

EXTENT

HERITAGE ADVISORS
TO AUSTRALIA AND
THE ASIA PACIFIC



Light Horse Interchange Business Hub, Eastern Creek, NSW (SSD 9667)

Aboriginal Cultural Heritage Assessment Report

Prepared for Western Sydney Parklands Trust

February 2020—Draft Report

Sydney
Melbourne
Brisbane
Perth

extent.com.au

EXTENT HERITAGE PTY LTD

ABN 24 608 666 306

ACN 608 666 306

info@extent.com.au

extent.com.au**SYDNEY**

Level 3/73 Union St

Pyrmont NSW 2009

P 02 9555 4000

F 02 9555 7005

MELBOURNE

13/240 Sydney Rd

Coburg Vic 3058

P 08 9388 0622

BRISBANE

Level 12, 344 Queen St

Brisbane Qld 4000

P 07 3051 0171

PERTH

1/191 St Georges Tce

Perth WA 6000

P 08 9381 5206

Document information

Extent Heritage project no.:	SYD18198
Client:	Western Sydney Parklands Trust
Project:	Light Horse Business Hub, Eastern Creek (SSD 9667): Aboriginal Cultural Heritage Assessment Report
Site location:	Light Horse Business Hub, Eastern Creek (SSD 9667)
Authors:	Georgia Burnett, Megan Sheppard Brennand, Laressa Barry, Cameron Neal

Document control

Version	Internal reviewer	Date	Review type
01 (Pre-ex draft)	Alan Williams	18 Jan. 2019	QA
02 (Pre-ex final)	Authors	27 Mar. 2019	Minor edits
03 (Post-ex draft)	Peter Douglas	19 Aug. 2019	QA
04 (Post-ex draft)	Andrew Holmes	18 Nov. 2019	QA

Copyright and moral rights

Historical sources and reference materials used in the preparation of this report are acknowledged and referenced in figure captions or in text citations. Reasonable effort has been made to identify, contact, acknowledge and obtain permission to use material from the relevant copyright owners.

Unless otherwise specified in the contract terms for this project Extent Heritage Pty Ltd

- vests copyright of all material produced by Extent Heritage Pty Ltd (but excluding pre-existing material and material in which copyright is held by a third party) in the client for this project (and the client's successors in title);
- retains the use of all material produced by Extent Heritage Pty Ltd for this project, for its ongoing business, and for professional presentations, academic papers or publications.

Executive summary

Extent Heritage Pty Ltd (Extent Heritage) has been commissioned by Parramatta Park and Western Sydney Parklands Trusts (WSPT, 'the proponent'), to undertake an Aboriginal Cultural Heritage Assessment Report (ACHAR) of the Light Horse Business Hub (hereafter the 'study area') in advance of proposed development. The project is being assessed as a State Significant Development (SSD 9667), in accordance with Part 4 Division 4.7 of the Environmental Planning and Assessment Act 1979. This report presents the findings of archaeological test excavation in the study area, undertaken to inform the project EIS.

Specifically, the excavations demonstrated the presence of two source-bordering alluvial terraces along Eskdale and Eastern Creek, within which discrete ~100m² patches formed key locales of Aboriginal visitation and occupation over the last 4,000 years. The nature of the cultural assemblage suggests intense but short-lived occupation, with a focus on the exploitation of locally available stone resources for artefact and tool production. Certain raw lithic material improvement strategies, in the form of heat treatment, were also employed on site and both sites are considered of high archaeological significance.

In contrast, the remainder of the study area is dominated by a low-density distribution of cultural material (<10 artefacts) in the form of small artefact scatter sites and isolated artefacts (several of which have been previously registered on the AHIMS database), and ultimately reflects an ephemeral or transient use of the wider area in the past. Such sites have limited research potential (typically restricted to only the technological attributes of the artefact assemblage), limited stratigraphic integrity, and are representative of other sites in the south western Cumberland Plain; and as such are considered of low archaeological significance.

Several on-site discussions identified the discrete patches of high-density cultural material as being of importance to the Registered Aboriginal Parties. Kamilaroi Yankuntjatjara Working Group provided an email outlining their support of the recommendations made in this ACHAR. They noted the area as highly significant to Aboriginal people as it is a desirable camping spot with plenty of resources. Kamilaroi Yankuntjatjara Working Group indicated that the names of the creeks would have had traditional names that are now lost; and, recommended the artefacts recovered be stored at the Deerubbin LALC.

A review of the proposed development design indicates that considerable impacts would occur to the Eskdale Creek alluvial terrace landform and the low-density background scatter present within the site. This would include impacts to 100% of the Eskdale Creek terrace landform (equivalent to 12,851m²) and more generally, impacts to a large portion (388,801m² or 71%) of the low density background scatter present across much of the rest of the study area. A management strategy and recommendations to address these impacts has been provided, which includes archaeological salvage of up to 100m² of the Eskdale Creek alluvial terrace deposit, in the vicinity of TP151.

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

- An Aboriginal cultural heritage management plan (ACHMP) must be developed, in consultation with the RAPs and consent authority, to provide the post-approval framework for managing Aboriginal heritage within the study area. The development of this

management plan has been recommended by DPIE. The ACHMP should make specific reference to:

- Processes, timing, and methods for maintaining Aboriginal community consultation through the remainder of the project.
 - Descriptions and procedures for development impact mitigation, including archaeological salvage, to be undertaken in advance of proposed development.
 - Description and methods of post-excavation analysis of chronological, soil, and environmental samples that will be recovered as part of the archaeological mitigation of development impacts.
 - Procedures for the long-term curation of Aboriginal cultural materials recovered as part of the project.
 - Processes for reviewing, monitoring, and updating the ACHMP as the project progresses.
- Prior to construction, mitigation measures (archaeological salvage) should be implemented in accordance with the approaches and methods outlined in Section 10.1 of this report. No construction or development activities should proceed until the on-site components of these works have been completed.
 - The Eastern Creek landform terrace will be conserved, with no development works impacting this area. Archaeological salvage will be undertaken in the Eskdale Creek landform terrace due to the impact the development will have on this deposit.
 - Consultation with the Registered Aboriginal Parties should continue throughout the project. This will allow stakeholders to continue their involvement in management and interpretation of Aboriginal cultural heritage values of the project.
 - The recommended mitigation measures are based on the analysis of the potential impacts as presented in Section 10.1 of this report. If development or construction activities are required beyond the identified impact footprint, the mitigation measures of this report would need to be reassessed, and any additional requirements implemented prior to construction/development beginning/resuming.
 - Aboriginal Site Impact Recording Forms must be prepared and submitted to the AHIMS Registrar to outline the findings of the archaeological excavations within the study 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.

Contents

1.	Introduction.....	1
1.1	Project description	1
1.2	Legislative context	2
1.3	Study area	4
2.	Aboriginal consultation.....	9
2.1	The process	9
2.2	This project	10
2.3	Aboriginal stakeholder feedback	11
3.	Existing environment	12
3.1	Key findings	12
3.2	Geology, geomorphology and soils	12
3.3	Hydrology.....	14
3.4	Past vegetation	15
3.5	Existing soil profile disturbance	16
4.	Ethnographic record	27
4.1	Key findings	27
4.2	Regional information	27
4.3	The study area.....	30
4.4	Information provided by RAPs.....	30
5.	Archaeological record	32
5.1	Key findings	32
5.2	Regional background	32
5.3	Local information.....	36
5.4	AHIMS data	39
5.5	Predictive model	41
6.	Field investigation	49
6.1	Key findings	49
6.2	Archaeological survey	49
6.3	Archaeological test excavation.....	63
7.	The archaeological and cultural resource	86
8.	Significance assessment	90
8.1	Statement of significance	90
9.	Impact assessment.....	92

9.1	Proposed development	92
9.2	Potential Aboriginal heritage impact	93
10.	Conclusions and recommendations	97
10.1	Management strategy	97
10.2	Recommendations	102
11.	References	104
	Abbreviations	111
	Glossary	112
	Appendix 1: Legislation	114
	A1.1. Commonwealth Legislation.....	115
	A1.2. NSW State Legislation.....	116
	Appendix 2: Aboriginal consultation.....	118
	Appendix 2-1. Aboriginal consultation log	119
	Appendix 2-2. List of identified Aboriginal stakeholders	121
	Appendix 2-3. List of registered Aboriginal parties for the project.....	122
	Appendix 2-4. Pre-notification documentation sent and received	123
	Appendix 2-5. Notification documentation sent and registrations received	124
	Appendix 2-6. notification documentation—newspaper advert.....	125
	Appendix 2-7. Presentation of information/assessment methodology sent and any feedback received.....	126
	Appendix 2-8. Report review—feedback received.....	127
	Appendix 3: Archaeological background.....	129
	A3-1. Site type information.....	130
	A3-2. AHIMS sites	132
	Appendix 4: Field investigation.....	133
	Appendix 4-1. Sedimentological analysis	134
	Appendix 4-2. OSL report	135
	Appendix 4-3. Lithic analysis report	136
	Appendix 4-4. Section drawings.....	137
	Appendix 4-5. Photographic catalogue	138
	Appendix 5: How significance was assessed.....	140

List of tables

Table 1. Summary of legislative context for the project.....	3
Table 2. Summary of Aboriginal consultation for the project.	10
Table 3. Definitions of levels of historical disturbance within the study area (refer to Figure 14 below).	18
Table 4. Aboriginal sites in the vicinity of the study area summarised by site feature.	40
Table 5. Previously recorded sites within and in close proximity to the study area.	43
Table 6. Archaeological survey unit descriptions for the study area.....	50
Table 7. Aboriginal archaeological sites identified within the study area. Note all coordinates are now given in GDA 1994/MGA Zone 56. Site locations are shown in Figure 23.	58
Table 8. Comparative data for other assemblages in the Cumberland Plain.....	70
Table 9. Summary of OSL ages.	72
Table 10. The Aboriginal archaeological and cultural resource of the study area.	88
Table 11. Summary table of significance of the cultural resource of the study area.	91
Table 12. Potential archaeological impacts from the proposed development.	95

List of figures

Figure 1. Location of the study area within its surrounding urban context.....	6
Figure 2. The Concept Masterplan for the proposed development. Source: WSPT (April 2019).....	7
Figure 3. The proposed development. Source: WSPT (April 2019).	8
Figure 4. The geological landscape underlying the study area.	19
Figure 5. Soil landscape mapping for the region (Bannerman and Hazelton, Soil Conservation Service of NSW, 1990). Note the mapping is based on aerial photographs and limited ground-truthing, and may not be accurate.	20
Figure 6. The hydrological landscape of the study area. Note that land within 200 m of water is considered to be archaeologically sensitive, according to DPIE.	21
Figure 7. The study area showing remnant vegetation communities.	22
Figure 8. Partial aerial photograph of the study area in 1943.....	23
Figure 9. The study area in 1965.....	23
Figure 10. The study area in 1970.....	24
Figure 11. The study area in 1986.....	24
Figure 12. The study area in 1994.....	25
Figure 13. The study area in 2009.....	25
Figure 14. Areas of historical soil profile disturbance within the study area.	26

Figure 15. Ethnographic encounters and known European expedition routes referred to in text.	31
Figure 16. Area of Potential Archaeological Deposit (PAD), identified by Navin Officer (1999) and submitted with the site card for #45-5-2564 (IF1) and #45-5-2565 (IF2) (hatched).	41
Figure 17. Previous studies undertaken in the vicinity of the study area.	45
Figure 18. The study area showing registered AHIMS sites within 1km ² radius, and displaying the range of site types in the nearby area.	46
Figure 19. The study area showing AHIMS sites within and near the study area, and the PAD identified by Navin Officer (1999).	47
Figure 20. Predictive model of Aboriginal archaeological potential for the study area, from the desktop review to inform the on-site investigation—based on historical disturbance, regional site distribution models and registered sites in the region.	48
Figure 21. Survey units examined during archaeological survey.	54
Figure 22. Previously registered and newly identified sites within the study area.	60
Figure 23. Stratigraphic units within Eskdale Creek terrace landform and their chronological age, from TP151.	66
Figure 24. Stratigraphic units within Eastern Creek terrace landform and their chronological age, from TP57.	67
Figure 25. Trace element analysis of a soil column from TP57. This includes a chronological, photographic and radiographic record of the core, along with trace elements shown to respond to human activity and/or have a correlation or inverse correlation with the cultural assemblage.	75
Figure 26. Trace element analysis of a soil column from TP151.	76
Figure 27. Excavated and unexcavated test pits within the study area. Note TP137, as well as TP151 and TP57 (inset map) were excavated as 1m ² ; the remaining pits were 0.25m ²	80
Figure 28. Summary of the cultural assemblage (number of artefacts) recovered from the test excavation program, as well as locations of previously registered AHIMS sites. Note TP137, 151 and 57 were excavated as 1m ² test pits.	81
Figure 29. Summary of Aboriginal archaeological material recovered during excavation. Note, two elevated terrace landforms ‘Eskdale Creek terrace’ and ‘Eastern Creek terrace’ were identified (respectively, blue and purple shading), within which discrete ~100m ² patches of high-density material (inset, around TP151 and TP57) were recovered, and formed foci of Aboriginal occupation.	82
Figure 30. Identified Aboriginal sites and areas of archaeological potential overlain with the proposed concept masterplan.	96

1. Introduction

1.1 Project description

Extent Heritage Pty Ltd (Extent Heritage) has been commissioned by Parramatta Park and Western Sydney Parklands Trusts (WSPT, 'the proponent'), to undertake an Aboriginal Cultural Heritage Assessment Report (ACHAR) of the Light Horse Business Hub (hereafter the 'study area') in advance of its proposed development.

The proposed development is being assessed as a State Significant Development (SSD 9667), in accordance with Part 4 Division 4.7 of the *Environmental Planning and Assessment Act 1979*. The Secretary's Environmental Assessment Requirements dated 7/11/2018 for the project require that an Environmental Impact Statement (EIS) be prepared for the proposal, which includes the following requirements for Aboriginal heritage assessment:

an Aboriginal Cultural Heritage Assessment Report prepared in consultation with Aboriginal people and in accordance with Office of Environment and Heritage guidelines.

The Office of Environment and Heritage (OEH) (now the Department of Planning, Industry and Environment (DPIE)) provided additional advice dated 12/10/2018 with respect to the content of the ACHAR:

6. The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the development and document these in an Aboriginal Cultural Heritage Assessment Report (ACHAR). This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2011), and guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW 2011).

7. Consultation with Aboriginal people must be undertaken and documented in accordance with the Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the ACHAR.

8. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the ACHAR. The ACHAR must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the ACHAR must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.

The relevant guidelines specified for the preparation of the assessment were:

- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH 2011).
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010).

- Draft Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation (Department of Planning 2005).
- Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010).

An Aboriginal Cultural Heritage Assessment Report was prepared by Extent Heritage (September 2019) and submitted to the Department of Planning as supporting documentation for an EIS for the project. This report included consultation with the Aboriginal community and archaeological survey, and resulted in the identification of eight archaeological sites within or adjacent to the study area. The report found that the development also had the potential to impact areas of moderate, high and very high archaeological potential, associated with slightly elevated creek flat and terrace landforms adjacent to major watercourses. The ACHAR recommended the development of an Aboriginal Heritage Management Plan (AHMP) incorporating archaeological test excavations, to provide the post-approval management framework for all future Aboriginal heritage requirements for the project.

This initial report was attached to the EIS as an appendix and the current report is based on the conclusions and recommendations outlined above.

1.1.1 Aims and objectives

This report describes the results of archaeological survey and excavation undertaken to identify the nature and significance of any physical remains of past Aboriginal occupation within the study area. The principle objectives of the investigation were to:

- Identify the type, nature and extent of any Aboriginal sites, objects, archaeological deposits, and potential archaeological deposits within the study area.
- Map the locations of known and potential Aboriginal sites, objects and identified deposits.
- Assess the significance of the study area.
- Assess and identify heritage constraints and opportunities and the potential impacts of the proposed development on Aboriginal sites or Aboriginal heritage values.
- Identify and recommend measures to mitigate any heritage impacts, and risks that would ensue as a result of implementation of the proposed development within the study area.

1.2 Legislative context

There are several Commonwealth and State Acts (and associated regulations) that manage and protect Aboriginal cultural heritage within development contexts. These are outlined in detail in **Appendix 1** and summarised in **Table 1**.

Table 1. Summary of legislative context for the project.

