry and arid - would have an increased tree community, *Araucaria* sp. are evergreen conifers (e.g. Bunya Pine, Wollemi Pine) that thrive in dry climates, and would have had root systems extensive enough to access the under-lying groundwater system. Conversely, the absence of sedges indicate that surface water was sparse, and many other groundcover species would have died out during this time.

Into the Holocene, the abundance of material, as well as the appearance of sponge spicules indicate increasingly moist and wet conditions, within which vegetation communities thrived. There is good

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\(^{10}\) The investigation of the fossilised plant material in a soil profile to reconstruct the past environment.
correlation between the samples from spits 1 and 4, and well-documented wet climatic events (intensified La Niñã and the mid-Holocene thermal maxima, respectively) (Williams et al., 2015). The reduction in tree cover, contrasting with the increased grasses and sedges at this time may reflect increasingly regular flooding of the Hawkesbury River destroying the large vegetation and/or landscape modification. The latter potentially a result of bush fires and burning (either natural or man-induced), evident by increased micro-charcoal in many of the upper samples.

Table 5. A summary of the phytolith analysis outlining main observations and interpretations.

<table>
<thead>
<tr>
<th>Spit</th>
<th>Depth (cm below surface)*</th>
<th>Stratigraphic Unit</th>
<th>Age (ka)</th>
<th>Observations</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80-85</td>
<td>3</td>
<td>0-0.98</td>
<td>Abundant grasses&lt;br&gt;Abundant sedges&lt;br&gt;Presence of sponge spicules&lt;br&gt;Some Araucaria sp.</td>
<td>Very Wet</td>
</tr>
<tr>
<td>4</td>
<td>95-100</td>
<td>3</td>
<td>4.7-6.5</td>
<td>Abundant grasses&lt;br&gt;Abundant sedges&lt;br&gt;Presence of sponge spicules&lt;br&gt;Some Araucaria sp.</td>
<td>Very Wet</td>
</tr>
<tr>
<td>7</td>
<td>110-115</td>
<td>3</td>
<td>10.0-11.6</td>
<td>Some sedges&lt;br&gt;Some unidentified vegetation.</td>
<td>Wet</td>
</tr>
<tr>
<td>10</td>
<td>125-130</td>
<td>3</td>
<td>14.7-16.2</td>
<td>Some grasses&lt;br&gt;Some sedges&lt;br&gt;Some Araucaria sp.</td>
<td>Variable conditions</td>
</tr>
<tr>
<td>13</td>
<td>140-145</td>
<td>3</td>
<td>19.0-20.3</td>
<td>Occasional grasses&lt;br&gt;Abundant Araucaria sp</td>
<td>Dry</td>
</tr>
<tr>
<td>16</td>
<td>155-160</td>
<td>3</td>
<td>22.8-23.9</td>
<td>Some sedges&lt;br&gt;Some Araucaria sp.</td>
<td>Variable conditions</td>
</tr>
<tr>
<td>19</td>
<td>170-175</td>
<td>3</td>
<td>26.0-27.0</td>
<td>Some grasses&lt;br&gt;Some sedges&lt;br&gt;Some Araucaria sp.</td>
<td>Wet</td>
</tr>
<tr>
<td>22</td>
<td>185-190</td>
<td>3</td>
<td>28.9-29.7</td>
<td>Some sedges&lt;br&gt;Some Araucaria sp.</td>
<td>Variable conditions</td>
</tr>
<tr>
<td>25</td>
<td>200-205</td>
<td>4</td>
<td>&gt;82</td>
<td>No data</td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td>215-220</td>
<td>4</td>
<td>&gt;82</td>
<td>Some grasses&lt;br&gt;Some sedges&lt;br&gt;Some Araucaria sp.</td>
<td>Wet</td>
</tr>
</tbody>
</table>

* Note that these depths include the addition of 80cm to account for over-lying fill and other sedimentary layers that were excavated as part of the historical archaeological program.

Based on the age-depth model presented in Figure 12.

5.6 Lithics

Detailed analysis of the cultural assemblage is provided in Appendices 8 and 9. The analysis divided the assemblage into four discrete archaeological landscapes (described in Section 6.1), but a summary of the overall findings are provided here.
The cultural assemblage consisted of 1,434 Aboriginal objects (stone artefacts), of which 1,347 had culturally modified diagnostic features. The remaining 87 included manuports, nodules, heat shatter, and a single piece of ochre, which while likely to be of cultural origin could not be robustly identified as artefactual.\textsuperscript{11}

In relation to the northern project area, 23 Aboriginal objects were recovered primarily from NA 6 (see Table 2). Artefact densities were very low ($\bar{x} = 0.81/m^2$ or 0.0005/kg) (Figures 13 and 14) and dominated by small complete (n=9) and broken (n=7) flakes, mostly made from silcrete (n=17) (Table 5). The artefacts were all recovered from stratigraphic unit 9, an alluvial deposit, between ~120 and 240cm below current surface; and the small size of the artefacts suggest that they are likely re-worked from upriver as part of the flooding conditions that led to this layer’s deposition, rather than visitation or occupation in the project area. OSL ages from stratigraphic units beneath this deposit indicate that it is likely <6.5ka, with some evidence it is only a few hundred years in age. Fragments of two edge-ground axes – generally considered to be <3.5ka in age - were also recovered, both from stratigraphic unit 9 (Figures 8-11) in SA 34 and the northern end of SH7.

Table 6. Cultural assemblage characteristics for northern project area.

<table>
<thead>
<tr>
<th>Artefact type</th>
<th>Artefact Count (n)</th>
<th>%</th>
<th>Maximum dimension (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Complete Flake</td>
<td>9</td>
<td>39.1</td>
<td>30.83</td>
<td>11.82</td>
</tr>
<tr>
<td>Broken Flakes</td>
<td>7</td>
<td>30.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal flake</td>
<td>4</td>
<td>17.4</td>
<td>19.65</td>
<td>7.65</td>
</tr>
<tr>
<td>Medial flake</td>
<td>1</td>
<td>4.3</td>
<td>18.20</td>
<td>0</td>
</tr>
<tr>
<td>Proximal flake</td>
<td>2</td>
<td>8.7</td>
<td>13.45</td>
<td>7.00</td>
</tr>
<tr>
<td>Angular fragment</td>
<td>2</td>
<td>8.7</td>
<td>18.75</td>
<td>6.15</td>
</tr>
<tr>
<td>Core</td>
<td>2</td>
<td>8.7</td>
<td>46.45</td>
<td>14.64</td>
</tr>
<tr>
<td>Tool</td>
<td>3</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angular fragment tool</td>
<td>1</td>
<td>4.3</td>
<td>28.80</td>
<td>0</td>
</tr>
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<td>Distal tool</td>
<td>2</td>
<td>8.7</td>
<td>13.65</td>
<td>4.60</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>25.55</td>
<td>12.81</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
<td><strong>100</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the southern project area, 1,324 Aboriginal objects (stone artefacts) were recovered, as well as 87 manuports/nodules and heat shatter.\textsuperscript{12} These were primarily recovered (n=995/75%) from the sand

\textsuperscript{11} In the case of the nodules/manuports, these consisted of large river pebbles ranging in size from 20g – 3.6kg ($\bar{x} = 908g$) in size, dominated by quartzite (n=13) and fine grained siliceous (n=5) raw materials, and found largely within (iii) above, usually in association with cultural material. Given their location 10-15m above the river’s edge, it seems unlikely that they could have reached their recovered position without having been transported by Aboriginal people in the past.

\textsuperscript{12} Note 20 Aboriginal objects were recovered from historical archaeological excavations in SH6 and SH7. Given the lack of provenance for these objects, they are not included in the analysis here. This results in an overall total of 1,304 for the southern project area.
sheet (3 and 4 in Figures 8-10), and the vast majority date to 27-17ka in age (Figure 11). These ages correlate well with other nearby archaeological loci (Windsor Museum – 33-15ka; PT 12 – 36-8ka, and 3-0ka). In this deposit, test pits contained very high artefact densities, ranging from 30/m² up to 155/m² (x̄=56/m²) (Figures 13 and 14). As is characteristic of Pleistocene archaeological sites in this part of the Sydney Basin (see Section 3), the cultural assemblage was dominated by IMTC, FGS, quartzite and volcanic raw materials (n=992/74.5%) (Table 6). The assemblage was primarily recovered from 70-110 cm below the current surface (Figure 11), although the undulating and steeply sloping nature of the project area meant that this was highly variable, with artefacts recovered from depths up to 4.1m below surface. The lack of cortex in the assemblage suggests that hunter-gatherers undertook primary knapping of the cobbles at the river’s edge, before moving upslope for further reduction of the material for stone tools. An alternate possibility is that the flakes with substantial cortex were moved off-site by hunter-gatherers, and hence their absence in the assemblage). The remaining assemblage was composed of various silcrete and quartz raw materials (n=347/26.6%) that were primarily recovered from a peak in artefacts at the top of SA 11 (Figure 12), and considered to be of pre-Bondaian/early-Bondaian transition (i.e. of mid-Holocene age).

The cultural assemblage contains a diverse composition of artefacts and tools, and strongly suggests that the locale was used for extended and/or repeated occupation in the past. Artefacts produced were relatively rudimentary and consisted of large unmodified flakes and pebble-tools, likely used for a range of hunting and plant working activities. While artefacts with cortex were not prevalent (<40%), where present they suggest exploitation of large cobbles from the Hawkesbury River. The presence of a number of river cobbles upslope, however, suggests that some were being brought upslope perhaps to apply heating methods, use as hearth stones, and/or anvils as part of the hunter-gatherer’s repertoire. Access to these cobbles would likely have only been during lower river levels, when such deposits would have been exposed. The loss of this resource, likely ~10ka, resulted in at least some of the raw material (mostly silcrete) being obtained from Rickaby Creek gravel outcrops that are known to occur along South Creek. The assemblage was dominated by broken flakes, angular fragments, and a high proportion of complete and broken hammer-stones (Table 7). While in low numbers, formal tool types were also found across the excavations, and included backed artefacts, Bondi points, a notched tool, utilised flakes (n=27) and numerous scrapers (n=10). These latter two tool types are, again, diagnostic of Pleistocene activity, with many of the other tool types found only in the upper 100cm. Relative mobility of these populations (determined through characteristics of the assemblage) (Figure 13) suggest that they were highly mobile in the early onset of the LGM, before becoming increasing tied to the river corridor during its peak (22-18ka). A finding that conforms with the wider understanding of hunter-gatherer’s response to the LGM across Australia, but somewhat disagreeing with the analysis at PT-12 where people were highly mobile throughout the event.

In addition to the Pleistocene assemblage, of note was the recovery of three probable glass artefacts (Tables 6 and 7). These artefacts, which included a scraper were recovered from SA 8 (spit 22), and SA 10 (spits 12 and 20) (Plate 4). Based on other historical material found in association with these objects, it can be determined that the glass artefact in SA 8 dates between AD1794-1880, and the two from SA 10 were found at levels equivalent to AD1794-1880 (spit 12) and AD1835-1859 (spit 22) – cumulatively providing a likely date around AD1820-1860. (Two other glass artefacts were also recovered, but are considered unlikely to have been culturally modified – see Appendix 8). Since documented Aboriginal occupation and activity largely ceased in the area by ~AD1837 (Walker, 1890), it suggests that most of these artefacts date to the earliest settlement and formation of Windsor, between ~AD 1794 and 1836. It is also highlighted that there are references to a number of corroborees being held in Thompson Square in the 1830s (Walker, 1890), and from which these artefacts may have been deposited.

Along the ridgeline, a disparate distribution of stone artefacts, with only small locales of moderate densities was recovered. The artefact assemblage recovered from this landscape was small (n=50) and contained a mixture of silcrete and IMTC raw material. One complete Bondi point manufacture on heat treated silcrete was recovered from SA12, and a microblade core associated with the manufacture of
backed artefacts was recovered from SA13. The ridgeline assemblage has similarities to a much larger assemblage recovered during salvage excavations at site BGW97, at the corner of George and Baker Streets, Windsor (JMCHM 1998). Based on this, the RL landscape is considered to extend across a greater part of the ridgeline running through Windsor, and reflects likely a mixed assemblage of Pleistocene activity (evident by IMTC dominated artefacts) over-printed by more recent Holocene visitation (evident by abundant silcrete artefacts and formal tool types). The lack of cortex in either assemblage suggests that past populations undertook initial reduction of raw materials elsewhere before visiting the ridgeline, where creation of more complex tools was undertaken. At least in the Holocene, the increasing appearance of tools requiring significant preparation time lends support to Aboriginal groups undertaking prolonged visits to the ridge over-looking the Hawkesbury River.

Plate 4. A scraper made from thick black glass and found towards the base of test pit SA 10.

Table 7. Raw material composition of the cultural assemblage from the southern project area.

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Artefact Count (n)</th>
<th>Artefact Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volcanic (includes basalt)</td>
<td>17</td>
<td>1.30</td>
</tr>
<tr>
<td>Fine Grained Siliceous (FGS)</td>
<td>44</td>
<td>3.38</td>
</tr>
<tr>
<td>Glass</td>
<td>5</td>
<td>0.38</td>
</tr>
<tr>
<td>Indurated Mudstone/Tuff/Chert (IMTC)</td>
<td>844</td>
<td>64.77</td>
</tr>
<tr>
<td>Quartz (clear, milky and crystal)</td>
<td>63</td>
<td>4.83</td>
</tr>
<tr>
<td>Quartzite</td>
<td>44</td>
<td>3.38</td>
</tr>
<tr>
<td>Silcrete (fine, medium and coarse)</td>
<td>284</td>
<td>21.80</td>
</tr>
<tr>
<td>Silicified wood</td>
<td>2</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,304</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Table 8. Cultural assemblage characteristics for southern project area.

<table>
<thead>
<tr>
<th>Artefact type</th>
<th>Artefact Count (n)</th>
<th>%</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complete Flake</strong></td>
<td>219</td>
<td>16.81</td>
<td>25.64</td>
<td>38.62</td>
<td>3.36</td>
<td>7.28</td>
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<tr>
<td><strong>Broken Flakes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal flake</td>
<td>240</td>
<td>18.42</td>
<td>17.11</td>
<td>20.10</td>
<td>0.93</td>
<td>1.75</td>
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<tr>
<td>Medial flake</td>
<td>140</td>
<td>10.74</td>
<td>14.68</td>
<td>10.54</td>
<td>0.67</td>
<td>1.36</td>
</tr>
<tr>
<td>Broken split</td>
<td>70</td>
<td>5.37</td>
<td>12.63</td>
<td>5.23</td>
<td>0.41</td>
<td>0.58</td>
</tr>
<tr>
<td>Proximal split</td>
<td>22</td>
<td>1.69</td>
<td>19.38</td>
<td>26.19</td>
<td>1.01</td>
<td>2.46</td>
</tr>
<tr>
<td>Proximal flake</td>
<td>72</td>
<td>5.53</td>
<td>16.47</td>
<td>8.67</td>
<td>1.36</td>
<td>2.63</td>
</tr>
<tr>
<td>Complete split</td>
<td>69</td>
<td>5.30</td>
<td>23.91</td>
<td>17.35</td>
<td>8.15</td>
<td>39.23</td>
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<td>Angular fragment</td>
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<td>21.51</td>
<td>19.97</td>
<td>5.90</td>
<td>35.32</td>
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<tr>
<td><strong>Cores</strong></td>
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</tr>
<tr>
<td>Core</td>
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<td>44.31</td>
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<td>Core fragment</td>
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<td>23.31</td>
<td>46.01</td>
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<tr>
<td><strong>Flake Tool</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete tool</td>
<td>16</td>
<td>1.23</td>
<td>32.51</td>
<td>10.02</td>
<td>11.88</td>
<td>11.88</td>
</tr>
<tr>
<td>Distal tool</td>
<td>7</td>
<td>0.54</td>
<td>21.73</td>
<td>12.71</td>
<td>2.04</td>
<td>2.88</td>
</tr>
<tr>
<td>Medial Tool</td>
<td>4</td>
<td>0.31</td>
<td>14.78</td>
<td>4.57</td>
<td>0.63</td>
<td>0.72</td>
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<tr>
<td>Proximal Tool</td>
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<td>0.31</td>
<td>13.05</td>
<td>2.11</td>
<td>0.57</td>
<td>0.49</td>
</tr>
<tr>
<td>Complete split tool</td>
<td>2</td>
<td>0.15</td>
<td>25.75</td>
<td>0.49</td>
<td>3.10</td>
<td>0.85</td>
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<td>Angular fragment tool</td>
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<td>49.68</td>
<td>67.25</td>
<td>20.39</td>
<td>31.63</td>
</tr>
<tr>
<td>Artefact type</td>
<td>Artefact Count (n)</td>
<td>%</td>
<td>Maximum dimension (mm)</td>
<td>Weight (g)</td>
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<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------</td>
<td>-------</td>
<td>------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Hammerstone/Anvil</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Broken Hammerstone</td>
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<td>0.61</td>
<td>102.34</td>
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<td>471.88</td>
<td>248.81</td>
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<td>Hammer stone</td>
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<td>0.69</td>
<td>106.92</td>
<td>31.03</td>
<td>578.71</td>
<td>300.69</td>
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<tr>
<td>Hammer/Anvil</td>
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<td>0.23</td>
<td>166.20</td>
<td>34.55</td>
<td>1153.67</td>
<td>559.56</td>
</tr>
<tr>
<td>Ground edge axe fragment*</td>
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<td>0.08</td>
<td>112.00</td>
<td>-</td>
<td>279.00</td>
<td>-</td>
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<tr>
<td>Microdebitage</td>
<td>20</td>
<td>1.53</td>
<td>4.98</td>
<td>1.16</td>
<td>0.06</td>
<td>0.03</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>41.92</td>
<td>17.15</td>
<td>124.95</td>
<td>65.54</td>
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<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 13. Relative mobility of hunter-gatherer populations based on the artefactual assemblage within source bordering dune archaeological landscape. The analysis is based on a compilation of the stone artefact material within stratigraphic unit 3 across all test pits (see Appendix 8 for further details).
Figure 14. Map showing artefact densities/m² recovered from the archaeological test excavations.
Figure 15: Map showing artefact densities/kg of sediment recovered from the archaeological test excavations.
6 RESULTS AND DISCUSSION

6.1 The Archaeological Resource

Based on the archaeological excavations, the project area can be divided into four main archaeological landscapes (Figure 16):

Ridgeline: The ridgeline, encompassing SA 12-23 inclusive, SA 26 and SA 27, contains a disturbed and truncated duplex soil profile typically less than 60cm in depth. With the exception of the undeveloped Thompson Square (encompassed by Bridge Street, George Street, and the Terrace), this landscape is heavily disturbed, and primarily characterised by Londonderry Clay immediately under the modern urban environment. Generally, there were few, if any, cultural material recovered from this landscape. Within Thompson Square, SA 12 and SA13 contained an intact and relatively undisturbed soil profile some 25cm thick, and within which substantial cultural material (46 lithics/m$^2$) were found. A similar finding was made in nearby test pit 057E560N by KNC (2012), which recovered 114 artefacts from a shallow soil profile in a single square metre. However, these cultural deposits are patchy (with SA 13 recovering very few Aboriginal objects), and appear to contain a mixture of temporal periods of cultural material (likely both Pleistocene and Holocene in age).

This deposit encompasses a portion of the previously identified WBRP PAD (#45-5-3581) (KNC 2012).

Source-Bordering Dune: The Thompson Square park areas on either side of Bridge Street, and encompassing SA 6, SA 8-11 inclusive, SA 24, SA 25, SA 28 and SA 29, contains a sand deposit between 1-1.5m in thickness (and generally ~70-80cm below the current land surface) (Figure 17). This deposit consists of two units: i) a lower medium sand layer (4 and 8 in Figures 6-8) deposited through fluvial processes (e.g. terrace, levee, etc), which is more prevalent across the project area than the upper unit, and includes SA 2, SA 4, SA 32 and SA 33; and ii) an upper layer composed of silts and fine sands (3 in Figures 6-8), formed through wind-blown processes (i.e. a source-bordering dune), and largely confined to the park areas. A small patch of the same upper deposit was also found on the ridgeline in SA 24 and SA 25, and likely extending east out of the project area. This deposit is very similar in sedimentology and composition to the nearby Windsor Museum site (Section 3.3.2), and likely forms a continuation of the same stratigraphic unit. OSL ages from the upper deposit suggest that the lower unit was deposited before 82ka, most likely during the last Interglacial (MIS 5), while the upper layer formed primarily during the LGM (~27-17ka) during increasingly arid and cool conditions (MIS 2-4). Phytolith analysis indicates that the project area contained sparse vegetation, including grasses, sedges and Araucaria sp trees. The upper deposit contains a substantial cultural assemblage, with artefact densities typically >30/m$^2$ (and up to 155/m$^2$ in places), and which demonstrates prolonged and/or repeat occupation of the area for exploitation of the river’s resources during the LGM.

The lower assemblage revealed a range of raw materials, all likely being sourced from the nearby Hawkesbury River, when lower sea-level would have seen the river exposing large gravel beds of IMTC, quartzite, FGS, and volcanic river pebbles. A similar procurement strategy to that found at Windsor Museum and PT-12 (Austral Archaeology, 2011; Williams et al., 2014). The lack of cortex in the assemblage suggests that hunter-gatherers undertook primary knapping of the cobbles at the river’s edge, before moving upslope for further reduction of the material for stone tools. (An alternate possibility is that the flakes with substantial cortex were moved off-site by hunter-gatherers, and hence their absence in the assemblage). The presence of a number of river cobbles upslope, however, suggests that some were being brought upslope perhaps to apply heating methods, use as hearth stones, and/or anvils as part of the hunter-gatherer’s repertoire. Artefacts produced were relatively rudimentary and consisted of large unmodified flakes and pebble-tools, likely used for a range of hunting and plant
working activities. Relative mobility of these populations (determined through characteristics of the assemblage) suggest that they were highly mobile in the early onset of the LGM, before becoming increasing tied to the river corridor during its peak (22-18ka). A finding that conforms with the wider understanding of hunter-gatherer's response to the LGM across Australia (Williams et al., 2013), but somewhat disagreeing with the analysis at PT-12 where people were highly mobile throughout the event (Williams et al., 2014).

While deposited in MIS 5, and older than the scientifically accepted colonisation of Australia by Aboriginal people, the upper part of the lower deposit (stratigraphic unit 4) also contains cultural material, and is considered to have formed a land surface over a significant period of time after its deposition. Attempts at dating these surfaces indicate that they have been subject to truncation and/or modification in the last few hundred years. However, the cultural assemblage within the deposit is comparable with findings in stratigraphic unit 3, and suggest an LGM age for visitation by past populations. It should be highlighted that the lower part of this deposit (stratigraphic unit 8) is culturally sterile, and where present without the over-lying deposits (e.g. SA 2 and SA33) should not be incorporated as an extension of the archaeological deposit.