Legislation	Description	Relevant to study area?	Details
Commonwealth			
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Protects Aboriginal places on the world, national and commonwealth registers.	No	There are no Indigenous heritage places within the study area listed on the World Heritage List, National Heritage List or the Commonwealth Heritage List.
<i>Native Title Act 1993</i>	Administers rights and interests over lands and waters by Aboriginal people. Provides for negotiation and registration of Indigenous Land Use Agreements (ILUAs). Often used in NSW to identify relevant stakeholders for consultation.	No	The study area consists of freehold land, and cannot be subject to a claim under this Act. There are no relevant entries for the study area on the National Native Title Register, Register of Native Title Claims or Register of ILUAs.
<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i>	Preserves and protects areas and objects of particular significance to Aboriginal people that are under threat from injury or desecration.	No	There are no areas or objects within the study area subject to a Declaration under the Act.
State (NSW)			
<i>Environmental Planning and Assessment Act 1979</i>	Requires environmental impacts, including to Aboriginal heritage, to be considered in land use planning. Provides for the development of environmental planning instruments, including State Environmental Planning Policies and Local Environmental Plans.	Yes	The proposed development is being assessed as an SSD project under Part 4 of this Act and is subject to project specific environmental assessment and reporting requirements. These requirements (SEARs) stipulate that Aboriginal heritage impact assessment is required (in accordance with standard DPIE procedures and guidelines) to assess whether the project has the potential to impact on Aboriginal objects, sites, or places of Aboriginal heritage significance.
<i>National Parks and Wildlife Act 1974</i>	Provides blanket protection for all Aboriginal objects and	Yes	While elements of this Act do not apply to SSD

Legislation	Description	Relevant to study area?	Details
	declared Aboriginal places. Includes processes and mechanisms for development where Aboriginal objects are present, or where Aboriginal Places are proposed for harm.		projects, the potential impact on Aboriginal objects must still be considered.
<i>Aboriginal Land Rights Act 1983</i>	Establishes Local Aboriginal Land Councils (LALCs). Allows transfer of ownership of vacant crown land to a Local Aboriginal Land Council. The Office of the Registrar, Aboriginal Land Rights Act 1983 (ORALRA), registers Aboriginal land claims and maintains the Register of Aboriginal Owners. Often used in NSW to identify relevant stakeholders for consultation.	No	The study area consists of freehold land, and cannot be subject to a claim under this Act. A request to search the Register of Aboriginal Owners was made to the ORALRA on 11 October 2018. The study area does not appear to have Registered Aboriginal Owners pursuant to Division 3 of the Act.

1.3 Study area

The study area is located 33km west of the Sydney CBD and is bound to the north by the M4 Western Motorway, to the east by Ferrers Road, and to the west by the Westlink M7 (Figure 1). The study area is owned and managed by the Western Sydney Parklands Trust. Its real property description is part of Lot 5 in Deposited Plan 804051 (475 Ferrers Road, Eastern Creek) and part of Lot 10 in Deposited Plan 1061237 (165 Wallgrove Road, Eastern Creek). It is located within the Blacktown City Council local government area, in the Parish of Rooty Hill, County of Cumberland.

1.3.1 Proposed development

Western Sydney Parklands Trust intends to redevelop the study area to accommodate industrial and light industrial land use activities. This is in accordance with the *State Environmental Planning Policy (Western Sydney Parklands) 2009*, the Western Sydney Parklands Trust Plan of Management 2030 and the Western Sydney Parklands Trust Plan of Management 2020 supplement.

An indicative concept masterplan and subdivision plan has been prepared for the study area and includes indicative building development areas and site works (Figure 2 and Figure 3). Key features of this are the demolition of existing structures and bulk earthworks, the creation of approximately 29.5 hectares of developable industrial zoned land and its associated access roads, bridge crossings, estate road, estate basin and infrastructure, as well as the realignment of Eskdale Creek. The wider study area of the Eastern Creek landform (in the east of the study area) was initially investigated for the purpose of possible flood mitigation infrastructure. Provision was initially made for the demarcation and construction of this infrastructure, however through design progression the Eastern Creek terrace has now been completely avoided.

Further detailed approvals will be sought for the construction of individual buildings, ancillary facilities and associated site works, which, if required, would be the subject of separate heritage assessment(s).

Further details of the proposed works for this assessment are provided below in Section 9.1.

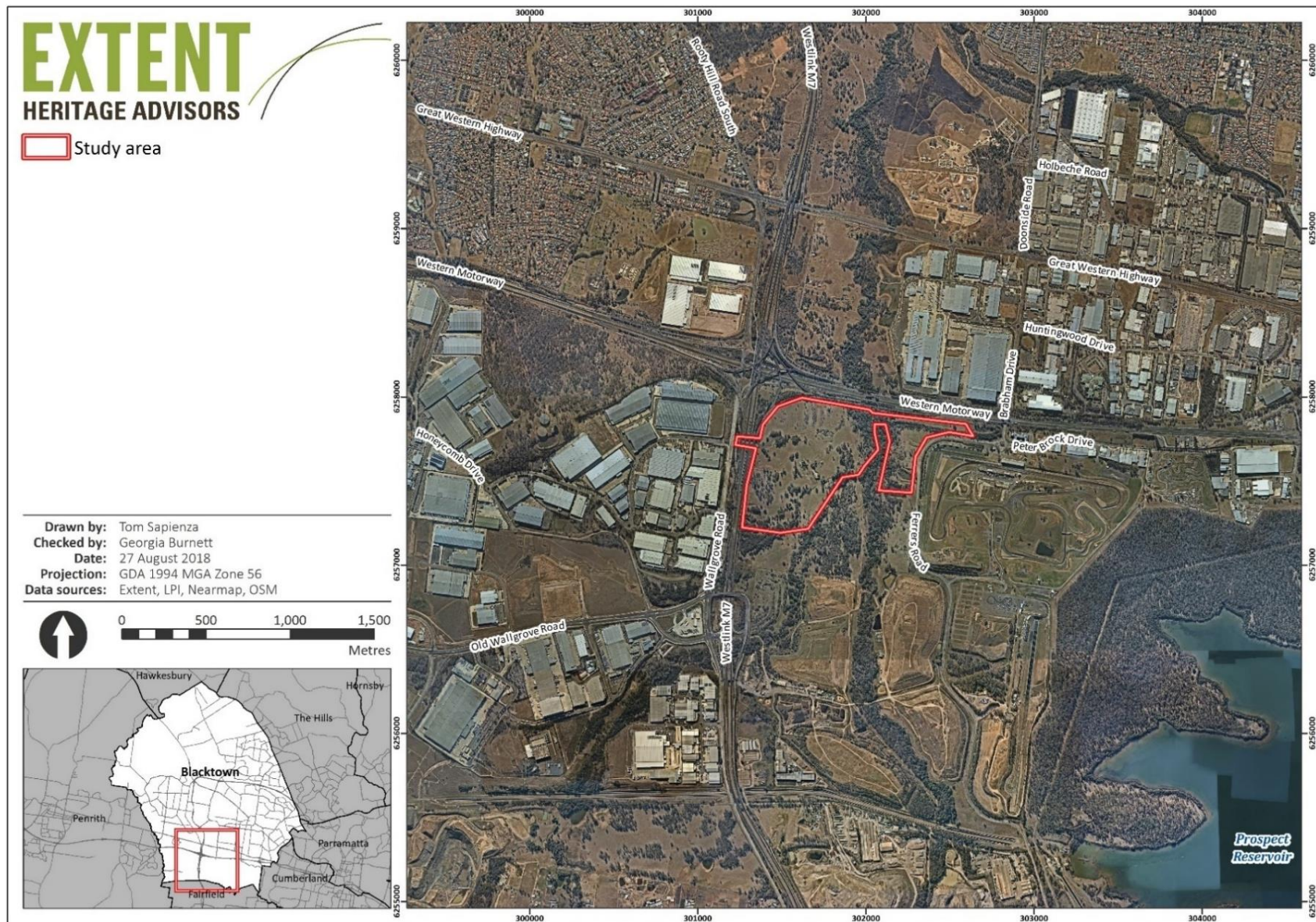


Figure 1. Location of the study area within its surrounding urban context.

DEVELOPMENT DATA			
OVERALL SITE AREA	136,285m ²		
LOT 8 (BUSH) - EXISTING ROAD	21,531m ²		
ACCESS ROAD BUFFER	21,312m ²		
TOTAL DEVELOPABLE AREA (LOT 1 TO 7)	293,687m ²		
TOTAL BUILDING AREA	100,000m ²		
FLOOR SPACE RATIO	36.4%		
DEVELOPABLE LOT	WH AREA	OFFICE AREA	TOTAL
LOT 1 SITE AREA (61,212m ²)	19,000	1,300	20,300
LOT 2 SITE AREA (64,141m ²)	16,800	900	17,700
LOT 3 SITE AREA (61,117m ²)	25,200	1,200	26,400
LOT 4 SITE AREA (10,666m ²)	21,400	1,200	22,600
LOT 5 SITE AREA (41,199m ²)	27,200	1,300	28,500
LOT 6 SITE AREA (18,406m ²)	20,000	1,300	21,300
LOT 7 SITE AREA (15,822m ²)	12,700	1,800	14,500
TOTAL	157,600	7,300	164,900
CARPARK PROVISIONS			
TOTAL CARPARK REQUIRED	724 spaces		
PROV. (N/A) (N/A) (N/A) (N/A) (N/A) (N/A) (N/A)			
TOTAL CARPARK PROVIDED	782 spaces		



Figure 2. The Concept Masterplan for the proposed development. Source: WSPT (April 2019).

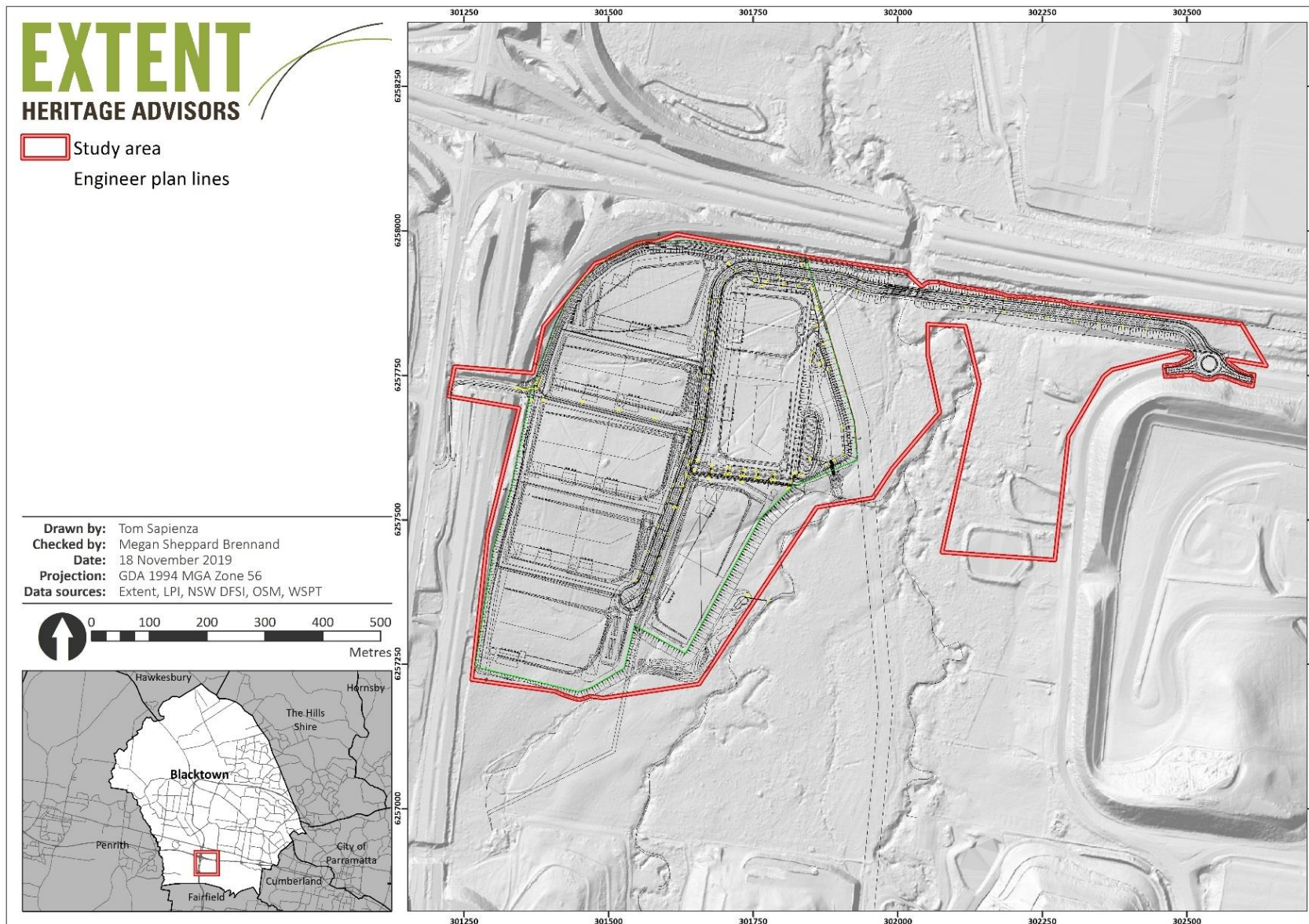


Figure 3. The proposed development. Source: WSPT (April 2019).

2. Aboriginal consultation

2.1 The process

Aboriginal consultation for this assessment has been undertaken in accordance with procedures set out in the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010). These guidelines identify a four-stage process of consultation, which includes:

Stage 1: Notification of project proposal and registration of interest

- Pre-Notification—Identification of the Aboriginal parties through contacting various government agencies.
- Notification—Contacting any Aboriginal community organisations identified to determine their interest (if any) in the project. This includes the placement of an advertisement in local print media seeking expressions of interest from Aboriginal community members.

Stage 2: Presentation of information about the proposed project

- Presentation of Project Information—Briefing registered Aboriginal parties (RAPs) about the project proposal and scope of the Aboriginal Cultural Heritage Assessment Report (ACHAR). This is usually undertaken through written correspondence and/or an on-site visit, and may undergo several iterations through the project lifetime as the nature of the assessment changes (e.g. field survey may lead to a requirement for test excavations).

Stage 3: Gathering information about cultural significance

- Seeking cultural information—Collection of information identifying any known Aboriginal objects of cultural value or places of cultural significance in the study area.
- Consultation protocols—Identification of any protocols that the RAPs would like adopted during the information gathering process, including how sensitive information will be managed.
- Potential impacts and mitigation measures—Discussion of potential impacts to heritage and appropriate mitigation options prior to developing the ACHAR. This is often undertaken onsite at the end of any field program and/or as part of the overall report review phase.

Stage 4: Review of draft Aboriginal cultural heritage assessment report

- Review of draft report—Review of the draft ACHAR by the RAPs, to provide comments on the overall findings, assessment of cultural significance and recommendations for management of Aboriginal heritage within the study area.

The consultation process for this project has two aims. Firstly, it is designed to comply with the DPIE consultation procedures to obtain and take into consideration comment and feedback from registered Aboriginal parties regarding our proposed assessment methodology, our assessment

report and its management recommendations. Secondly, through consultation with knowledge holders, the process seeks to accurately identify any Aboriginal cultural places and values that may be affected by proposed development of the study area.

2.2 This project

A log of completed actions and correspondence received during Aboriginal community consultation for the current assessment project is included in Appendix 2-1 and summarised in Table 2 below.

The consultation process identified 58 Aboriginal stakeholders in the region (Appendix 2-2). Of these Aboriginal stakeholders, 21 registered an interest in the project (Appendix 2-3), 4 participated in the survey, and 6 participated in the archaeological excavations.

Table 2. Summary of Aboriginal consultation for the project.

Consultation stage	Description	Date initiated	Date completed	Details
1	Pre-notification	11 Oct. 2018	26 Oct. 18	Further correspondence and information in Appendix 2-4.
	Notification	02 Nov. 2018	13 Dec. 2018	Further correspondence and information in Appendix 2-5.
	Advertisement in Blacktown Advocate	05 Nov. 2018	05 Nov. 2018	Newspaper advert presented in Appendix 2-6.
2	Presentation of Information about the proposed project	14 Dec. 2018	16 Jan. 2019	Further correspondence and information in Appendix 2-7. Twelve responses received from RAPs.
	Gathering information about cultural significance			
3	Field Investigation	17 Jan 2019 13 May 2019	17 Jan. 2019 12 Jun. 2019	Four Aboriginal stakeholder groups participated in the survey, and six participated in the archaeological excavations. Further details are provided in Section 6 and Appendix 2-7 below
4	Review of draft report, including impacts and mitigation options	27 Feb. 2019	27 Mar. 2019	Nine Aboriginal stakeholder groups provided positive feedback and comments on the pre-testing ACHAR. This feedback has been integrated into the report where relevant. Further details are provided in Section 2.3 and Appendix 2-8 below.

2.3 Aboriginal stakeholder feedback

The pre-test excavation ACHAR was distributed for a period of 28 days for review and comment by RAPs (see Table 2). A follow up reminder regarding finalisation of the ACHAR report was also provided prior to the end of the comment period.