While truncated in much of the lower park, OSL ages and the cultural assemblage also contains evidence for Holocene use of the source-bordering dune deposits. The upper assemblage within the SBD, which was primarily only present in the upper part of SA11, appears to date to the Holocene. Characteristics of the assemblage include backed artefacts, heat treated silcrete, and bipolar cores and flakes, and along with OSL ages suggest a pre- to early Bondaian (mid-Holocene) age as likely for its formation. The assemblage shows populations were again highly mobile, which compares well with our wider understanding of the period as one of ameliorating climate (the mid-Holocene thermal maxima) (Williams et al., 2015) – also found by the increasing abundance and hydrophilous nature of the vegetation found in the phytolith analysis This is further supported by the dominance of silcrete, which was likely sourced 5-10km from the project area; and also accounts for the heavy curation of the raw material. Activities on-site appear to have included minor production of microlith tools, perhaps indicating repair of existing equipment while utilising the resources of the river. Along with the relative mobility, the assemblage does not indicate long term or intense occupation of the SBD – a finding also found at other parts of the River, which seems to have fallen out of favour with past populations into the Holocene (Williams et al., 2014). It is considered that given the significant time gaps between several of the ages within this deposit, that there a number of stratigraphic disconformities, notably during MIS 3 and 4 (~70-29ka) and during the late Pleistocene/Holocene transition.

In parts, this deposit also contained evidence of post-contact cultural material (glass artefacts). While in more disturbed parts of the deposits, these artefacts are likely to have been deposited between AD1794 and AD1837, and lend support to the use of Thompson Square by Aboriginal people through the early settlement of Windsor.

This deposit has generally good integrity, with mostly localised impacts, including a sewer main running through the lower park (and upon which test pit 017E630N (KNC 2012) appears to have been excavated), and a former road to the south of the lower park, and which probably accounts for the heavy disturbance in SA 10 and SA 28. The roads surrounding the park have also resulted in the loss of the deposit, with excavations in Old Bridge Street (035E627N (KNC 2012) only revealing the lower, culturally sterile part of the fluvial deposit (8 in Figures 6-8). There is some evidence that the top portion of the deposit has been truncated in several areas, notably the lower park, and likely some 10-30cm of the deposit has been lost.

This deposit encompasses a portion of the previously identified WBRP PAD (#45-5-3581) (KNC 2012).

River’s Edge - Alluvium: The lower elevations (<11m AHD) of both northern and southern project areas, and encompassing NA1-8, SA 1, SA 3, SA 8, SA 32, SA34-SA36 inclusive, contains a compact silty
loam approximately 1-2m in thickness (1 in Figures 6-8). This deposit is a low energy alluvium, and forms part of the Hawkesbury River floodplain, and is present immediately below the modern road and/or top-dressing surfaces. Based on OSL ages, and its stratigraphic position, it was deposited in the last ~7ka; with parts of it potentially only being a few hundred years in age. This is corroborated by the cultural assemblage found within the deposit, which has the characteristics of a Holocene (10-0ka) period. Overall, the cultural assemblage in this deposit contained few Aboriginal objects, with 150 recovered from the test pits listed above (excluding SA 8, which is primarily part of the source-bordering dune), equivalent to 3.75/m². A significant proportion of these artefacts (n=50) come from one test pit, SA 35, the vast majority of which were recovered from over-lying fill units – when removed this results in an average artefact density of closer to 2.4/m² for the deposit.

This deposit has mixed integrity. The northern project area has been subject to less historical activities, and appeared more intact. The deposit in the southern project area frequently contained historical and more recent materials to significant depths (>1.5m below surface), and suggests modification or disturbance has occurred.

River’s Edge – Reclaimed/Introduced Fill: Along the river’s edge of the southern project area, substantial landscape modification and earthworks appears to have occurred. This is most evident in SA 5, SA 7, SA 30, SA 31, SA 37 and SA38, and suggests that reclamation and levelling of portions of the riverbank have been undertaken for use, safety and/or beautification. Based on historical photographs and the archaeological excavations, it appears that the river bank was relatively irregular and undulating, and over the last 200 years, these undulations have been in-filled with modern materials. This includes the areas in close proximity to the current bridge, and the wharf area.

While these deposits frequently contain cultural materials, they are heavily re-worked and disturbed.

### 6.2 Research Questions

As part of the archaeological research design, a number of research questions were posed for the test excavations to determine. This section provides responses to these questions were they can be resolved through the works undertaken.

- **What is the spatial and stratigraphic extent of Aboriginal sites and/or material culture within the WBRP?**

  As outlined in the preceding sections, the cultural material across the project area can now be well-defined, and has been divided into 10 stratigraphic units, or four archaeological landscapes. These are presented in Figure 16, and consist of:

  - **Ridgeline** – a disparate shallow duplex soil profile, often beneath historical overburden, and containing discrete concentrations of Aboriginal objects up to 50/m². Much of this landscape has been heavily affected by modern and historical activities, with only pockets of soil profile (and any associated cultural material) being present across the landscape. The landscape encompasses the elevated areas in the vicinity of George and Bridge Streets, and extends into the upper part of Thompson Square – the latter area being where most of the cultural material was recovered from this landscape.

  - **Source-Bordering Dune** – a fluvially and aeolian-derived sand body typically 1-1.5m in thickness, and extending across the upper and lower portion of Thompson Square, and into parts of Old Bridge Street, and The Terrace (Figure 17). A thin lens of the deposit is also located on the ridgeline east of the George/Bridge Street junction. The landscape is more intact in the upper Thompson Square, and has been subject to varying levels of burial by historical overburden and/or truncation from past activities. The deposit likely formed discontinuously between >82ka through to the mid-Holocene
(~5ka). Archaeological material within this deposit is extensive, and suggests two periods of visitation/occupation between 27-18ka (the onset and peak of the LGM), and the early- to mid-Holocene.

- River's Edge Alluvium – a thick clay and fine sand alluvium encompassing the entire northern project area, and the lower areas of the southern project area, including The Terrace, the wharf area and surrounding carpark. This landscape was likely formed through low-energy fluvial deposition probably in the last 6.5ka, if not much more recently. Cultural material is found throughout the deposit in low numbers (<5/m²), with many of them potentially re-worked either naturally or via human processes from other nearby archaeological landscapes.

- River's Edge – Reclaimed/Introduced Fill – disparate pockets of introduced and/or modified natural deposits used to in-fill and landscape areas primarily along the southern bank of the Hawkesbury River. Cultural material is found throughout the deposit in low numbers (<5/m²), with many of them potentially re-worked from other nearby archaeological landscapes.

**What is the age, integrity and significance of Aboriginal sites and/or material culture within the WBRP?**

The project contains evidence of Aboriginal visitation and/or occupation during the onset and peak of the LGM (27-17ka), the early- to mid-Holocene (~5-7ka), the late Holocene (<3ka), and the early European period (AD1784-1830). A summary of the age and integrity of each archaeological landscape is provided below. Significance of the deposits is presented in Section 7 below.

- Ridgeline – archaeological deposits within the ridgeline appear to represent a mixture of Pleistocene (>10ka) and late Holocene (5-0ka) cultural materials. Mixing of the assemblage is likely the result of pedoturbation processes common in duplex soils, and has resulted in the complete mixing of the two chronologically different assemblages. As such the integrity of the archaeological deposits of this landscape are considered low. Further, in most areas, historical and more recent activities have significantly affected – often removed – the soil profile (and associated cultural materials) within this landscape.

- Source-Bordering Dune – archaeological deposits within the source-bordering dune represent three periods of visitation/occupation to the area, between 27-17ka and ~7-5ka, and AD1784-1830. The majority of the assemblage dates to the Pleistocene period, and provides some of the earliest evidence of populations in the Sydney basin, and importantly thought a major climatic downturn (LGM), which saw the abandonment of extensive tracts of Australia. Detailed analysis of the assemblage indicates that the integrity of the deposit is excellent, with the cultural assemblage unlikely to have been extensively modified by pedoturbation. Conjoining of artefacts indicates that movement of the assemblage was likely <10cm, with one example of movement of up to 30cm. However, the upper Holocene assemblage is only evident in the upper part of Thompson Square, and suggests truncation of part of the assemblage in other parts of the project area. Post-contact artefacts were only found in historical deposits in the lower Thompson Square, and based on the associated historical material retains reasonably good integrity in many parts of the project area.

- River's Edge Alluvium – based on OSL ages, any archaeological material within this landscape is of late Holocene age (5-0ka). There is some evidence that the deposit may in fact only be a few hundred years in age (see Section 5.4). However, given the nature of the deposit as alluvium coming from upriver, and likely re-working local soil profiles, the assemblage may exhibit a range of chronological periods. The presence of IMTC raw materials strongly suggest that, originally at least, parts of the cultural...
material may have been of Pleistocene age. The depositional nature of the deposit results in the integrity of this deposit being poor.

- River’s Edge – Reclaimed/Introduced Fill – this is a very disturbed landscape having been created and/or modified in the last few hundred years. Any archaeological materials within it may come from a range of chronological periods. The depositional nature of the deposit results in the integrity of this deposit being poor.

**What are the environmental characteristics associated with the distribution of Aboriginal cultural heritage within the WBRP? Can the formative processes of the stratigraphic profile provide information on the nature and/or survivability of the archaeological resources? Are there other key factors in the distribution and extent of the material culture within the WBRP?**

Sediment and phtyolith analysis provide some information on the environment and formative history of the project area. Sampling was focussed on the source-bordering dune landscape, since it had the most extensive cultural assemblage, and the least evidence of historical modification.

The sediment analysis indicates that the source-bordering dune deposit (stratigraphic units 4 and 8) was originally deposited >82ka, likely though fluvial processes. Given this deposit appears to have been deposited as part of an active river corridor (e.g. terrace, levee, etc) up to ~14m above the current river’s surface, it strongly suggests that they formed during the end of MIS 5 (~120-71ka) when sea-levels were 4-6m higher than present (Rohling et al. 2007). The upper part of this archaeological landscape (stratigraphic unit 3) exhibits increasing finer sediments, and strongly suggests that aeolian or wind-blown processes dominated its later deposition and formation. The age of the deposit strongly supports this having primarily formed during the LGM, an increasingly dry and arid climatic period (~30-18ka). Given the prevailing wind is from the west, these deposits are likely to reflect sediment from the surrounding river floodplain, and possibly the under-lying fluvial deposits ramping against the steep slope making up the project area. Phytolith analysis corroborates parts of the above history, with evidence of sparse and xerophilous vegetation through the LGM, and suggesting increasingly dry and arid conditions. In the upper part of stratigraphic unit 3, the phytoliths show an increasingly abundant and hydrophilous plant community, and indicate increasingly moist and warm conditions through the Holocene.

While detailed analysis of other stratigraphic units was not undertaken, field observations provide some information. The ridgeline archaeological landscape consisted of a residual duplex soil profile, and likely formed from in situ pedogenesis of the under-lying Londonderry clay. The fine sand and clay units running along the edges of the river (stratigraphic units 1 and 9) were formed through alluvial processes in the last few thousand years, and reflects low energy submergence of these areas, followed by sediment accumulation as water recedes.

Over-lying all of these archaeological landscapes is a range of historical and more recent overburden units – all of which have likely resulted in the modification and/or truncation of parts of the earlier deposits. In the case of test pit SA11, an animal burrow was also observed.

With respect to the formative history of the deposits and its influence over the cultural assemblage, a number of observations can be made:

- The chronological picture of the site indicates that several of the deposits are likely too old to contain cultural material based on our current archaeological understanding of when populations arrived in Sydney. This is especially the case for stratigraphic units 2, 4 and 8. In the case of stratigraphic unit 4, the upper part of this deposit was likely exposed during hunter-gatherer use of the region, and so only the lower parts of the deposit should be considered unlikely to contain in situ cultural material.
• The source-bordering sand dune landscape has evidence of stratigraphic disconformities, most evident in the large age-gap between GL16115 (~82ka) and GL16118 (~28ka), but also potentially between GL16054 (~18ka) and GL160116 (~6ka). These disconformities suggest a previous landsurface, or scour of the deposit, has occurred during some time intervals. This may have the result of concentrating a cultural assemblage (i.e. all the artefacts end up on the created land surface) and/or removal of the cultural assemblage (i.e. washed away, or rolled downslope, etc); and both of which affect the age, integrity and significance of the assemblage. This does not appear the case for the lower assemblage recovered from the landscape, which has good chronological control (with no obvious disconformities), and conjoin analysis showing minimal movement of artefacts in the soil profile. However, the upper assemblage is situated within the upper disconformity (if present), and this may suggest some post-depositional influences have occurred. Currently, the characteristics of the upper assemblage appear consistent with the identified chronology, but there does appear to be an overlap (between spits 8-10) between the upper and lower assemblage, which are considered likely deposited 8-10,000 years apart – and as such some pedoturbation and/or other geomorphological process may have played a role in the upper 50cm. A similar finding was made at PT-12 (Williams et al., 2014).

• Given the depositional nature of the alluvial deposits along the river’s edge (stratigraphic units 1 and 9), it is unlikely that any cultural material represents visitation and/or occupation of the river. Rather, the assemblage is likely re-worked and re-deposited by the river during these events, and may reflect a range of chronological and locational events elsewhere along the river. In the case of smaller artefacts, these may have come some considerable distance upriver, however given the low energy nature of the deposit, larger artefacts are likely to have been more local.

• Historical activities have resulted in substantial modifications in some parts of the project area, notably the truncation of parts of the source-bordering dune landscape across many parts of the southern project area.

• Analysis of the major vegetation communities indicate that the LGM was increasingly arid in the region, and this lends support to the hypothesis that populations were congregating along the Hawkesbury River – one of the only major water sources for a considerable distance – to survive this climatic event. Conversely, the Holocene appeared to be increasingly wet and humid, conforming with wider paleoclimatic data, and also explain why the data suggest more mobile populations, and increasing use of the landscape as a whole – evident by the increasing number of artefacts appearing in the top of the source-bordering dune deposit.

• How do the cultural materials compare with other Pleistocene sites nearby? What can the material culture tell us about the populations and behaviour of Aboriginal hunter-gatherers during the last 30,000 years?

A detailed comparison of the WBRP assemblage with those from the Windsor Museum and PT-12 (Pitt Town) is presented in Appendix 8. All three sites seem to be closely related, and may reflect the same populations moving along the river corridor. The assemblages and likely activities of the populations (discussed below) are all very similar. Based on chronology, all three sites were visited and/or occupied across the same time interval, between ~35ka to 8ka, and importantly during and through the LGM. In the case of WBRP, the use of the region does not seem to have been as long or as extensive with the site primarily used for only about 11,000 years (27-18ka), compared with more than double this in the case of Windsor Museum and PT-12. Artefact concentrations of WBRP are also less than the other two assemblages (an average of 50/m² compared with 90-200/m²), and perhaps suggest it was not utilised as often or as extensively as the other two (Although, it must be highlighted that our results here are for a test excavation, whereas the other two projects discuss salvage excavations of much larger areas).

In all instances, the archaeological assemblage reveals a similar story of past populations utilising the resources of the Hawkesbury River during a period of climatic downturn. Across all of the sites, large
river cobbles were being extracted from the river, presumably from exposed gravel beds from the lowering of the river's thalweg to meet a lower sea-level at Pittwater, and taken to nearby elevated ground for production of stone tools. In the case of PT-12, entire river cobbles were regularly being carried, whereas at the Windsor sites, it appears removal of the outer parts of the cobble may have occurred at the river's edge before moving upslope. In all cases, complete river cobbles where found on elevated ground, and may suggest more complex artefact strategies being employed, such as heat treatment to produce better flaking qualities. From these cobbles, artefacts were produced at all sites that were relatively rudimentary, consisting of large unmodified flakes and pebble-tools, with occasional large scrapers, likely used for a range of general hunting and plant working activities. Based on ethnographic observations, resources also likely included the exploitation of the river for freshwater mussel, eels, fish and terenid. Although no direct evidence of these in the archaeological record is currently available. Phytolith analysis suggests a woodland community dominated by *Aracauria* sp was present through this period, and this perhaps also suggests exploitation of an evergreen coniferous plant community by hunter-gatherers, with resources such as pine nuts and resin being available. Relative mobility of these populations (determined through characteristics of the assemblage) suggest that they were highly mobile in the early onset of the LGM, before becoming increasing tied to the river corridor during its peak (22-18ka). There is some disparity between PT-12 and WBRP in terms of the level of mobility during this time, but little doubt both sites acted as a ‘refuge’ during the LGM.

The three sites show increasing differences in the most recent time period. Windsor Museum lacks a Holocene assemblage of any kind, potentially a result of historical truncation. The WBRP assemblage is indicative of use of the area in the early- to mid-Holocene (~7-5ka), but lacks any strong evidence of later (pre-European) use, while PT-12 is believed to have a hiatus during this time, but re-occupation and visitation in the last few thousand years. These varying assemblages all suggest greater complexity and diversity was occurring in the Holocene, and the importance of the river (at least this section of it) was diminished. None of the upper assemblages appear to have the same intensity or density as the earlier use of the site. Both sites show an increasing dominance of silcrete raw materials, likely obtained from the Riverstone region some 10km to the southeast, and suggest that in tandem with climatic amelioration, populations had spread and utilised much larger tracts of the Sydney Basin.

- **Is there any evidence for contact period archaeology between the local Aboriginal people and Europeans within the WBRP?**

Five glass artefacts were recovered from the lower Thompson Square test pits. These are encapsulated within the source-bordering dune landscape, although were primarily recovered from the over-lying fill deposits. Of these five, three are believed to have high likelihood of being culturally modified by Aboriginal people. Based on the manufacture age of the glass itself, and the historical finds recovered from the same spits/contexts, they appear to date to AD~1784 – 1860, with ethnographic information suggesting AD1837 as a more likely *terminus ante quem* date.

As three discrete objects within a fill unit, we cannot provide further direct information on the activities or interactions associated with these artefacts. However, ethnographic evidence shows a number of interactions between Europeans and Aboriginal people within Thompson Square during this time, notably several corroborees (Walker, 1890). The presence of stone artefacts at similar depths is also of importance, and provides further evidence that the behaviour of Aboriginal people remained, at least in part, unchanged following European arrival, simply integrating the glass as a raw material into their existing hunter-gathering strategies.

- **What are the cultural, social and public values associated with the Aboriginal archaeological resource in the southern project area?**
The values of the archaeological landscapes are provided in Section 7. This question will also be addressed in the wider Strategic Conservation Management Plan for the project.

- How should the Aboriginal sites in the region be conserved and managed in future?

As outlined in preceding questions, the archaeological record along the Hawkesbury River, especially on elevated ground between Pitt Town and Windsor (and potentially further), represents a very rare resource. The LGM was a global climatic downturn that resulted in significant re-organisation of hunter-gatherer populations. In Australia, current models suggest that populations contracted to ‘refuges’ to survive, but while such locales are conceptually known, many have little or no tangible record of the event or people’s behaviour through it. With the possible exception of the Willandra Lakes region, and the Pilbara, for the most part the tangible records available are also very limited – constrained to rockshelters or a handful of artefacts. Conversely, excavations at PT-12, Windsor Museum and WBRP reveal that along the Hawkesbury River, we have an unrivalled record of people’s visitation, occupation and exploitation of the river through this period. It is therefore essential that these deposits form the focus of future conservation and management.

Currently, there are substantial threats to these archaeological deposits, notably the expansion and urban development of the river’s edge. This is most evident in Pitt Town, where residential subdivision and ‘weekender’ type properties are encompassing vast tracts of the ridgeline upon which the deposits have been found. Large parts of PT-12 have been destroyed, including those areas where the data presented was collected. Similarly in Windsor, urban development has a high likelihood of destroying such deposits (many of which are yet to be identified). For example, a multi-storey unit block has been constructed on the corner of Baker Street and The Terrace, immediately opposite the Windsor Museum site, without any apparent consideration of Aboriginal heritage. In the case of the proposed bridge across the Hawkesbury River, the construction will also have an impact to the archaeological deposit, and management of this is discussed in subsequent sections.

A critical issue is the identification of these archaeological deposits, with much of the development outlined above approved long before they were identified. It is hoped that the sand body study will significantly progress this issue, and provide an identification of where such deposits may occur to allow State and local government to manage them more effectively.
Figure 16. Map summarising the archaeological landscapes (discussed in Section 6) across the project area. Note the source-bordering dune includes an under-lying culturally sterile layer that makes it appearance here larger than other figure - refer to Figure 18 for more detailed presentation of the archaeological deposit associated with this landscape.
Figure 17. Interpolated distribution and depth of the source-bordering dune archaeological landscape, calculated on the basis of known deposit depths from excavated test pits. (Note SA 6 is considered to contain the sand deposit, but could not be excavated during the program, and hence its exclusion in this model).
The statement of significance for each site was assessed based on a framework and range of criteria, which are discussed in detail in Appendix 10.

### 7.1 Key Findings

- The findings of each test pit and the four archaeological landscapes as a whole have been assessed against four criteria: scientific, historical, aesthetic and social/spiritual.

- Overall, the assessment found nine test pits of very high or high (State) significance, three of moderate significance, and 34 of low or very low significance. All those identified as of high or very high value were situated within the source-bordering dune archaeological landscape.

- The identification of these areas as of high or very high value was based on the significant age and integrity of the cultural deposit, and its ability to provide information on the behaviour, mobility and populations of Aboriginal people during the initial colonisation of the southeast Australia, and through the Last Glacial Maximum (27-18ka) - a significant climatic period of drying and cooling. These deposits also contained probable glass artefacts, and demonstrate post-contact interactions between Aboriginal people and early European settlers, and thereby meeting historical significance thresholds.

### 7.2 Statement of Significance

Based on the archaeological test excavation, four archaeological landscapes can be identified across the project area, Ridgeline, Source-Bordering Dune, River’s Edge – Alluvium, and River’s Edge – Reclaimed/Introduced Fill (see Section 5.1). The higher resolution recovery of Aboriginal objects across the project area compared with previous studies, provides a far greater understanding of the archaeological resource and its significance, as well as raising additional questions on the nature and use of the area by Aboriginal people in the past.