Appendix 2-8 includes all feedback received from the RAPs in relation to the pre-test excavation report. Where relevant, such feedback has been integrated into the report, and is summarised below:

- Muragadi Heritage Indigenous Corporation, Darug Tribal Aboriginal Corporation, Barraby Cultural Services, Kamilaroi Yankuntjatjara Working Group, Yurrandaali Cultural Services, Yulay Cultural Services and Didge Ngunawal Clan provided brief email responses in support of the report recommendations.
- Darug Land Observations provided a letter response in support of the pre-test excavation ACHAR and its recommendations. With respect to the long-term storage of any Aboriginal cultural material, they recommended that any artefacts impacted by the proposed development be reburied on country (within the Light Horse Business Hub site).
- Darug Custodian Aboriginal Corporation provided a letter outlining their organisation's connection to country, as well as raising concerns about the involvement of organisations potentially from other parts of the region. They supported the findings and recommendations of the report.
- Several of the RAPs have various levels of experience in archaeology, and cultural heritage management more broadly, and see this as part of their involvement in cultural maintenance and protection, and in caring for Country.
- The project was identified as an opportunity for Aboriginal community members to learn more about their heritage and about heritage management.
- In general, a preference was expressed for involvement in fieldwork, and that WSPT continue to consult with RAPs as the project progresses.

Appendix 2-9 includes all feedback received from the RAPs in relation to the post-test excavation report. Where relevant, such feedback has been integrated into the report, and is summarised below:

Kamilaroi Yankuntjatjara Working Group provided an email outlining their support of the recommendations made in the ACHAR. Noted the area as highly significant to Aboriginal people as it is a desirable camping spot with plenty of resources; also, that the names of the creeks would have had traditional names that are now lost; and, recommended the artefacts recovered be stored at the Deerubbin LALC.

3. Existing environment

3.1 Key findings

- The study area is part of the Cumberland bio-subregion, which is characterised by low rolling hills and wide valleys on Triassic Wianamatta group shales and sandstones. The study area is characterised by gently sloping alluvial plains, with occasional terraces or levees providing low relief. It is underlain predominantly by Quaternary alluvium, with narrow sections of the east and west underlain by the Bringelly Shale unit of the Wianamatta Group shales.
- The study area is predominately located within the South Creek soil landscape, with small portions to the east and west situated in the Blacktown soil landscape. Both typically contain a sandy or clay loam topsoil and a clay loam sub-topsoil unit, overlaying heavy clay.
- The study area lies within the South Creek sub-catchment of the Hawkesbury-Nepean catchment area. Four creeks flow within the study area: a fourth order portion of Eastern Creek, a third order portion of Reedy Creek, a second order portion of Eskdale Creek and a first order unnamed creek that flows into a man-made waterhole. Eastern Creek in particular has been shown to be a key resource for past Aboriginal populations. Historical flooding is likely to have affected low-lying parts of the study area, particularly causing erosion of topsoils (and reworking or removal of any associated cultural material). However, with such extensive water resources, the presence of past Aboriginal activity is considered likely.
- Based on a review of past land disturbance and vegetation maps, only small stands of vegetation along Eastern Creek appear to have remained relatively unchanged over the last 70 years, and may contain regrowth or natural bushland vegetation elements.
- An analysis of past land use indicates that the study area has been subjected to varying degrees of historical disturbance. Impacts have occurred throughout the course of the twentieth century from agricultural and pastoral activities including orcharding, cultivation, and equestrian activities, Department of Defence activities, and water and gas pipeline infrastructure. The expected impact of these activities on the archaeological stratigraphy of the site is cultural materials found in disturbed contexts.

3.2 Geology, geomorphology and soils

The study area is located within the Sydney Basin Bioregion, on the central east coast of NSW. Bioregions are large, geographically distinct areas that are distinguished from one another based on differences in geology, landform patterns, climate, ecological features and plant and animal communities. Bioregions are often further classified into finer-scale subregions, with localised differences in geomorphology and vegetation (Thackway and Cresswell 1995).

The study area is part of the Cumberland subregion, which is characterised by low rolling hills and wide valleys on Triassic Wianamatta group shales and sandstones. The subregion is partly covered by Tertiary river gravels and sands, and Quaternary alluvium occurs along the main streams (NSW National Parks and Wildlife Service 2002). The gently undulating shale-based landscape of western Sydney naturally support grey box, forest red gum and narrow-leaved

ironbark woodland with some spotted gum on the shale hills, and swamp box in low lying flood-prone areas.

3.2.1 Geology

The study area is underlain predominantly by Quaternary alluvium. Quaternary denotes the layer as forming during the most recent period of geological time (~2.58 Ma--~0.012 Ma). Alluvium is characterised by gravels, sand, silt, and clay, and often contains organic matter that makes it a fertile soil. These deposits are generally formed by flooding of nearby watercourses, which facilitate the erosion of nearby rocks.

In narrow areas of the east and west sections of the study area, the landscape is underlain by the Bringelly Shale unit of the Wianamatta Group shales (Figure 4). The lithology of the Wianamatta Group shales is predominantly shale with sporadic thin lithic sandstones. The group was formed during the Late Triassic period (~237 Ma--~201.3 Ma) as part of the coastal alluvial plain sequence (Jones and Clark 1991).

Bringelly Shale is the uppermost layer of the Wianamatta Group, and was formed by alluvial sediments during the Late Triassic period as the seas lowered due to increased aridity, probably during a single sea-level regression episode. The Bringelly Shale unit reaches maximum thicknesses of ~250m, and the unit rarely outcrops due to the deposition of overlying soils (Jones and Clark 1991). The lithology can be ordered or randomly distributed and commonly includes claystone and siltstone, laminate, sandstone, coal and highly carbonaceous claystone and tuff (Jones and Clark 1991). The unit is often carbonaceous and frequently contains fossilised roots and plant debris.

Silcrete is a raw material that was used extensively by Aboriginal people for the manufacturing of stone tools. While raw silcrete formations are not present within or immediately adjacent to the study area, silcrete associated with the St Mary's Formation and other Rickaby's Creek gravels are within 10km to the northwest (Doelman et al. 2015, 496).

3.2.2 Geomorphology and soils

The study area is predominately located within the South Creek soil landscape with small portions of the study area to the east and west situated in the Blacktown soil landscape (Bannerman & Hazelton 1990) (Figure 5).

The local topography of the South Creek soil landscape is characterised by gently sloping alluvial plains, with occasional terraces or levees providing low relief. Slopes are often <5% and local relief <10 m. This soil landscape comprises the active floodplain of many drainage networks on the Cumberland Plain. This type of landscape restricts a number of archaeological site types, such as rock shelter and rock engravings, which require sharp exposed sandstone relief not common in these areas. Conversely, surface artefact scatters and buried cultural material are likely to be more prevalent. Dominant soil materials in the South Creek soil landscape include brown apedal single grained loam and dull brown clay loam (A horizons) overlying bright brown clay (B horizon). Soil material along channels comprises friable to loose, sandy loam (50 cm) and apedal massive clay loam (15 cm) overlying light-medium clay (70 cm). Sometimes swales are filled with sand splays. Low terraces comprise sandy clay loam (2-50

cm) overlying apedal massive clay loam (15 cm) and medium to heavy clay (60-85 cm). High terraces may contain up to 190 cm of stratified clay (light to medium) over shale bedrock.

The Blacktown soil landscape occurs extensively across the Cumberland subregion, and is characterised by low hills and rises with broad rounded crests and ridges on Wianamatta Group shales. This type of landscape restricts a number of archaeological site types, such as rock shelter and rock engravings, which require sharp exposed sandstone relief not common in these areas. Conversely, surface artefact scatters and buried cultural material are likely to be more prevalent. On crests, the landscape comprises shallow (<30cm) loam topsoil over 10-20cm of clay loam to silty clay loam, over moderately deep (<100cm) clay. On upper slopes and mid-slopes, the soils are shallow (<30cm) loam topsoil over 10-20cm of clay loam to silty clay loam, over shallow to deep (20-150cm) clay. On lower sideslopes, the soils are shallow (<30cm) loam topsoil over 10-30cm of clay loam to silty clay loam, over moderately deep to deep (40 to >140cm) clay. These types of residual soils are typically shallow, comprised of thin clay loam topsoil (A1 horizon) over heavy clays (B horizon), and usually <50cm deep. The heavy clay unit is generally considered to pre-date the Aboriginal colonisation of Australia, and therefore only the upper A1 horizon has the potential to contain Aboriginal objects. The shallow depth of Blacktown soils has direct implications for the subsurface presence and survivability of historical and Aboriginal deposits. The soils rarely are deep enough to have significant or even stratified cultural deposits. The shallow nature of these A1 deposits has implications for the potential for and survivability of Aboriginal objects, as even minor disturbance and/or de-vegetation will often result in the complete removal of the upper parts of the soil profile in which objects may occur.

Although the Blacktown soil landscape generally lacks the sort of subsurface deposits in which archaeological material is commonly found, there are a large number of Aboriginal artefacts recorded as surface finds on this soil landscape. This is due to soil deflation and erosion processes that have operated on Blacktown soils, and which have tended to expose (rather than bury) the former land surfaces on which stone artefacts were deposited.

3.3 Hydrology

The study area lies within the South Creek sub-catchment of the Hawkesbury-Nepean catchment area. Four watercourses flow within the study area: Eastern Creek, Reedy Creek, Eskdale Creek and an unnamed watercourse that flows into a man-made waterhole (Figure 6). At their closest points to the subject area, Eastern Creek is a fourth order watercourse, Reedy Creek is a third order watercourse, Eskdale Creek is a second order watercourse, and the unnamed creek is a first order watercourse.

The watercourses within the study area have been subject to some redirection or disturbance from historical activities. Notably, Eskdale Creek appears to have been diverted near its confluence with Reedy Creek between 1965 and 1970 (Figure 9 and Figure 10). Also, based on historic aerials and topographic maps, the unnamed creek to the east of the study area probably extended further northeast (<500m) than its present-day extent.

The major watercourse, Eastern Creek, extends ~30km from below Sugarloaf Ridge, flowing north into South Creek. As well as providing water, Eastern Creek would have supported diverse marine, plant and animal resources. The presence of fresh water and diverse flora and fauna

(discussed below) would have enabled both seasonal and more permanent use of the area over time. The natural resources implicate that Aboriginal groups could spend large amounts of time in, and within close proximity to, the study area.

Blacktown City Council has undertaken hydrological analysis across the LGA, and the results of those studies indicate that a large portion of the study area is within the local flood zone (Blacktown City Council 2018). This has implications for the survival of subsurface Aboriginal objects, as soil profiles in the study area are likely to have been impacted during past flood events.

3.4 Past vegetation

From an Aboriginal heritage perspective, understanding areas of native vegetation is important for three reasons:

- Culturally modified trees may be found in these areas.
- These areas may have been subject to fewer disturbances in the post-contact period than other parts of the study area.
- Aboriginal representatives often feel that areas of native vegetation are important cultural values areas.

Remnant vegetation communities in the vicinity of the study area have been mapped by the NSW National Parks and Wildlife Service (NSW NPWS) (NSW NPWS 2002). This mapping program identified two vegetation communities within the study area: Shale Plains Woodland and, more predominately, Alluvial Woodland (Figure 7).

Prior to European settlement, Shale Plains Woodland covered extensive areas of the Cumberland Plain, and this vegetation community is still the most widely distributed community in the Cumberland Plain. It is an open eucalypt woodland, with an open shrub layer and grassy ground cover containing grey boxes, forest red gums and ironbarks. It tends to occur on flat to undulating terrain on Wianamatta Shale-derived soils, but can also occur on Holocene (10-0ka) alluvium in areas with good drainage.

Alluvial Woodland occurs exclusively along, or in close proximity to, minor watercourses in the Cumberland Plain, in soils derived from Wianamatta Shale. It occurs extensively along the Hawksbury-Nepean river system; in the study area, the woodland follows the courses of Eastern Creek and Reedy Creek. It includes native trees such as cabbage gum, forest red gum, and dense stands of Swamp Oak.

There is potential for the study area to retain some isolated stands of original vegetation (Alluvial Woodland). A partial aerial photograph of the study area from 1943 shows isolated stands of vegetation around Eastern Creek, particularly on the eastern side (Figure 8), while much of the remainder of the study area is cleared. These stands of vegetation coverage persist in the 1965, 1970, 1986, 1994, and 2009 aerials (Figure 9–Figure 13).

3.5 Existing soil profile disturbance

The study area has been the subject of various land disturbances since the 19th century, and much of the information regarding historical land use at the study area is derived from research undertaken for an historical archaeological assessment currently in preparation (Extent Heritage, 2019).

The first plans showing land incorporating the study area were made in the early 1800s, and these show that the land had been subdivided into 50 to 100 acre lots between five landowners. The relatively small parcels of the original land grants were consolidated by Richard Farrington between 1825 and 1826. In 1826, he sold a 420-acre block to Richard Brown and Edward Aspinall (*The Sydney Gazette and New South Wales Advertiser*, 1 March 1826; *The Sydney Gazette and New South Wales Advertiser*, 6 August 1827; Banksia Heritage 2003:7). This block, known as "Wallgrove" was then sold to Lieutenant Colonel Charles William Wall in 1827 (Curio Projects n.d.), who used it as a stopping point to fatten his stock when they were driven from Bathurst to the Sydney markets (Banksia Heritage 2003:7).

In 1833, the Wallgrove Estate was advertised for sale. It was listed as 460 acres of land with "about one hundred [acres] cleared, part in cultivation, and fenced into several small Paddocks...the Buildings consist[ed] of a good Cottage, well-adapted for a Family Residence, having seven good Rooms, a Dairy, and detached Kitchen, a Barn, three-stalled Stable, and other convenient Out-houses; also, an excellent Garden, well-stocked with the choicest Fruit Trees" (*The Sydney Herald*, 7 October 1833). The deed was thus transferred to Charles Roberts, who owned the Wallgrove Estate until his death in 1865. During his lifetime, Roberts kept stock. When it was advertised for sale in 1865, the improvements listed at Wallgrove included "a good Cottage Residence, with orchard and garden, and a number of out-offices, and the land ... subdivided into grazing and cultivation paddocks" (*Sydney Mail*, 16 December 1865).

The land was then passed to John Shand, a successful farmer and police magistrate. Shand and his wife raised five children on at Wallgrove and built a school (*The Sydney Morning Herald*, 22 October 1866), tannery and dairy (Shand 2012). The school and teacher's residence were likely updated c. 1871, when Shand put out a call for tenders for the erection of new buildings (*The Sydney Morning Herald*, 7 October 1871). After Shand moved to Redfern in 1890, the land was subdivided by his sons. In January of that year, the proposed subdivisions were advertised as "First-Class Small Farms and Tannery", with "superior" farms of various sizes. The land was "in large part cleared, open grazing land for a series of years". The Certificates of Title for the subdivided lots indicate that they were passed through a number of owners, primarily for pastoral activities.

On the western side of Eastern Creek, the property obtained by Joseph Hicks on 20 April 1918 was resumed by the Commonwealth of Australia in 1942 (CT 5252-172, 173, 174). This property became the location of the Wallgrove Army Camp. Overall the Army Camp, which spread across both sides of Wallgrove Road (west of the study area), had canvas accommodation for up to 5000 troops. Timber framed rectangular huts, known as P Huts, were also common structures within the camp (Banksia Heritage 2003). Development during this time included upgrading

Wallgrove Road to bitumen and installing electricity, fresh water and street lights. Trees and plants were also cultivated at the camp (Curio Projects n.d.).

After World War II, the Army Camp was used to house the many post-war migrants to Australia, and it was at approximately this time that the sewerage treatment plant was also constructed. Many residents of the hostel worked on the Snowy Mountains Scheme and other state-based labour projects (Banksia Heritage 2003). Brick and tile factories were common throughout the local area, especially after World War II (Mills 1996). The property remained a military establishment until the 1970s (AMAC 1997), with the Australian Defence Force based in part of the camp until the 1990s (Curio Projects n.d.). An RAAF transmission station complex was established on site in the 1960s.

During the 1960s, plans were made for the Sydney to Newcastle Natural Gas Pipeline, as well as for the construction of the Western Motorway. The pipeline, which bisects the area, was completed in 1982 (*The Australian Pipeliner*, 7 September 2009). Construction on the motorway began in the late 1960s, and by December 1972 had been completed between Russell Street at Emu Plains and Wallgrove Road at Eastern Creek. Access to the freeway at Wallgrove Road was provided via a modified half-diamond, which marked the temporary eastern terminus of the freeway. Two years later, in April 1974, the motorway was extended eastwards to the Great Western Highway at Prospect. In June 1992, east-facing ramps were opened to traffic at Wallgrove Road, Eastern Creek, where previously only west facing ramps existed. The M7, including Light Horse Interchange, were opened by 2005.

3.5.1 Summary of historical ground impacts

The following list summarises the historical impacts that may have caused some disturbance to potential artefact-bearing deposits. A map of these impacts is shown in Figure 14, and the definitions of the levels of disturbance are described in Table 3 below.

- Since ~1820s: agricultural and pastoral activities, vegetation clearance particularly in west, construction of various farming infrastructure.
- 1840s to early 1949: pastoral and agricultural activities.
- 1942 to 1990s: use by Defence Force and construction of army base infrastructure. Some regional infrastructure in 1970s (gas pipeline).
- 2001 to present: construction of various roadworks and limited infrastructure in preparation for greater development to follow.

Archaeologically, this may imply significant ground disturbance in the western portion of the study area. This does not preclude the presence of Aboriginal objects, but suggests they may be found in disturbed contexts. Limited evidence for disturbance near Eastern Creek is available, and there is potential for isolated stands of remnant vegetation along the riparian corridor to exhibit cultural modification (e.g. scarred trees).

Table 3. Definitions of levels of historical disturbance within the study area (refer to Figure 14 below).

Level of Disturbance	Description
High	<p>Areas of significant ground surface disturbance, resulting in the total removal of the surface stratigraphy and the truncation of any Aboriginal cultural deposits within those surface soil layers.</p> <p>These areas are associated with the M7 Motorway construction, gas pipeline installation, dam wall and major building construction, and other areas of cutting exceeding 50cm in depth.</p>
Moderate	<p>Areas of moderate ground surface disturbance, resulting in the partial removal of soils and the partial truncation of any Aboriginal cultural deposits.</p> <p>These areas are associated with minor building construction and levelling works, where cutting of between 30 cm–50 cm into the ground surface has been undertaken.</p>
Low	<p>Areas of limited ground surface disturbance caused by minor landscape modification and which results in the partial removal and/or reworking of soils and the redistribution of any Aboriginal cultural deposits.</p> <p>These areas are associated with low-impact paths and walking tracks, where cutting does not exceed 30 cm.</p>

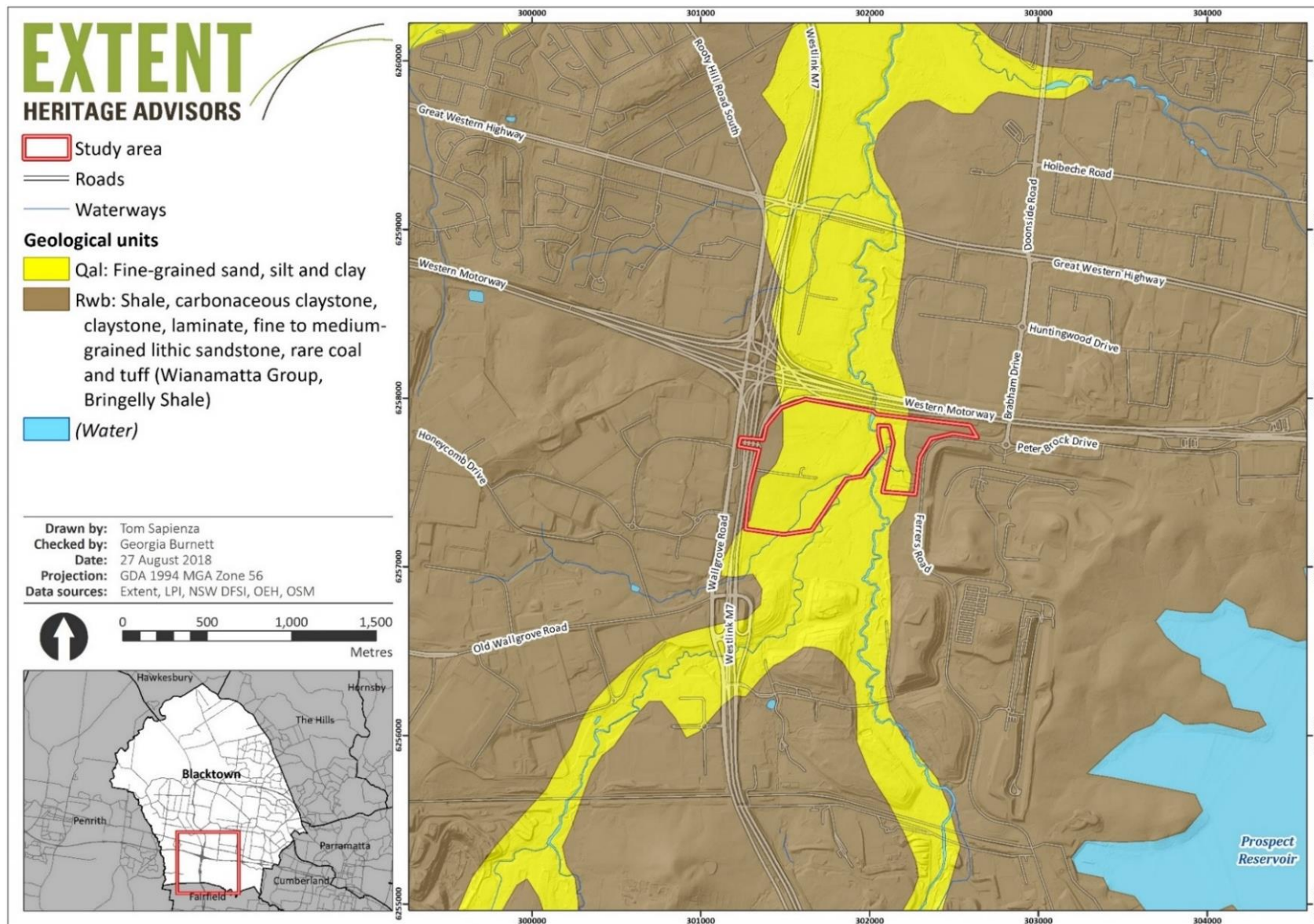


Figure 4. The geological landscape underlying the study area.

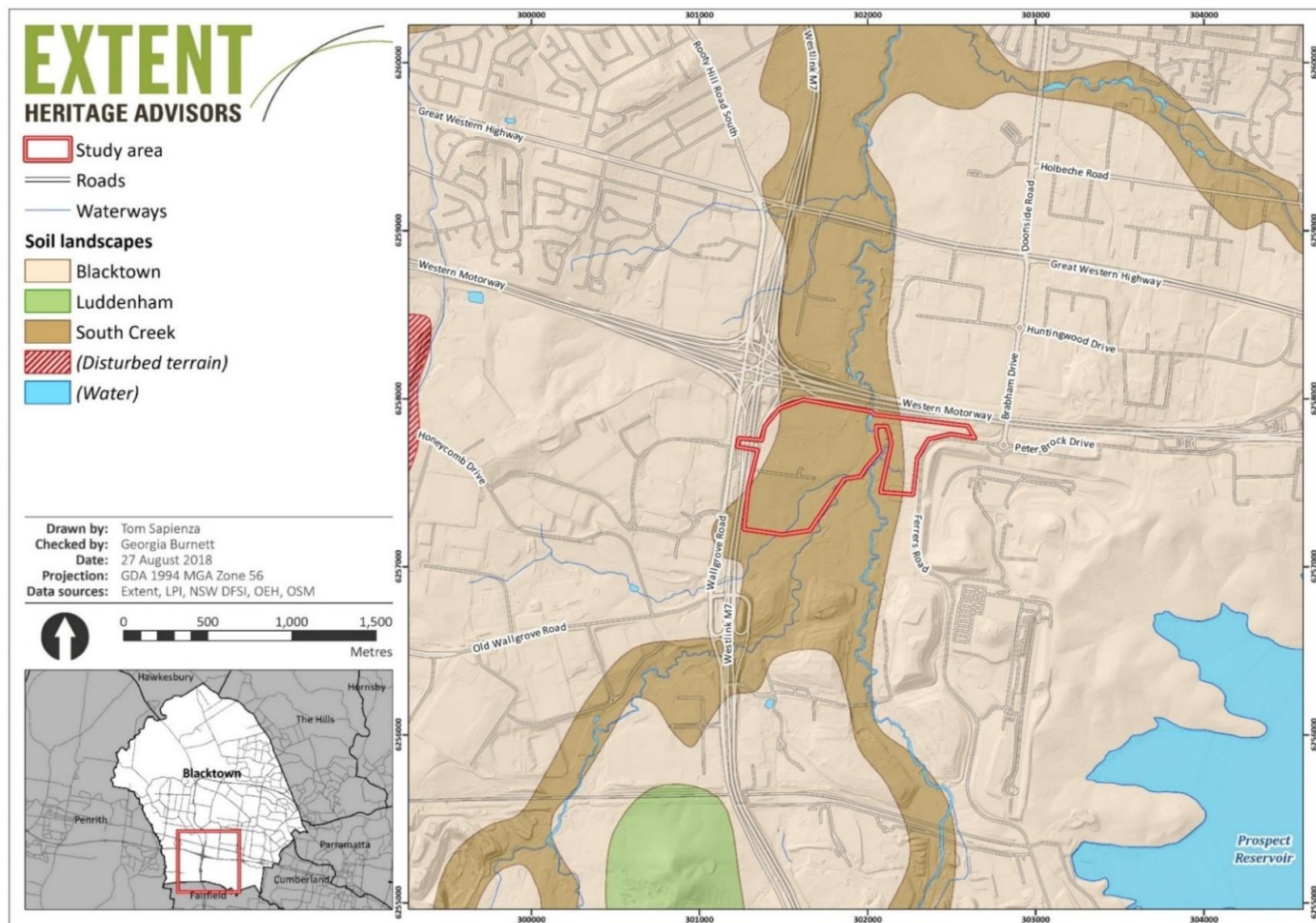
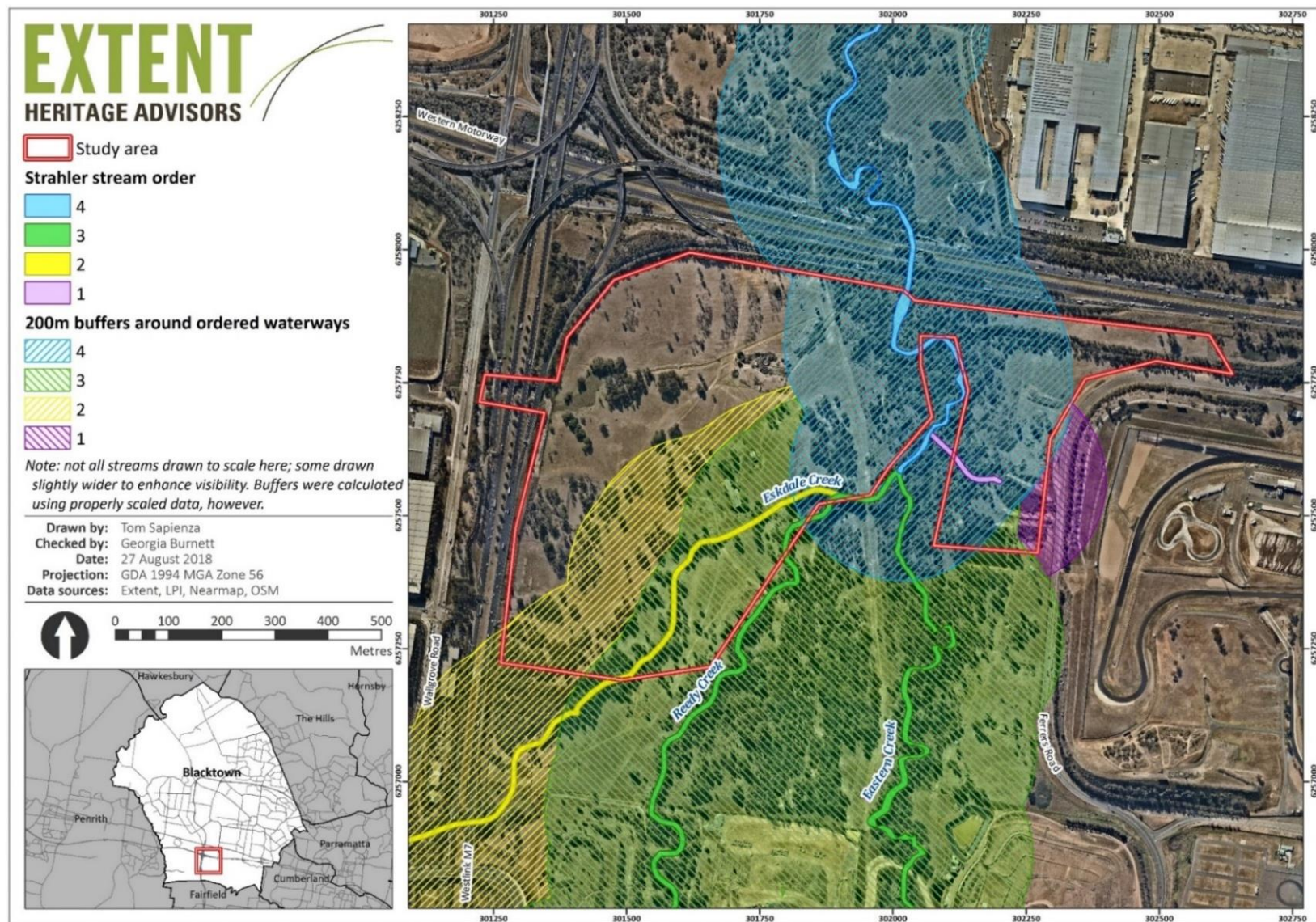


Figure 5. Soil landscape mapping for the region (Bannerman and Hazelton, Soil Conservation Service of NSW, 1990). Note the mapping is based on aerial photographs and limited ground-truthing, and may not be accurate.



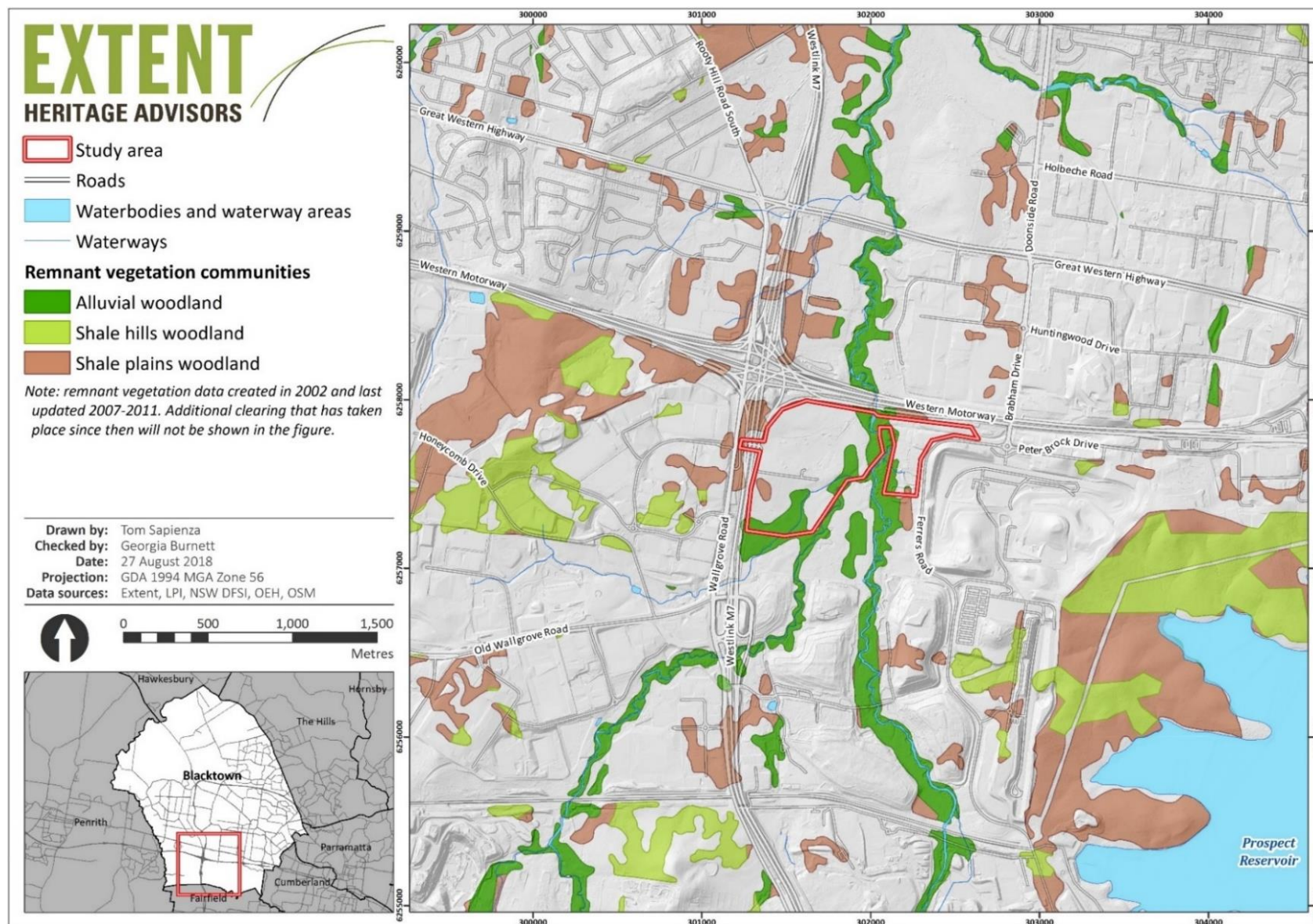


Figure 7. The study area showing remnant vegetation communities.