Specifically, the excavations revealed that the Thompson Square park areas on either side of Bridge Street contain the remnants of a source-bordering dune, which formed a key locale of Aboriginal visitation and occupation between 27-17,000 years ago. The abundance and diversity of the cultural material suggest prolonged and/or repeat occupation, with a focus on the exploitation of the river’s resources, especially large cobbles for artefact and tool production. The deposit is likely a continuation of the finds at the nearby Windsor Museum (Section 3.3.2), which shows initial visitation by 33ka, and ongoing occupation through to 8ka. Along with other regional findings of work at Pitt Town (Section 3.3.2), the assemblage here lends strong support to Aboriginal populations exploiting and using the Hawkesbury River corridor by ~30-35ka; and representing some of the earliest evidence of Aboriginal populations in southeast Australia (Williams et al., 2012, 2014). With the exception of a handful of artefacts at the base of the Cranebrook Terrace (Nanson et al., 1987) (frequently disputed), these cultural assemblages also represent the earliest evidence of people in the Sydney Basin. As well as the lower assemblage, the presence of an assemblage dating to the early- to mid-Holocene (7-5ka) is also of significance. At a continental scale, this period of ameliorating climate is widely documented as a period when Aboriginal populations were flourishing (e.g. Williams et al., 2015), however tangible evidence for this is spare. Here, we have one of only a handful of sites in the Sydney Basin that dates to this period. Also of note is the presence of several glass artefacts within the lower park that demonstrate post-contact interaction between the Aboriginal population and early European settlers. These artefacts appear to date to between AD1794 and the ~1830s, during a period when corroborees have been documented in Thompson Square (Walker, 1890).
Despite evidence indicating parts of the deposit have been disturbed, with an over-lying layer of historical overburden through the park areas, and localised impacts (including a former road in the vicinity of SA10 and SA28 and a sewer main through the centre of the lower park), the cultural deposits does not appear to have been subject to high levels of post-depositional change. The deposit can therefore be considered to have stratigraphic robustness, and provides a rare window into the Pleistocene occupation of the region. The scale and diversity of the cultural assemblage is also extensive and enough to have significance in its own right.

When considering the significance criteria: aesthetic, historical, cultural/spiritual and scientific, the source-bordering dune deposit (including SA 4, SA 8-11, SA 24, SA 25, SA 28, SA 29 and SA 32) is considered to meet regional/State thresholds in several respects (Tables 9 and 10; Figure 18). Scientifically, the site is considered to contain deposits that can provide significant information on how Aboriginal people lived and occupied the region over the last 30+ka, and through into the post-contact period. These include further understanding of some of the earliest populations within Southeast Australia during their initial colonisation and survival through the Last Glacial Maximum (a significant climatic downturn between 24-18ka); and spatial and temporal inter- and intra-site relationships between local populations at Windsor Museum, Pitt Town and other early sites along the Hawkesbury river. While a range of Pleistocene sand dune sites are known in the region, there are few where significant cultural material has been recovered in a controlled fashion, and with good chronological control. As such this site can be considered rare and intact, and is one of the most representative sites of its type, with only six other sand bodies with stratified cultural deposits known in the Sydney Basin, at Warkworth (Hughes et al., 2014; Scarp 2008), Pitt Town (Williams et al. 2012, 2014), Windsor Museum (Austral Archaeology, 2011), Parramatta (Jo McDonald Cultural Heritage Management, 2005; Extent Heritage 2016), Glenrowan (Tarro) (AHMS, 2015), and Hunter Street (Newcastle) (AHMS, 2011).

The deposit can therefore be considered to have high/very high scientific significance at a local and State level due to the presence of a stratified deposit that includes a high number and diversity of artefacts in a subsurface context. From an aesthetic perspective, given the quantity of cultural materials and their great antiquity, along with evidence of post-contact interactions, it is considered that the deposit would elicit a sensori-emotional response from the local community, and therefore can be considered to have meet moderate thresholds for this criterion. The presence of post-contact cultural materials with good temporal resolution and which can be potentially linked to known interactions within the project area, also results in this deposit meeting local thresholds for the historical significance criterion. While no formal written feedback from the Aboriginal stakeholders has been received regarding cultural significance as yet, several on-site discussions identified the site as being of high importance to the Registered Aboriginal Parties (RAPs).

The Ridgeline landscape was found to contain patches of high artefact densities (40+/m²), and can similarly provide information on the past use of the region by Aboriginal populations. However, the shallow soil profile on the ridgeline, often heavily truncated, limits the stratigraphic information that can be obtained from these deposits. For these reasons, this deposit does not meet several of the threshold criteria, and is considered of moderate-low significance (Tables 9 and 10). This significance ranking is primarily associated with the size of the cultural assemblage, and the technological attributes that can be obtained from them, rather than the context, composition or location of the deposit. While no formal written feedback from the Aboriginal stakeholders has been received regarding cultural significance, several on-site discussions identified the site as being of moderate-low importance to the Registered Aboriginal Parties (RAPs).

With respect to the other archaeological landscapes (Ridgeline, River’s Edge – Alluvium, River’s Edge – Reclaimed/Introduced Fill), while cultural materials are found throughout, they are often in very low densities and frequently disturbed and/or have post-depositional mixing. The findings suggest that many of the artefacts are likely re-worked and deposited through alluvial processes from upriver and/or eroded from deposits upslope. The cultural assemblage contains interesting and rare Aboriginal
objects, including two edge-ground axe fragments, however overall it is more indicative of only transient or ephemeral occupation in the last 7,000 years. As such, the deposits are considered to have low scientific, aesthetic and historical significance (Tables 9 and 10).

Table 9. Significance assessment of the archaeological deposits recovered within NA1-8 and SA1-38 inclusive. A summary of this data is presented in Table 10.
**Table 10. Summary of significance of the archaeological landscapes based on data in Table 9.**

<table>
<thead>
<tr>
<th>Archaeological Landscape*</th>
<th>Includes Test Pits</th>
<th>Significance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scientific</td>
</tr>
<tr>
<td>Ridgeline</td>
<td>SA12 – 23 inclusive, SA26, SA27</td>
<td>Very Low</td>
</tr>
<tr>
<td>River’s Edge – Alluvium</td>
<td>NA1-8 inclusive, SA8*, SA34-36 inclusive</td>
<td>Low</td>
</tr>
<tr>
<td>River’s Edge – Reclaimed/Introduced Fill</td>
<td>SA5, SA7, SA37, SA38</td>
<td>Low</td>
</tr>
<tr>
<td>Source-Bordering Dune</td>
<td>SA4, SA6, SA8-11 inclusive, SA25, SA28, SA29, SA32, SA33</td>
<td>High-Very High</td>
</tr>
</tbody>
</table>

* Note that SA8 sits within two archaeological landscapes, and has therefore been listed twice.

* R = Ridgeline; SBD = Source-Bordering Dune; REA = River’s Edge – Alluvium; RERIF = River’s Edge – Reclaimed/Introduced Fill.

^ This value is determined by the Aboriginal stakeholders as part of the consultation process.

† SA 6 was not fully excavated due to tree roots. However, based on its location and proximity to SA 8 and SA 9, it is considered likely to contain similar deposits, and hence its identification as of very high significance here. A glass artefact was also recovered from the material that was sieved for this test pit.
Figure 18: Archaeological significance of the cultural deposits across the project area.
8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Key Findings

- A review of the proposed development design indicates that impacts would occur to all four archaeological landscapes present within the project area.

- Of the four archaeological landscapes, all will be subject to impact, varying from 24 and 38% of the deposits. Of these, the most significant (source-bordering dune) will be subject to some 1,417m$^2$ (or ~22.5% of the identified deposit within the project area) when considering the direct impact of the road (and assuming disturbance to depths >3m), and adding a 4m buffer to address ancillary activities.

- A management strategy and recommendations to address these impacts has been provided, which includes archaeological salvage of 149m$^2$ of the source-bordering dune (equivalent to ~10% of this deposit within the impact corridor) within the lower Thompson Square park. Archaeological salvage is proposed to be undertaken as two open area excavations broadly centred on SA10, and in close proximity to SA 8, SA 9, and SA 29.

8.2 Potential Impacts

Based on data provided, potential impacts from the WBRP would include (Figures 18-21):

1. The installation of the bridge and lead-in roads along the eastern margin of Thompson Square, broadly along the alignment of Old Bridge Street. When including a 4m construction buffer, this would result in an impact corridor of ~30m in width. Construction would require the installation of some 36 pile supports drilled to bedrock overlain by a capping beam. The capping beam would require a broadly rectangle excavation ~1,300m$^2$ to depths of ~4m below current surface, and encompassing much of the lower Thompson Square and Old Bridge Street within the impact corridor.

2. Road access from The Terrace under the bridge to the wharf with a coach turning bay. This would require a broadly T-shaped excavation of ~1-3 metres below current surface encompassing the current wharf area, and associated carparks.

3. The installation of the bridge and lead-in road within in the northern project area. This includes the excavation of the riverbank by ~3m for the bridge abutment, and the overall elevation of the area by ~50-100cm as part of the installation of a roundabout, bike paths, and various roads leading to and from the bridge. A detention basin is also proposed in the southwest corner of the northern project area, and would result in impacts of ~800m$^2$ to depths of ~7m.

4. Re-alignment and installation of a range of utilities and linear infrastructure that needs to run through/beneath the new bridge structure. These include optic fibre, telephone, electrical, gas, water and sewer, and consist of 11 existing services (6 of which are proposed for removal), and 10 additional proposed services. A large number of the proposed utilities are proposed to be situated in Bridge Street (which is proposed for backfill once the bridge construction has been completed), with the remainder situated within the proposed bridge and buffer corridor outlined in (1).

5. Landscaping to raise Bridge Street to the same level as existing parts of Thompson Square would require some level of cutting and filling in this location (Figure 21). Based on the proposed design, the majority of the landscaping works would be within the existing cut that encompasses Bridge Street. However, there is some minor grading/filling on the edges of this cut to ensure a flat surface with the remainder of Thompson Square. Such grading is likely to extend 1-3 metres from the top of the Bridge Street cutting in either direction into upper and lower Thompson Square, and require ~50-80cm of the soil profile removed.
Based on (1) – (5) above, an understanding of the potential impacts to the four archaeological landscapes can be understood. Specifically, the greatest impacts to the cultural resource would result from the construction of the bridge and various road lead-ins on both sides of the Hawkesbury River (Figures 18-21). When including a 4m buffer around the construction, it is considered that 100% impact to the archaeological deposits would occur within these areas, notably a 25-30m corridor to the east of Thompson Square, and the entire northern project area. The coach turning bay (3) is largely encompassed within (1), with only a small portion on either side – these additions would result in moderate to high impacts to a small portion of the river’s edge alluvium and reclaimed land archaeological landscapes. The utilities and linear infrastructure are either within existing impacts (e.g. Bridge Street) or the proposed bridge corridor (1), so will have negligible additional effects to any cultural deposits beyond those outlined above. In relation to the landscaping (5), while it is extending into both the lower and upper Thompson Square (Figure 21), where cultural deposits have been found, the proposed impacts are likely to be less than the historical and/or modern overburden found above such deposits. Typically, the overburden overlying the cultural deposits was 80+cm, and as such the landscape modifications should not affect them. A series of mitigation measures are proposed for the landscaping in subsequent sections to ensure that this is the case.

Based on an overlay of the impact corridor (1) with the most significant archaeological deposit - the source-bordering dune (see Section 6) - some 1,417m² or ~1,245m³ would be affected (Table 9). This includes test pits SA 8-10, SA 24, SA 25, SA 28, SA 29, and SA 32, and equates to about ~22.5% of the overall deposit as it has been modelled across the project area. With the possible exception of the landscaping, no further impacts to the source-bordering dune landscape are considered likely beyond those listed here. In the case of the landscaping, the works are constrained to the overburden above the deposit, but indirect impacts may occur. Recommendations for the management of these impacts are outlined in Section 8.3.