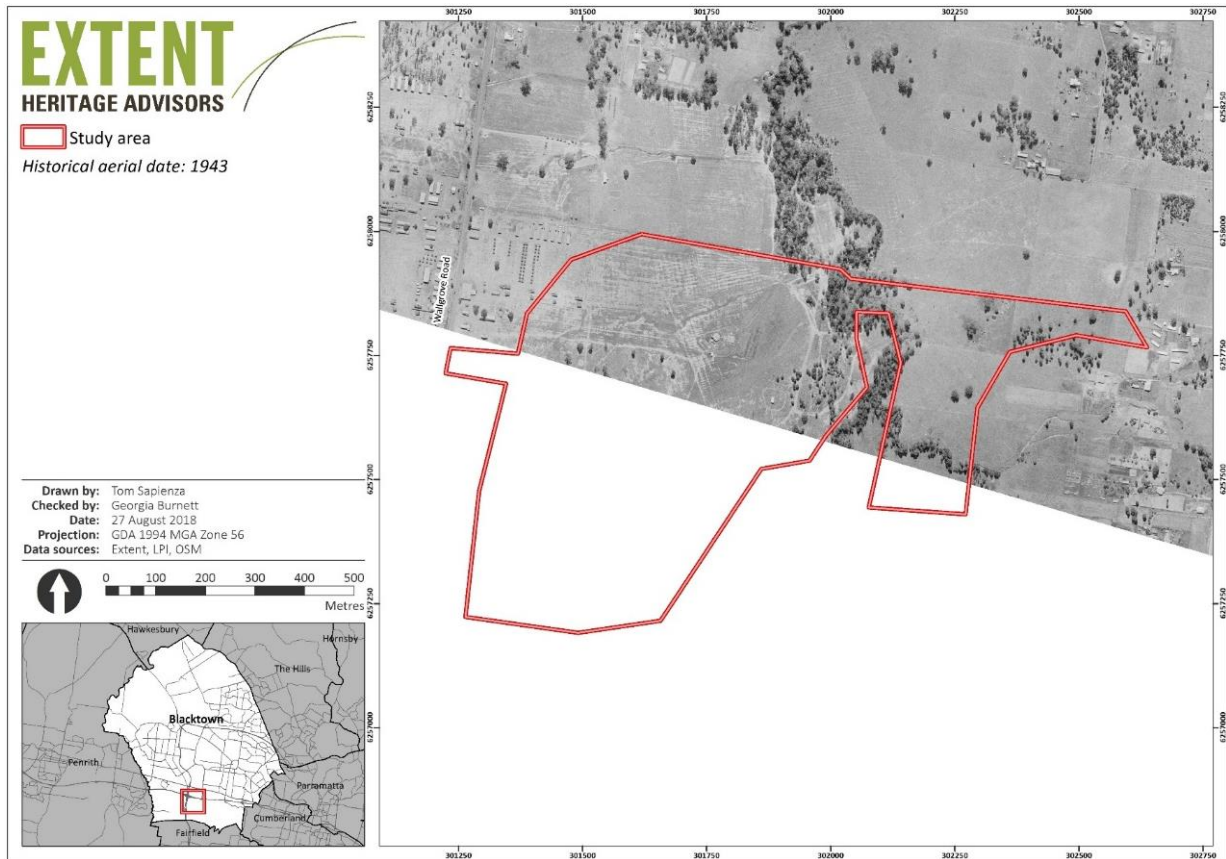


Figure 8. Partial aerial photograph of the study area in 1943.



Figure 9. The study area in 1965.

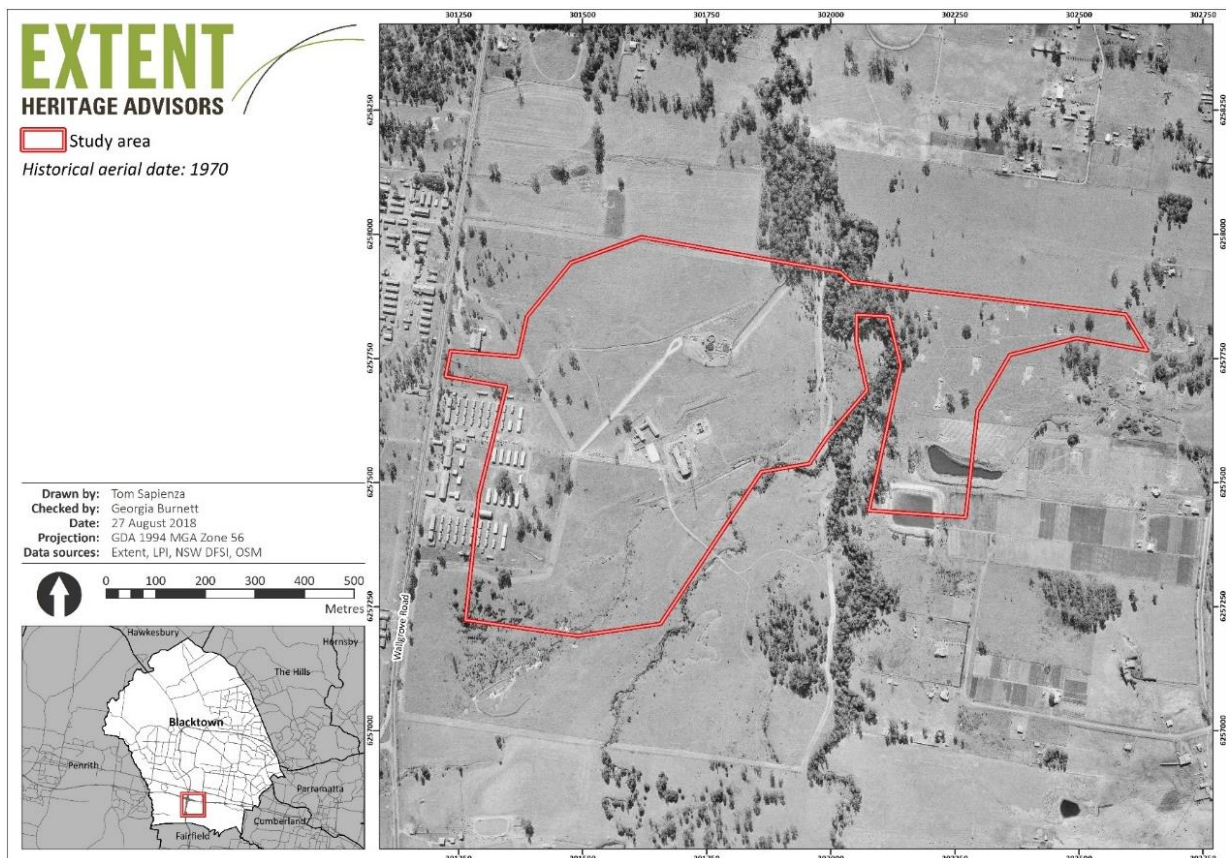


Figure 10. The study area in 1970.

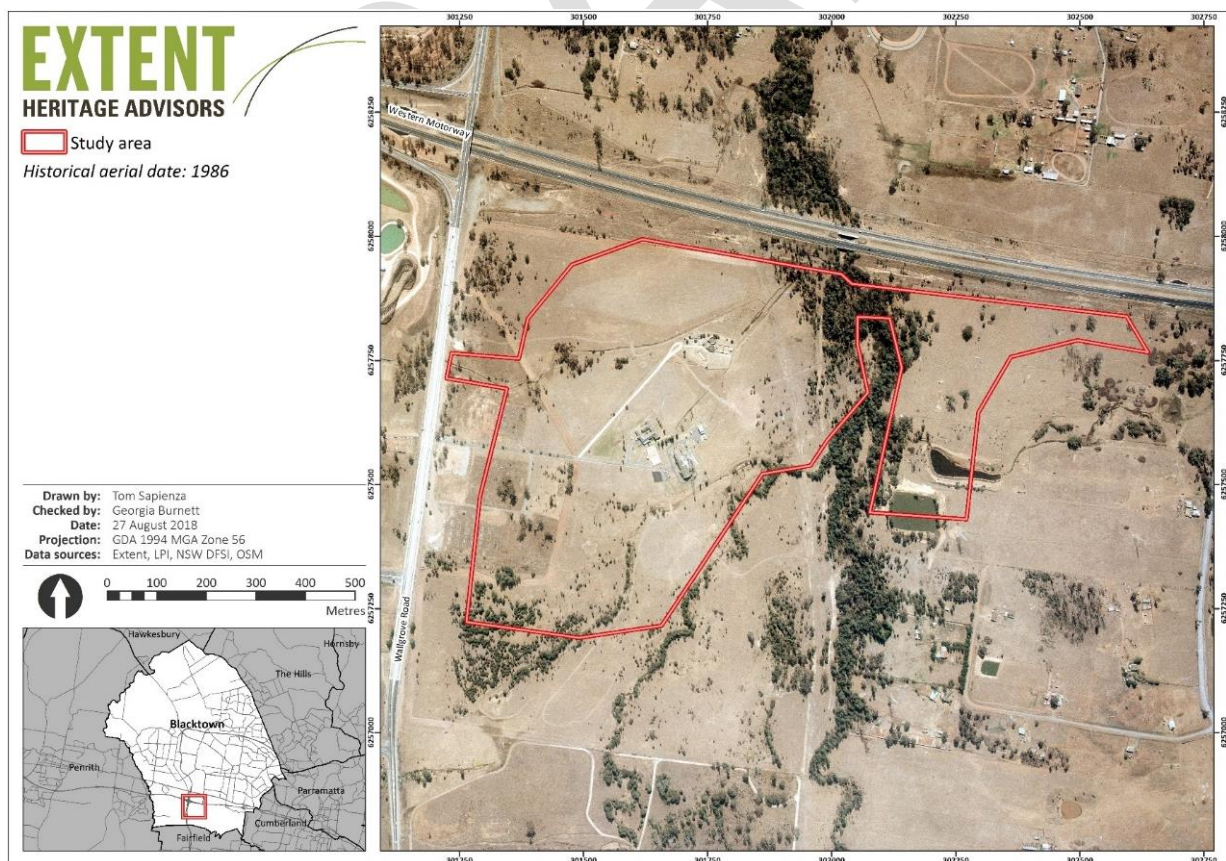


Figure 11. The study area in 1986.

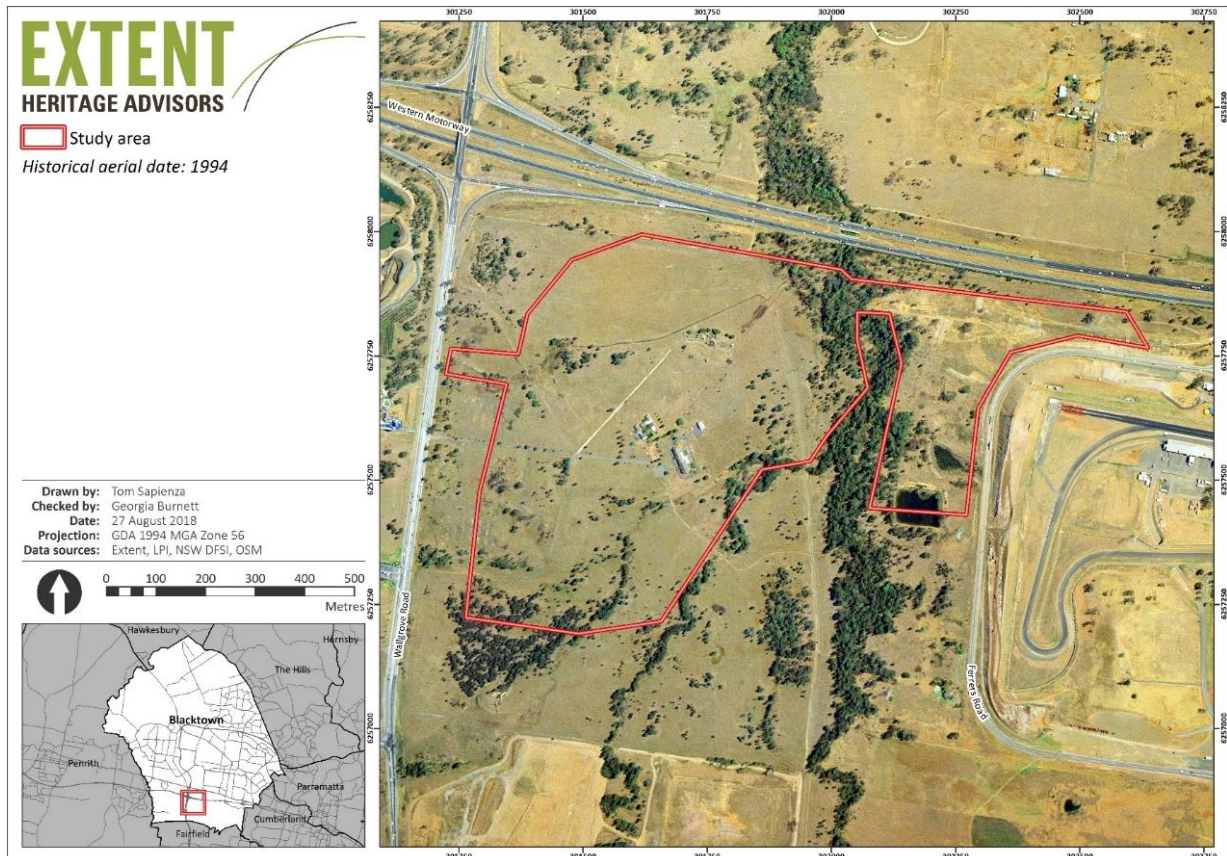


Figure 12. The study area in 1994.

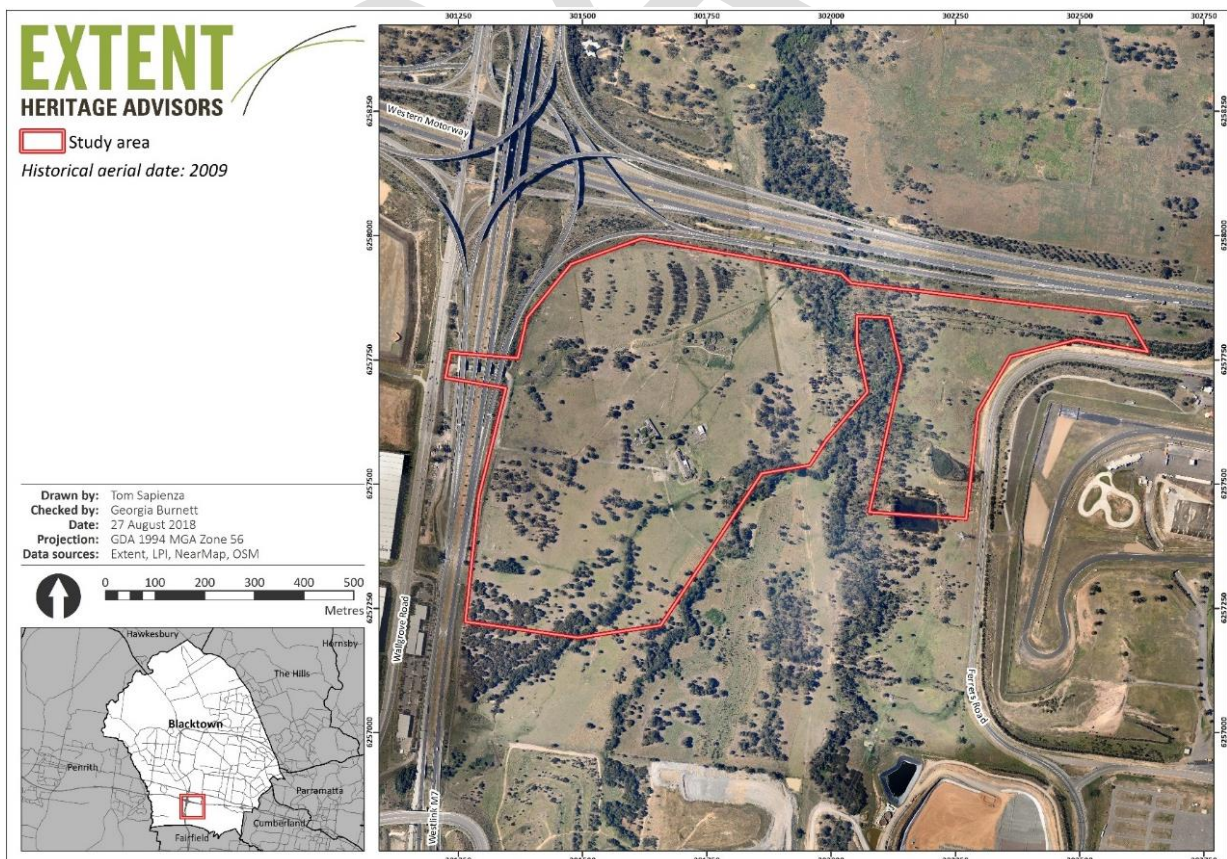


Figure 13. The study area in 2009.

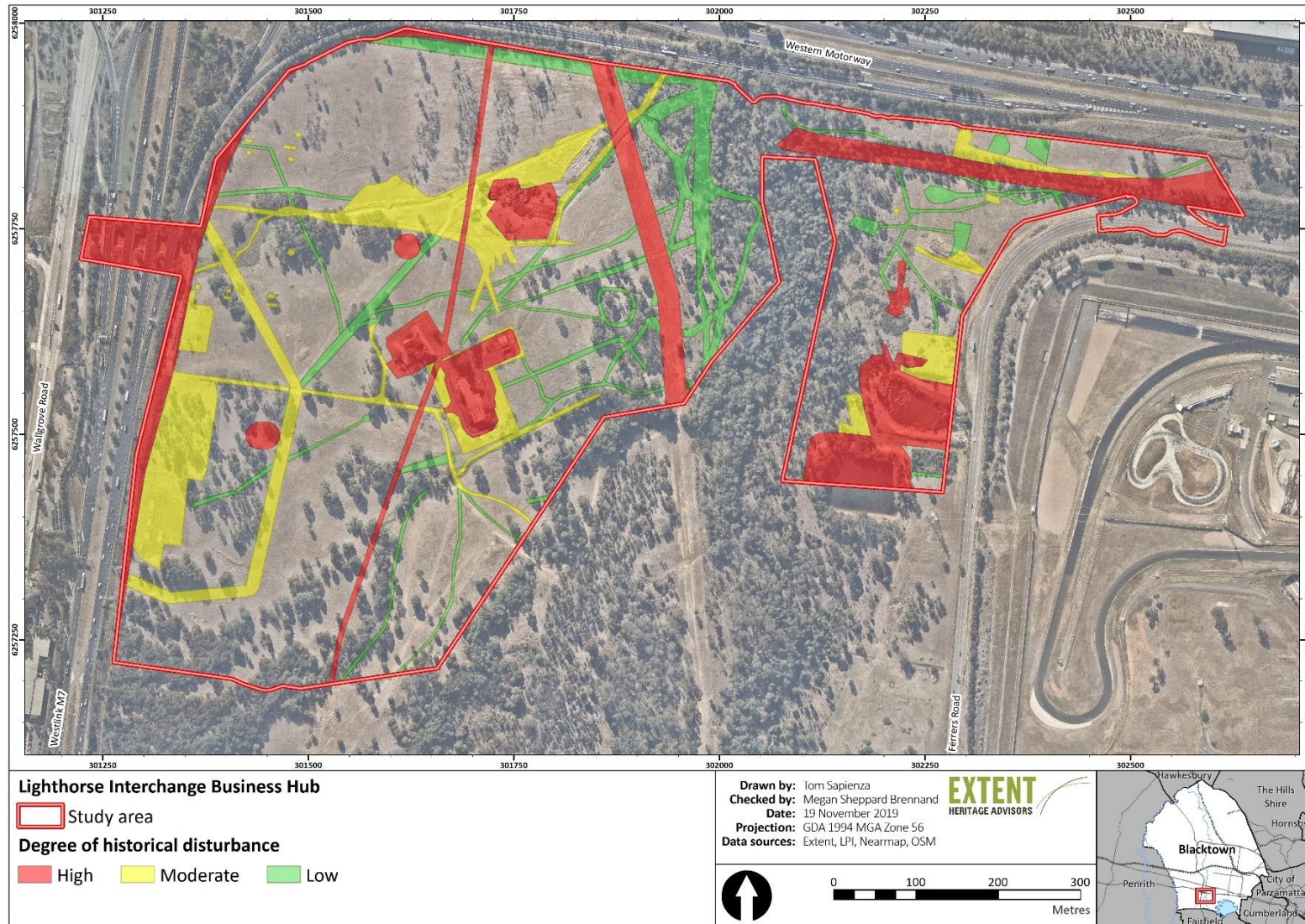


Figure 14. Areas of historical soil profile disturbance within the study area.

4. Ethnographic record

4.1 Key findings

- For the period from European colonisation until the mid-19th century there are detailed ethnographic and historic accounts that provide significant information about the lives of the Aboriginal people and groups who lived in and around the study area.
- Because the study area is near the point where several different groups' country intersected, the exact linguistic background of the inhabitants of the study area is uncertain, but it was almost certainly Dharug, Gandangara and/or Tharawal.

4.2 Regional information

Over thirty separate Aboriginal groups populated the Sydney region in 1788, each of which had their own country, practices, diets, dress, and dialects. These groups are now known of as 'clans', each of which is also identified with broader cultural-linguistic groups sometimes referred to as 'tribes'. Sydney tribes included Dharug, Darkinjung, Gundungarra, Tharawal, Guringai (Coastal Darug), Eora (Coastal Darug) and Awabakal (Attenbrow 2010, 23, 32).

Each clan was made up of thirty to fifty people who had own defined territory. Clans occasionally converged with other clans to trade, hunt, fight, feast, arrange marriages, conduct ceremonies, resolve disputes, and share information. There was often tension between neighbouring groups and the boundaries between territories were not lightly traversed (White 1790). On an expedition northwest of Parramatta, Watkin Tench records that his guides Colebee (Gadigal) and Ballederry (Burramattagal) quickly found themselves in "country unknown", and they described those who lived there as "bad". When the party finally reached the Hawkesbury River, he wrote that "[our] natives had evidently never seen this river before" (Tench 1961, 225–226).

The landscape of the Cumberland Plain was crossed with Aboriginal paths, many of which later became European roads, and the speed and sophistication of inter-clan communication was remarked upon by many European observers. On 23 October 1835, missionary James Backhouse encountered Aboriginal people in Richmond who knew of his brief visit to Wellington, over 300km away. He wrote: "Our persons, costume, and many other particulars, including our manner of communicating religious instruction, had been minutely described" (Backhouse 1843, 339).

Unfortunately, in 1789 the same paths that wove Aboriginal communities together rapidly spread smallpox throughout the region. The devastating outbreak forced major reorganisations among clan groups. When William Bradley sailed into Sydney in May 1789, he recorded the "dreadful havoc" that smallpox had wrought amongst Aboriginal communities. "[We] did not see a Canoe or a Native the whole way coming up the Harbour & were told that scarce any had been seen lately except laying dead in & about their miserable habitations" (Bradley 1969). As entire communities were destroyed by the disease, traditional burial practices broke down and clans merged together for survival (Hunter 1793). Bradley reported that bodies were found in

caves, along streams, around the harbour and along the entire path between Port Jackson and Broken Bay.

Although Aboriginal people practiced extensive ceremonies, primary sources offer only glimpses of the ceremonial life of Sydney Aboriginal communities. Some Aboriginal customs were recorded by Europeans relatively regularly, such as the avulsed teeth and scarifications of certain initiated men, and the kangaroo teeth necklaces and the missing little finger joints of mountaineer and coastal women. But, due to the secrecy surrounding some types of ceremonial events, there are serious limitations to even the most richly described accounts like the “Yoo-long Erah-ba-diang” initiation ceremonies Collins recorded at the head of Farm Cove and in the “middle harbour” (Collins 1804: 365-374); the contests and dances conducted on “a clear spot between the town and the brick-field” (Collins 1804: 236); and the operation performed by Yellomundee, a “caradyee”, on Colebee’s wound on the banks of the Hawkesbury (Tench 1961: 232).

The Cumberland Plain woodland, particularly when it had a fire-managed understorey dominated by grasses, was a fundamental part of the Aboriginal subsistence economy. This was due primarily to its abundant game resources, and particularly grazing and browsing mammals such as kangaroos and possums. Contributing to the importance of particular portions of the Cumberland Plain were those areas near freshwater creeks, wetlands and rivers, which also made significant contributions to the Aboriginal subsistence economy.

More information was recorded about the lifeways of Aboriginal groups in the area. The inland clans fished for mullet and eels in rich lagoons, and much of their food came from yams dug out from the river banks and worms known as “cah-bro” extracted from river driftwood. Colebee and Ballederry called these people the “climbers of trees,” after their practice of skilfully ascending gums in pursuit of animals by cutting footholds in the trunks with a stone axe. More hunting traps were plotted in the area from Parramatta to Richmond than any other part of Sydney. These included “bird decoys” full of feathers, hollowed-out trees, and a tapering chute at the foot of Richmond Hill “between forty and fifty feet in length”, constructed of earth, weeds, rushes, and brambles (Collins 1798).

The foraging strategies used by the inland people of the Cumberland Plain were described in some detail by David Collins in the early years of European settlement (Collins 1798: Vol 1, Appendix IV):

The natives who live in the woods and on the margins of rivers are compelled to seek a different subsistence [to those on the coast], and are driven to a harder exercise of their abilities to procure it. This is evinced in the hazard and toll with which they ascend the tallest trees after the opossum and flying squirrel [gliders]. At the foot of Richmond Hill, I once found several places constructed expressly for the purpose of ensnaring animals or birds.

...By the sides of lagoons I have met with holes which, on examining, were found excavated for some space, and their mouths so covered over with grass, that a bird or beast stepping on it would inevitably fall in, and from its depth be unable to escape.

In an excursion to the Hawkesbury, we fell in with a native and his child on the banks of one of the creeks of that noble river. We had Cole-be with us [a Cadigal clansman from the coastal sandstone country of Sydney’s east], who endeavoured, but in vain, to bring him to a

conference; he launched his canoe, and got away as expeditiously as he could, leaving behind him a specimen of his food and the delicacy of his stomach; a piece of water-soaked wood (part of the branch of a tree) full of holes, the lodgement of a large worm, named by them cah-bro [cobra or *Teredo* spp.; a type of burrowing mollusc known as shipworm]

...They resort at a certain season of the year (the month of April) to the lagoons, where they subsist on eels which they procure by laying hollow pieces of timber into the water, into which the eels creep, and are easily taken.

These wood natives also make a paste formed of the fern-root and the large and small ant bruised together; in the season they also add the eggs of this insect.

Fire was a constant presence in early Sydney, and Aboriginal people quickly became known as the “fire-makers” (Cox 1815). Fire was an Aboriginal multitool, used to open paths and to clean country; to drive animals into the paths of hunters and to cook the kill; to keep warm at night and to carry as a torch the next day; to treat wood, melt resin and crack stone for tools; to gather around and dance and share stories.

Mapping ethnographic records gives us an insight into local burning regimes. Examples of fires around Sydney included “moving lights” seen on the harbour at night (Banks 1998: 243) to lone trees burning on the Cumberland Plain, “the smoke issuing out of the top part as through a chimney” (White 1790: 153). “In all the country thro’ which I have passed,” wrote Arthur Phillip in May 1788, “I have seldom gone a quarter of a mile without seeing trees which appear to have been destroyed by fire” (Phillip 1914: 31).

On a hot dry day in September 1790, for example, David Collins observed Aboriginal people “burning the grass on the north shore opposite to Sydney, in order to catch rats and other animals” (Hunter 1793). Almost exactly twelve months later, on 31 August 1791, they were again “firing the country” in the same place on a hot day ahead of heavy rains. While Collins regarded this to be another “remarkable coincidence”, it suggests a connection to the land and an understanding of the seasons which the settlers could not fathom. This dismissive approach proved devastating during 1799 flood of the Hawkesbury. Settlers who ignored the flood warnings given by Aboriginal people were engulfed by a destructive torrent as the river “swell’d to the height of fifty feet above its common level” (Collins 1804: 488).

After contact, early Sydney remained, in the words of historian Grace Karskens, “an Eora town” (Karskens 2009: 351). Crowds of Aboriginal people would flow through the settlement at Sydney Cove, eating in the yard of Government House, sharing a table with the Governor himself, or gathering at Bennelong’s hut. Large parties of convicts paid regular visits to an Aboriginal family in Woolloomooloo, “where they danced and sung with apparent good humour” (Collins 1798: 37). A short-lived fish trade sprang up in Parramatta, where Aboriginal people sold fresh bream and mullet for bread and salted meat (Collins 1798: 165). Fierce warfare broke out on the Hawkesbury. Clans came “not less than one Hundred Miles” to attend Governor Macquarie’s “Annual Meeting of the Natives” at Parramatta (Macquarie 1917: 95). Each of these events makes up a single piece of ethnographic evidence, but together they knit together a rich tapestry of Aboriginal activity around early Sydney.

4.3 The study area

The study area is situated quite near the location where the territories of multiple language groups met, and so no definitive statements can be made about the traditional language spoken within the study area. However, the results of decades of academic research strongly suggest that the local language was Dharug.

Tindale's mapping of Aboriginal languages places the study area in country associated with the Eora people, but within 2km of a boundary with territory associated with the Daruk people (Tindale 1974). In Goodrum's efforts to specifically position Aboriginal groups or clans, the study area is near locations recorded as being associated with Toogagal, Gomerrigal, Cannemegal and Bool-Bain-Ora people (Goodrum 1987). Kohen's 1993 work identifying Aboriginal clans indicates that the study area is in proximity to locations associated with the Warrawarry and Weymali clans (Kohen 1993). Kohen mapped the study area in country associated with the Dharug language (Kohen 1993), and close to the interface between Dharug, Tharawal and Eora country (Horton 2000).

Early colonial records include a single ethnographic observation made in the vicinity of the study area (Figure 15). On 26 April 1788, during inland travels by Governor Phillip and several others, hunting traps and marked trees were seen in the general area of what is now Prospect Reservoir:

In our way back, which we easily discovered by the marks made in the trees, we saw a hollow tree on fire, the smoke issuing out of the top part as through a chimney. On coming near, and minutely examining it, we found that it had been set on fire by the natives; for there was some dry grass lighted and put into the hole wherein we had supposed they used to snare or take the animal before alluded to (White 1790).

The burning tree would have been an Aboriginal hunting trap. The marks made in the trees were most likely climbing notches made by a stone axe.

One historic European expedition route also bisects the study area. An exploratory expedition undertaken over two days, 26-27 June 1789, by Watkin Tench; Mr. Arndell, assistant surgeon of the settlement; Mr. Lowes, surgeon's mate of the Sirius; two marines; and a convict. The following observation was made:

This Country between Prospect Hill & the [Nepean] River appears better than on the other side Prospect Hill [sic] & in many places very Good [sic].

The map appears to be intended for an English audience, perhaps with a goal of attracting emigrants, and notes the type and quality of country explored, and water sources.

4.4 Information provided by RAPs

No additional ethnographic information was supplied by the RAPs for this report.

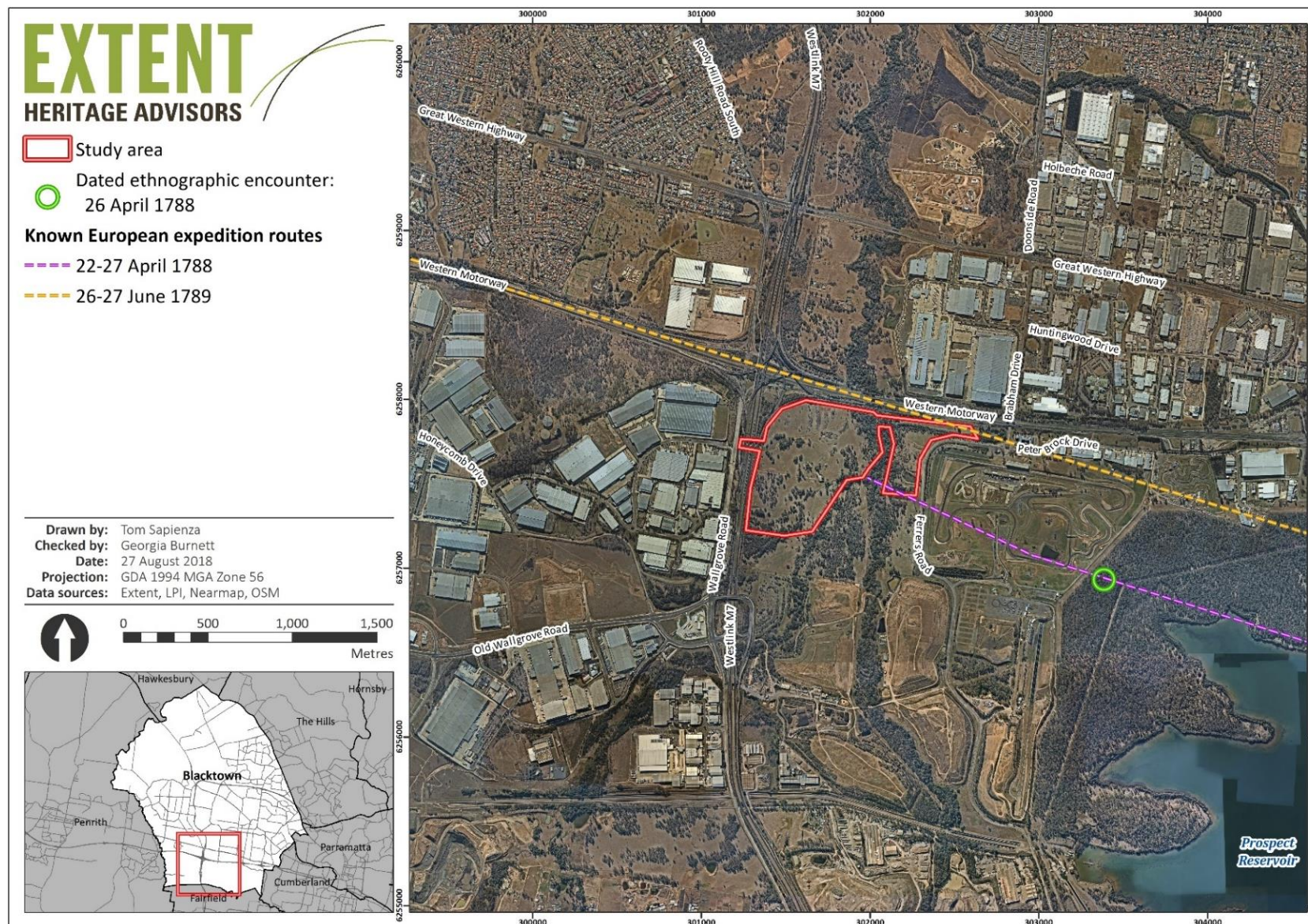


Figure 15. Ethnographic encounters and known European expedition routes referred to in text.