Construction activities (1) – (5) above would also result in impact to the remaining three archaeological landscapes found within the project area (Table 11). Of these, only the ridgeline landscape in the southeast corner of Thompson Square (upper park) recovered significant cultural material, specifically SA 12 (and test pit 057E560N (KNC 2012)), within (1). However, while originally identified as of high significance (KNC 2012), this area has been downgraded to moderate value based on the patchy distribution of the cultural deposit and the lack of stratigraphic information associated with the assemblage. While impacts appear substantial to the River’s Edge – Alluvium, much of this is associated with the northern project area. Cultural materials found in this location were both of low densities, and generally very deep (>1.4m below surface), and as such despite the values presented in Table 11, it is considered impacts would be relatively minor overall. Recommendations for the management of these impacts are outlined in Section 8.3.

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13 The proposed development impacts to the source-bordering dune deposit are based on those deposits considered thicker than 50cm within the interpolated model (Figure 15), which more accurately reflects observations on the ground. This results in impacts that amount to 22.5% by surface areas, or 31% by volume.
<table>
<thead>
<tr>
<th>Archaeological Landscape*</th>
<th>Total Area within Project Area (m²)</th>
<th>Significance</th>
<th>Area of Harm - m² (%)</th>
<th>Degree of Harm</th>
<th>Consequence of Harm</th>
<th>Management Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ridgeline</td>
<td>6,835</td>
<td>TBD</td>
<td>Low-Moderate</td>
<td>1,623 (24)</td>
<td>High</td>
<td>Partial loss of significance</td>
</tr>
<tr>
<td>Source-Bordering Dune</td>
<td>6,272†</td>
<td>TBD</td>
<td>High to Very High</td>
<td>2,367 (38)†</td>
<td>High</td>
<td>Partial loss of significance</td>
</tr>
<tr>
<td>River’s Edge – Alluvium</td>
<td>27,455^</td>
<td>TBD</td>
<td>Low</td>
<td>7,086 (26)^</td>
<td>High</td>
<td>No loss of significance</td>
</tr>
<tr>
<td>River’s Edge – Reclaimed/Introduced Fill</td>
<td>2,227</td>
<td>TBD</td>
<td>Low - Very Low</td>
<td>752 (34)</td>
<td>High</td>
<td>No loss of significance</td>
</tr>
</tbody>
</table>

* Areas are based on the amount of the deposit identified within the project area, and do not account for any deposit beyond this curtilage since they are unknown.

† Values include both the northern and southern project area. However, impacts to the northern area are not accurately defined, and may change.

‡ This value is based on the entire sand body as mapped in Figure 15, and not just the deepest parts of the deposit that are used elsewhere in the report to determine archaeological mitigation measures. Note this value is based on the interpolation of stratigraphic units 3 and 4, and excludes the under-lying stratigraphic unit 8. The latter is more extensive, but was found to be culturally sterile.
Figure 19. The potential impacts within the project area, including the main bridge construction and road lead-ins, as well as associated utilities. As discussed in text, the road construction, notably the excavation for the capping beam and piles, would result in significant impacts to the source-bordering dune landscape encompassed with SA6, SA8-11 inclusive, SA28 and SA29. Conversely, existing and proposed utilities are primarily within the main bridge construction, or existing Bridge Street, and unlikely lead to additional impacts to cultural deposits.
Figure 20. The potential impacts in the northern project area. This portion of the project area was dominated by the river's edge alluvium archaeological landscape, which contained a low density of Aboriginal objects dating to the last 6.5ka.
Figure 21. The proposed landscaping in the southern project area showing the difference between current and post-construction ground levels. While impacts occur across the upper and lower Thompson Square, these are generally less than 50cm, and therefore likely to only effect fill and overburden material above the cultural deposits.
8.3 **Management Strategy**

The development of heritage management strategies and recommendations in the context of a proposed development are based on the significance, or heritage values of the site concerned, the relevant legislative protection, and the feasibility of the overall development.

In general, avoidance of impact must be recommended as the first or best option for the management of the heritage values for the project area. However, the following management strategy has been prepared based on discussions with RMS that it is not feasible to redesign the proposed development in order to completely avoid impact to Aboriginal heritage. In situations where conservation *in situ* is not feasible, alternative mitigation measures, commonly conservation *ex situ*, is recommended.

The archaeological excavations identified ten geomorphological (or stratigraphic) units across the project area, which can be divided into four archaeological landscapes. The most significant of these landscapes was a source-bordering dune (stratigraphic units 3 and 4 in Figures 6-8), which extends across the Thompson Square park areas on either side of Bridge Street, as well as into the surrounding streets (including The Terrace and Old Bridge Street); a small portion of the deposit is also found on George Street to the east of the roundabout. The significance of this deposit is associated with the high densities of Aboriginal objects recovered from it (75% of the entire assemblage found through the works), and its great antiquity, with OSL ages indicating much of the assemblage is between 27-17ka in age. When combining this cultural assemblage with the nearby Windsor Museum finds, and works at Pitt Town, it represents some of the earliest evidence of Aboriginal populations in the Sydney Basin, and southeast Australia as a whole. There is also some evidence that occupation and visitation remained continuous since that time, with artefacts diagnostic of the early- to mid-Holocene (7-5ka), and glass artefacts representing the post-contact period.

Based on a review of the proposed impact for the bridge replacement, some 38% of this cultural deposit will be affected (Figures 18-21). Given this level of impact to a deposit considered of high or very high (regional/State) significance, it is recommended that archaeological mitigations are implemented. Specifically, that cultural deposits within the impact corridor, and especially in the vicinity of test pits demonstrated to contain substantial stratigraphically robust artefact densities (e.g. SA 8-10, SA 28 and SA 29), are subject to carefully archaeological salvage excavation prior to development.

In addition, the source-bordering dune deposit provides a number of important findings about past Aboriginal visitation and occupation of the project area, including their survival through the Last Glacial Maximum – an incredibly arid and cold climatic event during which much of Australia was abandoned – the use of the areas in the early- to mid-Holocene (7-5ka) as climate ameliorates and populations become more sedentary, and evidence for the interaction of Aboriginal people and Europeans in the early 19th Century. These findings and others throughout this report should be included in the Interpretation Plan to ensure they are appropriately expressed at the completion of the project.

The remaining archaeological landscapes frequently exhibit heavily disturbed and/or heavily truncated soil profiles. With few exceptions, Aboriginal objects within these areas was low, and where present rarely had stratigraphic integrity. Based on these findings, it is not proposed that any further investigation or recovery of these deposits is considered necessary prior to development.

8.3.1 **Salvage Excavation Rationale**

Following the assessment and its findings, it is considered that additional archaeological mitigations are warranted within the source-bordering dune archaeological landscape that may be impacted by the proposed development (Figures 18-21). The proposed development would impact a substantial proportion of this deposit, a cultural deposit of high and very high significance. This deposit is of
prodigious archaeological and cultural importance, since it contains evidence of some of the earliest visitation and occupation of Aboriginal populations to the Sydney Basin (and southeast Australia); demonstrates continuous occupation through the Last Glacial Maximum, and was likely a refuge for people during a time when Aboriginal populations crashed (Williams, 2013); and provides tangible evidence for interactions between Aboriginal people and early European settlers in the early 19th Century.

Given the importance and significance of this deposit, the mechanical excavation of some 15.8m² of the deposit (0.16%) to date is inadequate to provide a meaningful or statistically robust dataset to characterise the deposit, or for its long term curation (i.e. conservation ex situ). This small sample size must also be compared against the Windsor Museum site, the only other investigation in this deposit, which unfortunately did not undertake a detailed investigation, analysis or curation of that part of the cultural deposit (due to it being the first excavation in the sand deposit, and was not well-understood at the time of investigation). In addition, the cumulative impact of this activity to the wider deposit is unknown, since its extent is poorly studied to date. Following the same elevations along the southern bank of the river suggests that other portions of the deposit may be present, such as in undeveloped parkland and back gardens along The Terrace; this is, however, a prediction based on our understanding of the geomorphology of the place, rather than observations based on wider sampling and testing. Given the generally developed nature of Windsor, the cultural deposits within Thompson Square are likely to represent some of the best preserved portions of the cultural assemblage in this general region. Within Thompson Square, the impact corridor includes some of the more intact and deeper portions of the source-bordering dune deposits, as well as the two test pits (SA 8 and SA10) that contained post-contact cultural materials.

It is considered that the level of test excavation has been adequate to characterise and assess the development footprint in relation to cultural materials, but is insufficient to appropriately document the findings of source-bordering dune archaeological landscape if it were to be partially impacted or destroyed. (This is especially the case in these archaeological excavations, since the depth of the deposits made many of the test pits unsafe to enter for detailed sampling and recording, as the timing of the testing program did not allow of the installation of shoring within test pits). Given the nature of the development, it is unlikely that burial in situ, or conservation of these deposits is feasible, and as such archaeological salvage – conservation ex situ – is the only viable alternative. Such works would also provide an improved characterisation of the parts of the site remaining unaffected by the development.

Due to the relatively coarse nature of the test excavations (the main aim of which was to identify the presence or absence of Aboriginal objects, as well as their broad spatial patterning and extent), salvage excavations are proposed so as to undertake a more detailed recovery and recording of cultural deposits within the impact corridor; obtain a much larger sample of the archaeological assemblage for analysis and long-term curation for future generations; and to undertake additional environmental and chronological analysis to further understand the site’s formation and use in the past. The information gathered from a program of mitigation salvage would contribute to the sparse body of knowledge on past Aboriginal people’s activities and occupation of the area, contributing to the archaeological literature and providing an important source of information for the Aboriginal community to draw on. It would further resolve the research questions posed in Section 4.1.1, many of which have only been partially answered through the test excavations (Section 6.2). It would also result in greater interpretive and education outcomes for the local and regional community, and further empowerment of the local Aboriginal community. There is also a range of cultural reasons for undertaking the salvage, to ensure the Aboriginal communities have an awareness of, and association with, the deposits before their destruction.

8.3.2 RESEARCH AIMS
The aims of the salvage excavation proposed include:

- To answer and/or resolve the research questions outlined in Section 4.1.1, notably in relation to the formative and stratigraphic nature of the deposits, and what they can tell us about Aboriginal populations during the initial colonisation and use of the Sydney Basin, and the post-contact interactions in the early 19th Century.

- Using fine resolution excavation and environmental analyses to further characterise the archaeological deposits relating to the past Aboriginal occupation of the source-bordering dune archaeological landscape. This includes a greater understanding of resource exploitation; technological attributes (e.g. heat treatment); identification of any change through time in spatial and chronological phases of activity; and site formation processes.

- To obtain the largest possible assemblage of Aboriginal objects, for detailed documentation and long term curation, within the spatial limits of the impact corridor and the financial/time constraints of the project.

- To allow greater cultural association between the site and the Aboriginal stakeholders (i.e. a form of ‘cultural salvage’) through involvement in the excavation, and options for the interpretation of the results, should the community decide that this is appropriate.

- To ensure that the development can proceed with a minimised risk of unknown or unexpected significant Aboriginal objects/features being harmed during construction.

- To compile the existing knowledge of past Aboriginal activities along this portion of the Hawkesbury River corridor, which is proving of high importance to our understanding of Aboriginal history.

- To inform future interpretation proposed for the project area.

- To maximise the amount of information that can be obtained from this portion of the deposit to assist and improve our conservation of the remaining portions of the deposit.

8.3.3 ARCHAEOLOGICAL SALVAGE PROGRAM

The Proposed Archaeological Salvage

Overall, we propose to undertake 149m² of open area excavation of the source-bordering deposit within the impact corridor (Figure 22). This number represents ~10% of the potential impact, and provides an equitable balance between the volume of archaeological material that may be recovered, compared with the costs and time to undertake such works. From an archaeological perspective, assuming average artefact densities of ~50/m² are present across the deposit (as appears to be the case), this would result in the recovery of ~7,500 artefacts. This value would form a substantial collection for analysis and long term curation, and be broadly comparable with the assemblages at both Windsor Museum (~12,000) and Pitt Town (~10,000). Cumulatively, these three sites assemblages have the potential to represent one of the most substantial and significant artefact collections in the Sydney Basin, and across much of Australia for the LGM period.