5. Archaeological record

5.1 Key findings

- Although the broader Cumberland Plain has been the subject of hundreds of archaeological studies, the part of the plain in which the study area is located is one for which significantly fewer details are known about the nature, distribution and survival of archaeological materials.
- Recent studies in the vicinity of the study area indicate that Aboriginal archaeological materials will be present in those parts of the study area that have not been subject to high disturbance. Further, it is likely that the archaeological materials present in the study area will be very similar to those found along other major waterbodies in the Cumberland Plain and mostly comprise of varying densities of surface and/or subsurface stone artefacts.
- Since 2010, no Aboriginal Heritage Impact Permits (AHIPs) have previously been issued within the study area. A consent to destroy permit was issued for an artefact scatter site immediately outside of the study area as part of the development of the Eastern Creek Grand Prix Circuit (#45-5-0751, Consent to Destroy Permit 450037, dated 1 December 1989).

5.2 Regional background

5.2.1 A history of research in the Sydney basin

One of the first investigations in the region was at Lapstone Creek, south west of Emu Plains, in the foothills of the Blue Mountains (McCarthy 1948). Initially undated, this site was one of several used by McCarthy and others to differentiate the Bondaian and Eloueran artefact assemblages (e.g. Lampert 1966, 1971; McBryde 1966, 1974; Megaw 1965, 1968; Moore 1970, 1981). Radiocarbon ages suggesting a basal age of c.4 ka for the site were published in the late 1960s from archived samples of charcoal (McCarthy 1978; Polach et al. 1967). McCarthy (1978) also identified several 'surface workshops' along the banks of the river between Castlereagh and Emu Plains. These were large surface artefact scatters that were dominated by early reduction of pebbles derived from the Hawkesbury River. The sites were dominated by uniface pebble blanks, edge-ground implements, and percussions stones, with minor representations of microliths, and were considered to be of late Holocene age.

In the 1970s Stockton and Holland (1974) undertook excavations at several rock-shelters in the Blue Mountains (including Kings Tableland, Walls Cave, Lyrebird Dell and Springwood Creek), which demonstrated occupation of the region through the Last Glacial Maximum and terminal Pleistocene (25-10ka). Excavations revealed initial occupation of the Blue Mountain/Hawkesbury region by c.22 ka, with a Capertian assemblage dominating between c.12 to 6 ka and a Bondaian assemblage from c.3 ka and European arrival (and peaking after 600 years). The terms Capertian and Bondaian are explored further in the later sections of this report. However, in brief the 'Capertian' and 'Bondaian' were terms, coined in the 1940s, to

characterise two different types of artefact assemblage. The Capertian is composed of amorphous pebble-tools dominated by silicified tuff and constrained to the Terminal Pleistocene, and the Bondaian generally composed of microliths and dominated by silcrete, and constrained to the late Holocene. A sterile phase was identified between the two assemblages at many of the Blue Mountain sites. As part of this work a disturbed rock-shelter at Shaws Creek, K1, was excavated with preliminary findings indicating a potential for deep-time deposits in close proximity to the Hawkesbury River (Stockton 1973).

Subsequently, as part of his doctoral research, Kohen (1986; Kohen et al. 1984) undertook excavations of KII rock-shelter, a more undisturbed site immediately east of K1. This excavation identified two main assemblages: a lower assemblage (within units 1-4/phases VI-IV) composed of amorphous core/flake tools and thick flakes, and an upper assemblage (within units 5-6/phases I-III) that included backed blades, geometric microliths, edge-ground hatchets and bipolar/scalar pieces (Kohen et al. 1984). The lower assemblage was dominated by chert (also referred to as silicified tuff), while the upper assemblage was dominated by igneous and metamorphic materials, as well as an increasing abundance of silcrete. Radiocarbon ages for the two assemblages indicated that the lower had a minimum age of 13 ka, while the upper was present in various guises from 4-1.2 ka. In contrast to Stockton (1973), Kohen saw no evidence of a hiatus between the two assemblages. With the exception of Cranebrook Terrace, the KII site currently provides the earliest evidence of occupation along the Hawkesbury River.

In the same study, Kohen (et al.1984) also referred to an open stratified site at Jamisons Creek, Emu Plains, where two ages suggested an initial occupation from c.7 ka, with a proliferation of backed blades associated with a hearth date to c.3 ka. Thermo-luminescence (TL) dating of an open site at Regentville (RS 1), similarly found a focus of occupation between 5.2 ± 0.5 ka (W 1892) and a basal age 7.6 ± 0.8 ka (W 1893) (McDonald 1995).

The earliest date for alleged Aboriginal occupation in the region comes from Cranebrook Terrace, where five reportedly flaked pebbles identified as stone tools by Stockton were found within a gravel pit (Stockton and Holland 1974). Subsequent work by Nanson et al. (1987) demonstrated these gravels to be c.40 ka. If correct, these finds would be the oldest site on the Australian eastern coast. However, the artefactual status of the pebbles, their provenance (several were in an eroded context rather than in situ) and the association between the dates (which ranged from 10 to 42 ka) and the artefacts have been sources of controversy ever since. Mulvaney and Kamminga (1999) rejected these findings and despite extensive monitoring of the Penrith gravel pits over the past 30 years no other comparable artefacts or evidence of early human occupation has come to light at those levels (see Mitchell 2010 for further discussion).

Excavations by Austral Archaeology Pty Ltd at the Windsor Museum site recovered an extensive artefact assemblage within a sand dune deposit dated to between 149 ka and 8.5 ka (Mitchell pers. comm.). Correlating these TL ages with the archaeology has proven to be difficult as the sediments are known to be bioturbated but it is very likely that the oldest artefacts are of late Pleistocene age.

As part of a salvage excavation for the Rouse Hill Infrastructure project, a basal layer of silicified tuff artefacts was recovered at RH/CC2, a stratified open site, and while undated, based on artefact typology, it was considered to be of a terminal Pleistocene age (JMCHM 2005a, 2005b).

Consulting work on the western Cumberland Plain by Smith (1986) at Quakers Hill and McDonald et al. (1994) at Seconds Ponds Creek have recovered hearths and other features in association with extensive artefact scatters dated to the late Holocene. Further afield in tributaries of the Hawkesbury River, studies at Upper Mangrove Creek (Attenbrow 2004), Darling Mills SF 2 rock-shelter (Attenbrow 1993) and MR/1 (Moore 1981) have all demonstrated terminal Pleistocene and early Holocene occupation.

Between 2008 and 2013, Archaeological and Heritage Management Solutions Pty Ltd undertook archaeological investigations of a large sand body, PT 12 (#45-5-3198), in Pitt Town, northwest Sydney, in advance of development. PT 12 sand body is situated on the edge of a ridge line that follows the Hawkesbury River and associated tributaries. The most significant works consisted of a large salvage excavation totalling 100m² in two locations on the sand body. These works recovered ~10,000 artefacts along with a large number of OSL ages. The findings of the study indicate that the sand body had formed >100ka, with occupation by Aboriginal people at ~36ka, and continuing through until 8ka (Williams et al., 2012, 2014). Currently, this represents the earliest evidence of permanent occupation of the Sydney region.

More recent work by Extent Heritage on a large archaeological mitigation in advance of ~40km of pipeline along several creeklines in northwest Sydney (AHMS 2015). This project involved 500m² of open area excavation and recovered ~10,000 artefacts, along with an intense dating program. The findings all indicated that much of the Sydney Basin had only been colonised in the last few thousand years. It was hypothesised that earlier in the past, populations focussed on the main river systems and coast, only in-filling the intermediate region when demographic pressure reached a threshold in the last few thousand years. This is further supported by Attenbrow (2010) who considered that the vast majority of dated sites in the Sydney region are less than 5,000 years old (35 out of a total of 48 dated sites).

5.2.2 Cumberland Plain site distribution

A total of ~7,000 sites have been recorded on the DPIE AHIMS database for the Cumberland Plain sub-region. The majority of these sites are artefacts (open camp sites or isolated finds) (n=3,756 or 54%) followed by Potential Archaeological Deposits (PADs) (n=1,212 or 17%), grinding grooves (n=936 or 13%) and other undefined site types (n=1,056 or 15%). These findings are similar to the frequency of site types recorded for the overall Sydney region. The absence of rock-shelters with art or deposit for the western Sydney area may be accounted for by the geology of the area which lacks sandstone escarpments and shelters. Other site types in western Sydney include stone quarries, non-human bone or organic material, shell, and water holes.

A study of the regional archaeology of the Cumberland Plain by Kohen (1986) made a number of findings about site location patterns in the Sydney area. The study demonstrated that proximity to water was an important factor in site patterning. Kohen (1986) found that 65% of open artefact scatter sites were located within 100 metres of permanent fresh water. Only 8 per cent of sites were found more than 500 metres away from permanent fresh water (Kohen 1986). In short, Kohen (1986) argued that open artefact scatters are larger, more complex and more densely clustered along permanent creek and river lines. Kohen's (1986) study also found that

silcrete (51%) and chert (34%) are the most common raw materials used to manufacture stone artefacts. Other raw materials include quartz, basalt and quartzite.

Although the patterns described above have been generally supported by subsequent investigations, Kohen's study was limited by a reliance on surface evidence. Extensive excavation across the Cumberland Plain has since shown that areas with no surface evidence often contain sub-surface deposits buried beneath current ground surfaces. This is a critical consideration in aggrading soil landscapes, such as those commonly found across the Cumberland Plain. In a 1997 study of the Cumberland Plain, McDonald (JMCHM, 1997) found that:

- 17 out of 61 excavated sites had no surface artefacts before excavation.
- The ratio of recorded surface to excavated material was 1:25.

The character and composition of the excavated sites in McDonald's study could not be properly predicted on the basis of the surface evidence. In short, surface evidence (or the absence of surface evidence) does not necessarily indicate the potential, nature or density of sub-surface material.

The results of McDonald's study clearly highlight the limitations of surface survey in identifying archaeological deposits in this landscape. The study also shows the importance of test excavation in establishing the nature and density of archaeological material on the Cumberland Plain.

McDonald has undertaken over 20 years of consulting archaeology in the Cumberland Plain, and, like Kohen, has developed a predictive model for the distribution of Aboriginal objects. In a recent publication, White and McDonald (2010) p. 29 summarised this model as follows:

Topographic and stream order variables correlate with artefact density and distribution. High artefact density concentrations may have resulted from large number of artefact discard activities and/or from intensive stone flaking. Highest artefact densities occur on terraces and lower slopes associated with 4th and 2nd order streams, especially 50–100 metres from 4th order streams. Upper slopes have sparse discontinuous artefact distributions but artefacts are still found in these landscape settings.

It must be noted, however, the on-site investigation in the southwest of the subregion has been significantly less than in the northwest. The limited studies that have been undertaken suggest that the models outlined above are generally robust, but there are differences. This is primarily for two main reasons: 1) there appear to be few raw material sources in the southwest. The sites containing tens of thousands of stone tools a few hundred metres from the Plumpton Ridge (a large silcrete outcrop) in the northwest for example, have no counterpart to the south, and based on existing evidence are unlikely to be present; and 2) the southwest is higher in the creek catchment, making the geomorphology slightly more rugged and the creeks often stronger and more erosive, than the northwest. This results in archaeological sites being commonly lost in close association with the creekline, and more often found on mid, upper slopes and hill crests between 120-180m from the creek's edge.

More recently, a large-scale excavation of a series of pipelines along major creeklines by Extent Heritage (AHMS 2015) further contributed to McDonald's work. The key findings included:

- The archaeology of the Cumberland Plain is characterised by a cultural landscape consisting of foci of activity against background low density spread of Aboriginal objects found in all undisturbed locations, generally in the order of $<6/m^2$; and therefore, it has been suggested that a 'site', or a place of specific Aboriginal cultural activity, is identified only when this threshold is exceeded. Areas of extensive occupation or repeated use contained densities $>45/m^2$ and frequently higher, with densities of $>150/m^2$ being not uncommon for the largest sites.
- While the works were constrained to the linear corridor of the pipeline, the testing program (frequently with resolution of 5 or 10m spacing of test pits) generally showed the length of high artefact densities (*a priori* sites). All of these results suggest that the linear length of high-density sites is in the order of 10-20m, and assuming a similar width, can be extrapolated to a 100-400m² occupation area.

5.3 Local information

This section provides a summary of previous studies undertaken in the proximity of the study area (Figure 17).

Sites in the vicinity of the study area are dominated by low-density artefact scatters and/or isolated finds. Sites appear to have lower artefact densities than elsewhere in the Cumberland Plain. These assemblages tend to be dominated by silcrete, and are strongly indicative of a late Holocene (5-0ka) visitation and/or occupation of the region, but chert, quartz and mudstone are also present. Artefact densities are generally lower closer to the local watercourses (likely due to scouring effects based on regional archaeological models that suggest greater artefact densities should be present), but become increasingly dense and more significant with elevation.

Archaeological Study of Aboriginal Sites in the Western Cumberland Plain (Kohen 1986)

This work was an investigation of Aboriginal sites in the Blacktown area, done both as part of Kohen's PhD research (1986a) and also as a consulting report on behalf of Blacktown City Council (1986b)). The study area of these works includes the current study area. The work was undertaken in the areas around Prospect Reservoir, Erskine Park, Marsden Park and Ropes Creek, and involved sample surveys and the reassessment of previously recorded Aboriginal sites. The study identified 25 archaeological sites with more than 50 recorded artefacts, most of which were located along watercourses and on ridgelines. Two artefact scatters were identified within the current study area (AHIMS #45-5-0453 and #45-5-0469) and three artefact scatters were identified within 200m of the study area (AHIMS #45-5-0454, #45-5-455 and #45-5-0465). The stone artefact assemblage comprised silcrete, chert, quartz, silicified wood, basalt and quartzite flakes and cores. The sites were mostly located along watercourses and on ridgelines.

Sydney International Grand Prix Circuit, Eastern Creek (Crew 1989)

This work was an investigation of Aboriginal cultural heritage material within the development application area of the Sydney International Grand Prix Circuit at Eastern Creek. The study area for this assessment is within and immediately to the west of the current study area, from the west bank of Eastern Creek to encompass what is presently Sydney Motorsport Park (Lot 3 DP1079897). The study area identified nine open sites and ten isolated artefacts. Of these sites, one is located within the current study area (AHIMS #45-5-0756), and seven are within 200m of the current study area (AHIMS #45-5-0751, #45-5-0752, #45-5-0753, #45-5-0754, #45-5-0757, #45-5-0760 and #45-5-0761). These sites recorded 106 artefacts, and the materials observed included silcrete, chert, mudstone, and quartz. Tool types identified include flakes, cores, a small number of backed blades, and a pebble manuport.

Sites AHIMS #45-5-0752, #45-5-0760 and #45-5-0761 are described as being located along tributaries of Eastern Creek. These creeks do not appear on current maps, though the unnamed tributary extending west from Eastern Creek appears to extend close to the location (~175m northeast) up to the late 1980s (Figure 11). The area to the east of Eastern Creek was noted as having very poor visibility during the survey, and therefore the results may not accurately reflect surface or subsurface Aboriginal archaeological potential.

All of these sites, with the exception of AHIMS #45-5-0751, are indicated as still present in the landscape. As the assessment indicated that construction of the raceway would result in the destruction of these sites, salvage was recommended for some of the sites identified.

Horsley Road Deviation, Eastern Creek (Rich 1989)

Previously recorded sites EC1 (AHIMS #45-5-0761) and EC9 (#45-5-0751) were identified as partially destroyed, and a further three sites were identified during this survey (AHIMS #45-5-0750, #45-5-0751, and #45-5-0752). Two of these sites are within 200m of the current survey area (AHIMS #45-5-0751 and #45-5-0752). AHIMS #45-5-0751 and #45-5-0750 were identified as destroyed as part of the Grand Prix Circuit complex development, which is not reflected in the AHIMS database.