In accordance with the approaches outlined in the ARD (Appendix 1), we propose open area excavations, since these are usually the most successful for achieving the research objectives above, most notably retrieving a large assemblage and gaining greater understanding of the use and
occupation of the site; and is the simplest and most cost-effective approach to large-scale excavations (rather than multiple smaller excavations across a large area). Given excavations are likely to exceed 2m below surface, the HSE requirements for larger excavations would also be more straightforward than multiple smaller areas.

The mitigation works are proposed to focus around four test pits within the impact corridor, and which have shown high artefact densities and/or other features of archaeological significance. These include SA 8, SA 9, SA 10 and SA 29. The excavations have also had to consider several logistical and HSE conditions in the vicinity of these test pits, specifically:

- The presence of a large, deep sewer main running broadly east-west through the lower park (between SA 8 and SA 9) restricts the size of any excavation to avoid it. This is especially the case in the northern (lower) part of the park, where the deposit begins to taper off. Avoidance of the pipe is preferable since it has likely compromised the integrity of any archaeological deposit present.
- The sand body deposit tapers off to the north (lower part) of the park in the vicinity of SA8. This restricts any excavations too far north of SA 8, without the potential to miss the deposit. When combining this issue with the sewer main to the south, it provides a finite north-south distance within which a salvage area could be situated.
- There are several large trees in the vicinity of SA 29. These have likely affected the integrity of any under-lying cultural deposit, and cannot be easily removed at this stage of the project. The salvage areas are therefore proposed to maintain as much distance as possible from these features.
- The upper soil profile of the site is likely to contain asbestos due to the presence of a 20th Century structure in this area, and based on previous findings. These deposits would need to be managed carefully and removed from site. It would be unfeasible and unsafe to have personnel undertake detailed investigation of these upper deposits (which have previously shown to contain minimal cultural deposits).
- Due to the substantial depths needing to be reached as part of the excavations (~2-2.5m below surface), a suitable distance needs to be included around the edge of the salvage areas to allow benching or shoring to be installed. Typically, this is about a metre beyond the excavation area, and accounts for why the salvage areas would not abut the very edge of the impact corridor (Figure 22).

Based on the findings of the archaeological program, and the practical constraints outlined above, we propose to undertake two large open area excavations in the vicinity of the four test pits (Figure 22). The southern salvage area would be 10 x 10m in size (equating to 100m²), while the northern salvage would be 7 x 7m in size (equating to 49m²). The southern salvage has been situated to be as close to SA 9 and SA 10 as feasible within the constraints, while the northern one is in close proximity to SA 8 and SA 29. The location and orientation of the salvage areas are indicative at this stage, and may require slight revision when established on the ground, and existing infrastructure, trees, fall of slope, etc, are all better mapped. It is considered that this approach is similar in extent and approach to other sites in the Cumberland Plain (that usually undertake open area excavations in 100m² (10 x 10m) increments (e.g. ENSR AECOM, 2008; Jo McDonald Cultural Heritage Management, 2005; Staib, 2002, Williams et al., 2014), while spaced widely enough to provide an opportunity to explore intra-site activities across the archaeological landscape (within the confines of the impact corridor). In over 15

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14 It should be noted that the two open area salvage locations would be divided by ~2m wide baulk of sediment encompassing an existing sewer main. In the event that the baulk becomes unstable or unsafe to remain, it may also be removed as part of the salvage works. In this situation, any deposits identified as having archaeological integrity would be managed in accordance with the methods proposed here. Conversely, any areas considered to reflect pipe trench backfill, or have low archaeological integrity would simply be bulk excavated and removed from site.
years of consulting archaeology, we find this approach (outlined below) provides sound archaeological outcomes efficiently.

Salvage Excavation Methodology

The proposed methodology is consistent with the archaeological excavations at nearby Pitt Town (Williams et al., 2014), and broadly similar to those at the Windsor Museum site (Austral Archaeology, 2011); and in accordance with those indicated in the ARD (Appendix 1). The use of the results in the post-excavation analysis and reporting showed that the methodology provided meaningful information, which could allow for long term curation with the Australian Museum; data acceptable for international publication; and able to assist in wider education and interpretive outcomes.

A surveyor would be engaged to plan the locations of the salvage excavation areas, and establish a site datum, in order to record the level of deposits and features. All excavations would be started at the current land surface. While there is generally 50-100cm of overburden above the main cultural deposit, modified glass artefacts have been found throughout the soil profile. Therefore, the overburden must also be investigated to recover any further post-contact cultural material that may be present. These works would be undertaken concurrently, and with participation of historical archaeologists to ensure any historical deposits are appropriately recovered and recorded. Excavation would be undertaken to the base of stratigraphic units 3 and 4 (Figures 6-8) where present. Based on the test excavations, this would likely result in excavations of 2-2.5m below current surface level. Given these depths, for HSE purposes, the following excavation procedure is proposed:

1. The salvage area locations plus a 1m buffer would be excavated to the base of the historical deposits (~1m below surface) by the historical archaeological team as part of their mitigation program. Where early 19th Century deposits are encountered, these would be investigated by a combined Aboriginal and historical team, and include sieving of the sediment for post-contact cultural materials. This process would provide a suitable and safe working platform at ~1m below the current surface - larger than the salvage area, and resulting in a final benched excavation at completion of the works.

2. The excavations of the salvage excavation would be undertaken by the Aboriginal archaeological team to the base of the stratigraphic units 3 and 4. These works would begin at the base of the excavations reached in (1), and be constrained to the salvage area (likely 1m less than the works in (1)). This overall depth of the salvage excavations would, therefore, be ~2-2.5, below current ground surface (based on the test excavation program), but would be ~1-1.5m below the working platform developed by (1).

Following the historical archaeological mitigation program (1 above), all excavation would be undertaken manually, using shovels, mattocks and trowels, etc, by a team of archaeologists and Aboriginal stakeholders. Excavations would be undertaken in contiguous 0.25m² (50x50cm) test pits and in 5 cm spits up to the total area permitted. Each test pit would be dug discretely with AHD heights being obtained every four spits to ensure vertical integrity. Each test pit would be given an alphanumeric label for identification purposes. A standard site recording form would be used for each spit of each excavation unit (50x50 cm). Details would include site name, date, site recorder, spit number and depth, square ID, description of finds, description of soil, sketch plan of excavation (if relevant to show feature) and a bucket tally.

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15 At least one archaeologist experienced and skilled in the recognition of historic material will be nominated and included in the Aboriginal archaeological team to ensure that historic relics, features and deposits uncovered are appropriately identified and recorded.
Some of the targeted test pit locations contained historical relics and features (notably SA 29), and which are proposed for historical archaeological salvage. It is considered that these would generally be 0-1m in depth, and form part of the historical archaeological mitigation program (1 above). Where these deposits extend into the Aboriginal archaeological program and/or where early 19th Century deposits with potential to contain cultural materials are encountered, the Aboriginal archaeological team would work with the historical team to excavate these areas using their preferred approach (which may differ from above). We would ensure that all sediment (whether recovered by spit or context) is sieved in accordance with the approach for the rest of the Aboriginal salvage excavations. Once natural soil profiles beneath the historical deposits or overburden is identified, the methodology proposed here would be implemented.

Sediment from each 5cm spit would be collected separately, weighed, and sieved through a 3mm mesh. Any Aboriginal objects recovered from the sediments would be retained in a plastic bag with the relevant pit alpha-numeric code written upon it. Within the overburden layers, historical materials would also be recovered to provide a chronology of any post-contact cultural material that may be present.

If discrete high-density artefact concentrations or cultural features, such as hearths, are revealed during the excavation, these will be excavated and recorded (by photography and planning). The locations of in situ artefacts in such features may also be individually recorded.

During, or immediately following, completion of the excavation, a range of soil and chronological samples would be taken. Soil and environmental samples would be taken at regular intervals through the soil profile (probably in the order of 2-5cm) and retained in labelled plastic bags for subsequent analysis. A number of latex peels and/or other core sample of the sedimentary record would also be taken for future curation with the cultural deposits. Radiocarbon and/or OSL samples would be taken in areas where Aboriginal objects are found, and generally try to bracket the deposit (to provide a maximum and minimum age). Material for radiocarbon analysis may also be undertaken opportunistically if archaeological features containing charcoal or other dateable material are evident.

All test pits, and the final open area, would be documented using photographic records, written descriptions and scaled drawings.

Excavation procedures and protocols may be modified at the discretion of the Excavation Director in consultation with the Aboriginal stakeholders and client as the conditions in the field and nature of the excavations develop.

**Post-Excavation Salvage Area Management**

At the completion of the salvage works outlined above, an interim management plan would be developed with the RAPs to ensure the short and long term protection of the completed salvage areas. This would include the protection of the completed salvage area, and importantly the exposed vertical sections of other parts of the deposit around the edges of the excavation that have the potential for collapse or slumping prior to the construction works. Some portions of these deposits, notably along the western edge of the salvage areas, would not be subject to direct impacts from the bridge construction or subsequent works.

While finer details of the management of the completed salvage areas would be developed in the management plan, it is proposed that they would be back-filled at the earliest opportunity following the excavations. The back-filling would be undertaken to at least the height of the archaeological deposits, and undertaken with either sediment extracted from the excavations and/or imported clean fill material. Such back-filling would reduce the potential for vertical section collapse and/or slumping to occur following the archaeological salvage program.
Management of Landscaping

As outlined in Section 8.2, a range of landscaping is proposed for Thompson Square, notably cut and fill along the fringes of Bridge Street (proposed for in-filling), and the lower park. The majority of cutting in these areas would result in the loss of ~50-100cm of the current land-surface. Given the depth of historical and/or modern deposits in these areas regularly exceed these depths (e.g. SA 8 and SA10 each had ~1.5m of overburden, while SA11 had ~60cm), it is considered unlikely that cultural deposits would be affected by these proposed works. However, while removal of cultural deposits is considered unlikely, in many locations the final depth of the proposed landscaping will be very close to the top of some of these stratigraphic units. This is of most concern within the upper and lower Thompson Square park areas, where the source-bordering dune landscape is known to be present.

Given there is likely to be some latitude in the landscaping, where minor changes of a few centimetres would be unlikely to affect the final designs, an archaeologist would monitor the works and ensure any excavations are stopped where cultural deposits are observed. Specifically, the archaeologist would observe the removal of the soil profile until the final design level is reached. Where the under-lying cultural deposits (stratigraphic units 3-5 inclusive) are observed before these depths are reached, the archaeologist would stop the landscaping works. These deposits would then be covered with geofabric material, and re-buried with at least 10cm of sediment to minimise any future impacts from users of the park. In the event that the deposits are observed at significantly shallower depths than the final design requires, the design would either need to be modified, or suitable mitigation measures would need to be developed by RMS in consultation with the DPE, OEH and Aboriginal stakeholders for these deposits. In this situation, mitigation measures would likely require controlled archaeological excavation of the deposits proposed for impact.

The particular stratigraphic unit, location and depth of deposit would all be documented by the archaeologist and incorporated into the project’s documentation to assist in future management of the site.

Monitoring of areas proposed for fill as part of the landscaping would not require monitoring, since these would be unlikely to affect the under-lying cultural deposits, which as outlined above are typically already beneath ~1m of overburden. Where areas proposed for fill, first require cutting, would require monitoring as outlined above.

These monitoring works would occur during the construction phase of the project, and be overseen by the Heritage Representative.
Figure 22. The proposed archaeological salvage program focussing on SA8-11 and SA 29 in the lower Thompson Square park. Note the salvage areas should be considered indicative, and are established to encompass (but not necessarily centred upon) SA 8-11 and SA 29 based on local conditions and to be within the impact corridor. Please note that these locations are indicative.
8.3.4 POST EXCAVATION ANALYSIS AND REPORTING

The post-excavation analysis would be designed to address the research objectives and specific research questions (Section 4.1.1 and 8.3.2), along with other relevant questions that may arise based on the results of the excavation. Results of analysis would be presented in relation to comparative site data where possible and where useful in addressing the research questions.

Post-excavation analysis would be similar to those outlined in detail in the ARD (Appendix 1: Section 5.6), and include detailed stone artefact analysis (including usewear and residue analysis), shell/faunal, geomorphological, palaeoenvironmental, and chronological analysis. As a guide, these should include (but not be limited to):

- **Lithic Analysis:** cataloguing of all cultural material recovered, including measurements, weight, raw material, reduction and tool identification. A program of conjoin analysis, and investigation of usewear/residue analysis is also considered crucial to resolve some of the post-depositional questions associated with the site.

- **Shell/Midden Analysis:** cataloguing of all cultural material recovered, including measurements, weight, species type, MNI.

- **Geomorphology:** collection of soil samples excavation to assist in understanding the site formation and post-depositional disturbance. Samples should include bulk 5cm soil samples (i.e. 0-5cm, 5-10cm, 10-15cm, etc) and high resolution soil/environmental samples at 2cm resolution (i.e. 2-3cm, 4-5cm, 6-7cm, etc) from a master sequence at each of the open area excavations. In addition, soil micromorphology samples should be collected from the main cultural layers, at stratigraphic interfaces, and from any areas of geomorphological and/or archaeological interest to further understand the site formation history.

- **Palaeoenvironmental:** this analysis can utilise the material from the geomorphological samples, and should include the investigation of pollen and phytoliths to understand the past vegetation and climate of the region prior to, and during periods of Aboriginal visitation and occupation.

- **Chronology:** OSL and/or radiocarbon samples should be collected from top and bottom of each stratigraphic unit, and bracketing any cultural materials recovered from each open area excavation to provide a strong chronology for the deposit. Based on the archaeological test excavation, this is likely to equate to ~5-8 samples per open area excavation (~20-24 in total).

The aim of this work is to both adequately document, analysis and record the cultural deposits and assemblages for future generations, and to build upon the findings of the archaeological test excavation analysis.

The reporting would be developed to fulfil the MCoA conditions in relation to the archaeological salvage, and to provide input into the SCMP and any interpretive outcomes from the project. The report would be developed in accordance with OEH’s guidelines (as current best practice), and include the following broad sections:

- A short summary.
- Describe Aboriginal consultation undertaken during the project.
- Provide details of the Aboriginal objects which were partially or completely harmed (i.e. recovered through the excavations) during the works.
- Provide a description of the methods and results of the any excavations.
• Comment on the effectiveness of the mitigation measures (i.e. salvage excavations).
• Comment on the effectiveness of any management plan if in place.
• The current and proposed location of any Aboriginal objects recovered.
• Details the results of any analysis of recovered Aboriginal objects.
• Ensure the necessary Site Impact Recording Forms are lodged with OEH at completion of the project.

8.3.5 ABORIGINAL OBJECT CURATION

All Aboriginal objects recovered will be securely stored at the archaeologists' office for analysis. Given the significance of the source-bordering dune deposits, we believe it meets the thresholds for lodgement with the Australian Museum, and therefore propose this repository for long term curation. The curation of the assemblage at this repository, and consideration of other options, would be undertaken following the post-exavigation analysis and reporting by RMS in consultation with the Aboriginal stakeholders.

8.4 Recommendations

The recommendations below are made to ensure that the proposed development mitigates impacts on significant Aboriginal cultural heritage and complies with all State legislative requirements. We highlight that the preferred heritage outcome is, as always, to redesign the project to avoid impacts on Aboriginal cultural heritage altogether wherever possible and where this is not possible to minimise impacts.

Based on the findings of this report, the following recommendations are made:

• The findings of this report should be integrated into the Strategic Conservation Management Plan and other pertinent documents required as part of the project.
• The findings of this report should be integrated into the Interpretation Plan to ensure representation of the extensive past Aboriginal visitation and activity within the project area is appropriately expressed following the completion of the project.
• The recommendations of this report should ensure integration with the requirements of the Hawkesbury River Regional Sand Body study to ensure a holistic approach is applied to any future on-site works.
• Consultation with the Registered Aboriginal Parties should continue throughout the project. This will allow stakeholders to continue to have an involvement in the management and interpretation of the Aboriginal cultural heritage issues of the project.
• The planning and execution of the proposed development should address the Aboriginal heritage issues identified in this document, and should avoid and/or minimise Aboriginal heritage impact where possible.
• Subsequent phases of development should address the Aboriginal heritage issues identified in this document, and should avoid and/or minimise Aboriginal heritage impact where possible.
RMS should advise all relevant personnel and contractors involved in the design, construction and operation of the proposed development, of the relevant heritage issues, and recommendations identified in this report. This should be undertaken as part of the broader site inductions usually required prior to any personal or contractors working on the project.

Prior to construction, mitigation measures (archaeological salvage) in accordance with the approaches and methods outlined in Section 8.3 of this report should be implemented. No construction or development activities on-site should proceed until the on-site components of these works have been completed.

The recommended mitigation measures are based on the analysis of the potential impacts as presented in Section 8.2 of this report (see also Figures 18-21). In the event that development or construction activities are required beyond those identified impact corridor (as shown in Figures 18-21), the mitigation measures of this report would need to be re-assessed, and any additional requirements implemented prior to construction/development beginning/resuming.

The most significant impact is likely to be the construction of the bridge along the eastern edge of Thompson Square, and construction buffer (Figure 18). Given the proximity of significant cultural deposits to this corridor, it is recommended that temporary fencing of the extent of the impact corridor should be installed for the duration of the proposed construction as shown in Figure 18 (as practical given the urban nature of the project area) to avoid inadvertent direct or indirect impacts to the archaeological landscape by the works.

During construction, mitigation measures (landscape monitoring) in accordance with the approaches and methods outlined in Section 8.3 of this report should be implemented.

An Aboriginal Site Impact Recording Form must be prepared and submitted to the AHIMS Registrar to outline the findings of the archaeological excavations within the project area.

A copy of this assessment should be provided to the Registered Aboriginal Parties to review and provide comment on the findings and recommendations prior to the implementation of future archaeological stages.

Once finalised, a copy of this report should be submitted to OEH AHIMS report library.
9 REFERENCES


ENSR AECOM (2008) Stage 1 archaeological test excavations -GCC Precincts Oran Park and Turner Road, South West Growth Centre, NSW. *Unpublished Report to NSW Growth Centres Commission.*


Hughes, P., N. Spooner and D. Questiaux (2014). The central lowlands of the Hunter Valley, NSW: Why so few early sites have been found in this archaeologically-rich landscape. *Australian Archaeology* (79):34-44.


### 10 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AAJV</td>
<td>Austral Archaeology/Extent Heritage Joint Venture</td>
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<tr>
<td>AHIMS</td>
<td>Aboriginal Heritage Information Management System</td>
</tr>
<tr>
<td>AHMS</td>
<td>Archaeological and Heritage Management Solutions (now Extent Heritage)</td>
</tr>
<tr>
<td>ARD</td>
<td>Archaeological Research Design</td>
</tr>
<tr>
<td>BP</td>
<td>Before present (AD 1950)</td>
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<tr>
<td>CHL</td>
<td>Commonwealth Heritage List</td>
</tr>
<tr>
<td>CRM</td>
<td>Cultural Resource Management</td>
</tr>
<tr>
<td>DECCW</td>
<td>Department of Environment, Climate Change and Water (now OEH)</td>
</tr>
<tr>
<td>ka</td>
<td>Abbreviation for thousands of years ago (e.g. 1 ka equals 1,000 years ago)</td>
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<tr>
<td>LALC</td>
<td>Local Aboriginal Land Council</td>
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<tr>
<td>LGM</td>
<td>Last Glacial Maximum</td>
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<tr>
<td>MIS</td>
<td>Marine Isotope Stage</td>
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<tr>
<td>NPW Act</td>
<td>National Parks and Wildlife Act 1974</td>
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<tr>
<td>OEH</td>
<td>Office of Environment and Heritage (formerly DECCW)</td>
</tr>
<tr>
<td>OSL</td>
<td>Optically Stimulated Luminescence</td>
</tr>
<tr>
<td>PAD</td>
<td>Potential Archaeological Deposit</td>
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<tr>
<td>RAP</td>
<td>Registered Aboriginal party</td>
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**11 GLOSSARY**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Aboriginal object</td>
<td>A statutory term defined under the <em>National Parks and Wildlife Act 1974</em> as ‘any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains’.</td>
</tr>
<tr>
<td>Environmental Planning and Assessment Act 1979</td>
<td>Statutory instrument that provides planning controls and requirements for environmental assessment in the development approval process. The Act is administered by the Department of Planning and Environment.</td>
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<tr>
<td>Holocene</td>
<td>A geological definition for the time period between ~10,000 years to present day.</td>
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<tr>
<td>Isolated Find</td>
<td>An isolated find is usually considered a single artefact or stone tool, but can relate to any product of past Aboriginal societies. The term “object” is used in the ACHA, to reflect the definitions of Aboriginal stone tools or other products in the <em>National Parks and Wildlife Act 1974</em>.</td>
</tr>
<tr>
<td>Last Glacial Maximum</td>
<td>A global climatic event at the end of the last Glacial period dating to 24-18ka. This event represented the nadir of the glacial period, and was characterised by extreme cooling and aridity across Australia.</td>
</tr>
<tr>
<td>Marine Isotope Stage</td>
<td>A global timescale linked to warming and cooling periods over the last 2 million years, and widely used in palaeoclimatology.</td>
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<tr>
<td>National Parks and Wildlife Act 1974</td>
<td>The primary piece of legislation for the protection of Aboriginal cultural heritage in NSW. Part 6 of this Act outlines the protection afforded to and offences relating to disturbance of Aboriginal objects. The Act is administered by OEH.</td>
</tr>
<tr>
<td>Office of Environment and Heritage (OEH)</td>
<td>The OEH is responsible for managing the Aboriginal Heritage (and other) provisions of the <em>National Parks and Wildlife Act 1974</em>.</td>
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<tr>
<td>Optically Stimulated Luminescence dating</td>
<td>A dating technique that measures the amount of radiation accumulated in sediment (specifically quartz grains) to identify when it was deposited and buried.</td>
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<tr>
<td>Pleistocene</td>
<td>A geological definition for the time period between ~1.8million to 10,000 years ago. From an archaeological perspective in Australia, it is typically referring to ~50,000 – 10,000 years, which encompasses the colonisation and initial occupation of Australia by Aboriginal people.</td>
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<tr>
<td>Potential Archaeological Deposit (PAD)</td>
<td>An area assessed as having the potential to contain Aboriginal objects. PADs are commonly identified on the basis of landform types, surface expressions of Aboriginal objects, surrounding archaeological material, disturbance, and a range of other factors. While not defined in the <em>National Parks and Wildlife Act 1974</em>, PADs are generally considered to retain Aboriginal objects and are therefore protected and managed in accordance with that Act.</td>
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