All newly identified sites are located on the present day Ferrers Road, within <150m from the unnamed tributary to the east of Eastern Creek. The assemblages comprise of 24 artefacts of silcrete, chert, mudstone and quartzite; no formal tool types were identified, aside from one core. Two artefacts showed signs of use-wear. Present day aerials suggest these sites have been destroyed or otherwise adversely impacted by the development of the Eastern Creek Motorsports Park.

M4 Motorway Upgrade between Parramatta and Mays Hill and Prospect and Emu Plains (Helen Brayshaw Heritage Consultants 1996)

Part of the study area for this assessment include the north edge of the current study area, that which forms the road corridor of the M4. The work noted severe prior disturbance associated with road construction activities along the entire M4 road corridor, though no precise extent was given for the disturbance.

The study identified one site within 50m of the current study area. AHIMS #45-5-1066 comprises 11 artefacts of silcrete, chert and mudstone, 80-160m east of Eastern Creek. This site was assessed as having very limited subsurface potential due to its proximity to a raised bridge associated with the M4, and the construction activities associated with the bridge, though the broader area around Eastern Creek was assessed as having moderate archaeological potential.

Eastern Creek Waste Management Facility (Navin Officer Heritage Consultants 2000 and 2001)

These reports document the Aboriginal archaeological assessment, and subsequent testing program, of the expansion works associated with the Eastern Creek Waste Management Centre. The survey works encompassed portions of Lot 12 & 13 DP 1049029, Lot 1 DP 1073820, Lot 2 DP 1041745, Lot 1 DP 1073820, Lot 20 & 21 DP 1205425, and Lot 1 DP 1077822. The subsurface testing works were comprised of 16 test pits within an approximately 450m x 30m study area, located on the east and west banks of Eastern Creek (Lot 20 DP 1205425, Lot 1 DP 1073820).

The initial investigation identified two Aboriginal sites (artefact scatters) and six isolated artefacts; the secondary subsurface testing phase recovered an additional 66 artefacts. Surface density of the study area was not calculated, presumably due to the low rate of surface finds, and subsurface density was calculated as 6.3/m². However, distribution patterning was noted as varied between the east and west banks of the creek. To the west, densities were highest in areas of higher elevation approximately 110m from the creek line. To the east, densities were highest 15m from the creek line, on the terrace plain. Material types included silcrete, chert and quartz and comprised predominately of flakes and flake pieces.

Wonderland Business Park Development (Dominic Steele Consulting Archaeology 2002 and 2003)

These reports document the initial Aboriginal archaeological assessment of ~40ha of land at the corner of Wallgrove Rd and the M4 Western Motorway, and subsequent testing program, which covered an area of approximately 850m x 400m and comprised 20 test pits.

The initial investigations relocated four of six previously recorded Aboriginal sites in the area, and one possible scarred tree. Three isolated finds previously recorded within the study area could not be relocated during the survey. A surface density was calculated at 0.0001/m² for the study area. During the testing phase, a total of 38 artefacts were identified, which was averaged as a sub-surface density of 0.25/m². Of these artefacts, eight were identified as confirmed stone tools, one ground axe fragment, and 29 were identified as manuports (raw material with no evidence of being worked). Material types comprised of silcrete, quartz, tuff and volcanic rock.

Sydney Zoo Bungarribee Precinct (Artefact Heritage 2015–2016)

Artefact Heritage undertook archaeological survey and test excavation in advance of the proposed development of Sydney Zoo, as part of a State Significant Development (SSD). A total of five Aboriginal archaeological sites (#45-5-0455, #45-5-0465, #45-5-4433, #45-5-4772 and #45-5-4771) and one area of potential archaeological deposit (SZ PAD01) were identified during the archaeological assessment. The five archaeological sites comprise low density

artefact scatters of predominantly silcrete material, located on elevated landforms overlooking Eastern Creek. One site was identified on an existing access track where ground surface visibility was high. The assessment found that these sites had low archaeological significance and limited research potential; and recommended that no further archaeological investigation or mitigation was required as part of the proposed development. Instead, it recommended that the Aboriginal archaeological and cultural resource of the site be managed through the development of a Construction Environment Management Plan (CEMP) and unexpected finds procedure during construction works.

Bungarribee Tourism Hub (AHMS 2015, Extent Heritage 2018)

Extent Heritage undertook archaeological survey (then, as AHMS 2015) and archaeological testing in advance of the proposed development of the Bungarribee Tourism Hub. The assessment identified six Aboriginal sites within the study area (#45-5-0453, #45-50469, #45-5-4308, BBH-AS1, OTC/9, PAD WSP/01) One additional unregistered artefact scatter (OCT/10) was located only 11m outside the study area but likely extended into the curtilage. A program of archaeological excavation was implemented to characterise the nature, distribution and significance of the Aboriginal archaeological and cultural resource of the site.

The excavations recovered 39 Aboriginal objects from 24 of the excavated test pits, at an average artefact density of ~1.9/m². Fifty-nine of the test pits also contained naturally fractured silcrete pieces. The findings of the test excavation indicate that this area was not likely a focal point for Aboriginal people in the past, and was rather more likely used ephemerally or transiently. The study area was considered to have low research potential and low archaeological significance.

The report recommended that an Aboriginal Cultural Heritage Management Plan (ACHMP) be developed for the study area to provide protocols, procedures and tasks to manage the cultural resource prior to, during and post development works.

5.4 AHIMS data

The Aboriginal Heritage Information Management System (AHIMS) database is managed by DPIE, and includes all spatial and compositional information of Aboriginal objects and sites previously recorded and registered, through academic and cultural resource management (see Appendix 3-1 for further explanation of site types).

An extensive search of the DPIE AHIMS database was carried out on 17 July 2018 (AHIMS Search ID # 358029) (Appendix 3-2). There are 72 registered Aboriginal sites within a 1km radius of the study area; six of these are duplicate records, bringing the total site number down to 66. In addition, one site (AHIMS #45-5-3779) was recommended to be listed as “not a site” due to confirmed high levels of subsurface disturbance. Another site (AHIMS #45-5-3434) is registered within 500m of Paramatta River; as the study area is over 12km away from Paramatta River, this site is also excluded from this discussion. All further discussion will be based on the amended total of 64 sites, though these sites are included in Figure 18. Site types include artefact scatters, potential archaeological deposits (PADs), modified (carved or scarred) trees, and art (pigment or engraved) sites.

Regarding site distribution, sites in the area appear to be identified in areas subjected to regional development. As described above, Aboriginal site patterning in the Cumberland Plain is normally described as being strongly influenced by proximity to water and areas elevated above the local landscape. Proximity to water is suggested to reflect past Aboriginal preference for locations with reliable fresh water and also good surface visibility along watercourses. The PADs registered in this area seem to follow this trend, as all four are situated within 200m of Erskine Creek, with three sites located within 100m. Kohen (1986) also suggested that proximity to elevated areas was a particularly important factor for intensively occupied locations.

In the case of the sites identified in this search area, neither pattern holds strongly. Only 13 (20%) sites are within 100m of a watercourse, while 21 (32%) of the sites are more than 500m from a watercourse. In Kohen's study, 65% of sites were within 100m of a watercourse and 8% were more than 500m from a watercourse. Nor are the majority of sites in close proximity to ridgelines or hilltops. Only 4 (6%) of the sites are within 200m of a ridgeline, spur, crest or hilltop, and over half the sites (54, or 83%) are farther than 500m from these topographical features. However, when assessed against the criteria outlined in White and McDonald's (2010) study, the sites within the search area sit more comfortably. White and McDonald show that sites are more likely to be situated on terraces or lower slopes, of which the search area primarily comprises (White and McDonald 2010: 36).

Notably, the site cards for AHIMS #45-5-2564 and AHIMS #45-5-2565 note a Potential Archaeological Deposit (PAD) zone that encompasses Eastern Creek, Reedy Creek, and Erskine Creek within the study area (Figure 16). No associated report was lodged with these site cards. However, this PAD was presumably noted due to the confluence of creeks in the area.

Table 4. Aboriginal sites in the vicinity of the study area summarised by site feature.

Site feature	# of instances	% of total
Artefact	56	87.50
Potential Archaeological Deposit (PAD)	4	6.25
Modified Tree (Carved or Scared)	2	3.13
Art (Pigment or Engraved)	1	1.56
Potential Archaeological Deposit (PAD), Artefact	1	1.56
Total	64	100.00

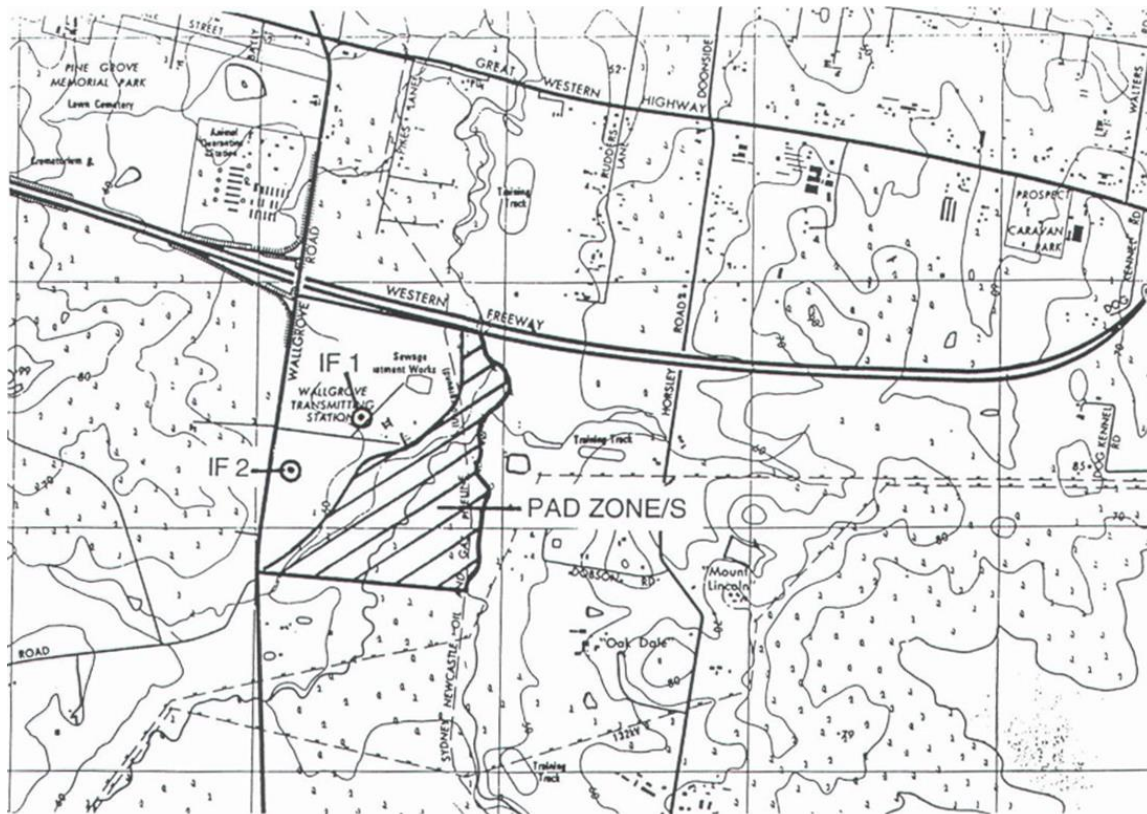


Figure 16. Area of Potential Archaeological Deposit (PAD), identified by Navin Officer (1999) and submitted with the site card for #45-5-2564 (IF1) and #45-5-2565 (IF2) (hatched).

5.5 Predictive model

Archaeological predictive models identify, locate and map where archaeological resources are likely to survive. They can apply to small single sites or large areas, and can be simple exercises or enhanced by the use of specially designed GIS based spatial models. The model for the study area is shown in Figure 20, and is based on series of environmental and archaeological variables:

- **Areas of very high potential:** the model identifies a corridor of very high archaeological potential within relatively undisturbed and/or partially cleared areas within 200m of Eastern Creek. As a major fourth-order creekline, this watercourse would have been considered the primary water-gathering resource in the area; and deposits along its banks have been shown elsewhere to contain significant Aboriginal archaeological deposits of high complexity, and are of a high density. Stands of vegetation within this corridor appear not to have been cleared throughout the historic period and may retain evidence for Aboriginal cultural modification and/or scarring.
- **Areas of high potential:** the model identifies a corridor of high archaeological potential within relatively undisturbed but mostly cleared areas within 200m of Reedy Creek. As a third-order creekline, this watercourse would have formed a secondary water-gathering resource in the area, and one artefact scatter has previously been registered within this area on the AHIMS database (#45-5-0756).

- **Areas of moderate potential:** areas of moderate potential are associated with partially cleared land within 200m of Eskdale Creek and another unnamed first-order tributary off Eastern Creek.
- **Areas of low potential:** areas of low potential are associated with land that is not within 200m of any major or minor watercourse, or has been subjected to previous disturbance. These areas are located on slightly elevated landforms.

Certain landforms and locations are likely to have been favoured for occupation and are therefore likely to retain higher densities of artefacts; in particular lower slope and terrace/levee landforms, and areas near confluences of watercourses where good access to water was provided. Within these areas, discrete high-density deposits may be present, possibly associated with micro-landforms and areas of localised elevation. In contrast, near low order streams and drainage lines there are usually fewer sites and those sites that are present tend to have lower artefact densities.

The cultural assemblages recovered from sites in proximity to higher order streams and drainage lines tend to show evidence of both a variety of tool types and repeated occupation over time. Some of these high-density sites show evidence of knapping activities, which occur during the manufacture of stone tools. In contrast, the cultural assemblages from sites near low order drainage lines are less varied (as well as fewer in number) and appear to indicate more transient and casual occupation. However, low-density artefact scatters have been found on the surface of all landforms, including creek banks, creek terraces, flats, elevated spurs, crests ridge tops and lower and upper slopes. These results are indicative of a 'background scatter' of occupation occurring across the region with sporadic areas of intensive or repeat usage.

Analysis indicates that local availability of stone raw materials is also a key factor in Aboriginal occupation and site distribution. Plumpton Ridge, one of the most important silcrete quarries in the region, is approximately 8km north of the study area and would have been easily accessed for raw materials.

In summary, the Aboriginal archaeological resource that is considered likely to be present within the study area consists of stone artefacts, present on the ground surface and also within subsurface archaeological deposits. There is some possibility for the presence of mature trees with cultural scarring along drainage channels where pre-contact/remnant vegetation has not been entirely removed.

Table 5. Previously recorded sites within and in close proximity to the study area.

Site ID	Site name	Datum	Easting	Northing	Site type	Description	Reference	Comments
45-5-2565	IF2	AGD 1966	301200	6257240	Isolated find	An isolated white chert flake on the eroded edge of a minor drainage line in the area to the west of the ex-RAAF transmission station.	Navin Officer (1999)	Note: report not available through AHIMS database
45-5-2564	IF1	AGD 1966	301450	6257430	Isolated find	An isolated red-brown silcrete flake exposed in a dirt track just west of the ex-RAAF transmission station.	Navin Officer (1999)	Note: report not available through AHIMS database
Not registered	PAD (associated with 45-5-2564 and 45-5-2656)	-	-	-	Potential archaeological deposit	An area of potential archaeological deposit that encompasses the alluvial flats and creek corridor(s) of Eastern Creek, Reedy Creek, and Erskine Creek. Previous archaeological work on Cumberland Plain provides evidence of very high potential for such landforms to exhibit localised concentrations of subsurface archaeological material.	Navin Officer (1999)	Note: report not available through AHIMS database
45-5-0756	EC6 (Eastern Creek)	AGD 1966	302070	6257300	Artefact scatter	35 artefacts located on two dam walls in the south east of the study area. Majority of the artefacts recorded were silcrete with some chert.	Crew (1989)	Strong likelihood of additional artefacts with further investigation.
45-5-3264	WSP17	GDA 1994	302412	6257853	Artefact scatter	8 artefacts located along a dirt track (20 x 20m) in the north east of the study area immediately adjacent to M4. 200m west of Eastern Creek on a hill slope. Surrounding area quite disturbed with clay, ploughing, animal grazing and dams.	JMCHM (2006)	

Site ID	Site name	Datum	Easting	Northing	Site type	Description	Reference	Comments
45-5-1066	Eastern Creek 1	GDA 1994	302060	6257750	Artefact scatter	11 artefacts were recorded, 9 silcrete, 1 chert and 1 indurated mudstone. The artefacts were found in exposures either side of the drainage line <100m from creek. Very disturbed	Brayshaw and Haglund (1996)	Site destroyed in accordance with AHIP C0002113 (KNC 2017)
45-5-0751	EC 11	AGD 1966	302290	6257550	Artefact scatter	Ten artefacts (nine silcrete and one indurated mudstone) found in a 3 x 3m area, on a haul road immediately adjacent to study area and on a flat rise adjacent to Eastern Creek tributary.	Rich (1989)	Site recorded as being destroyed

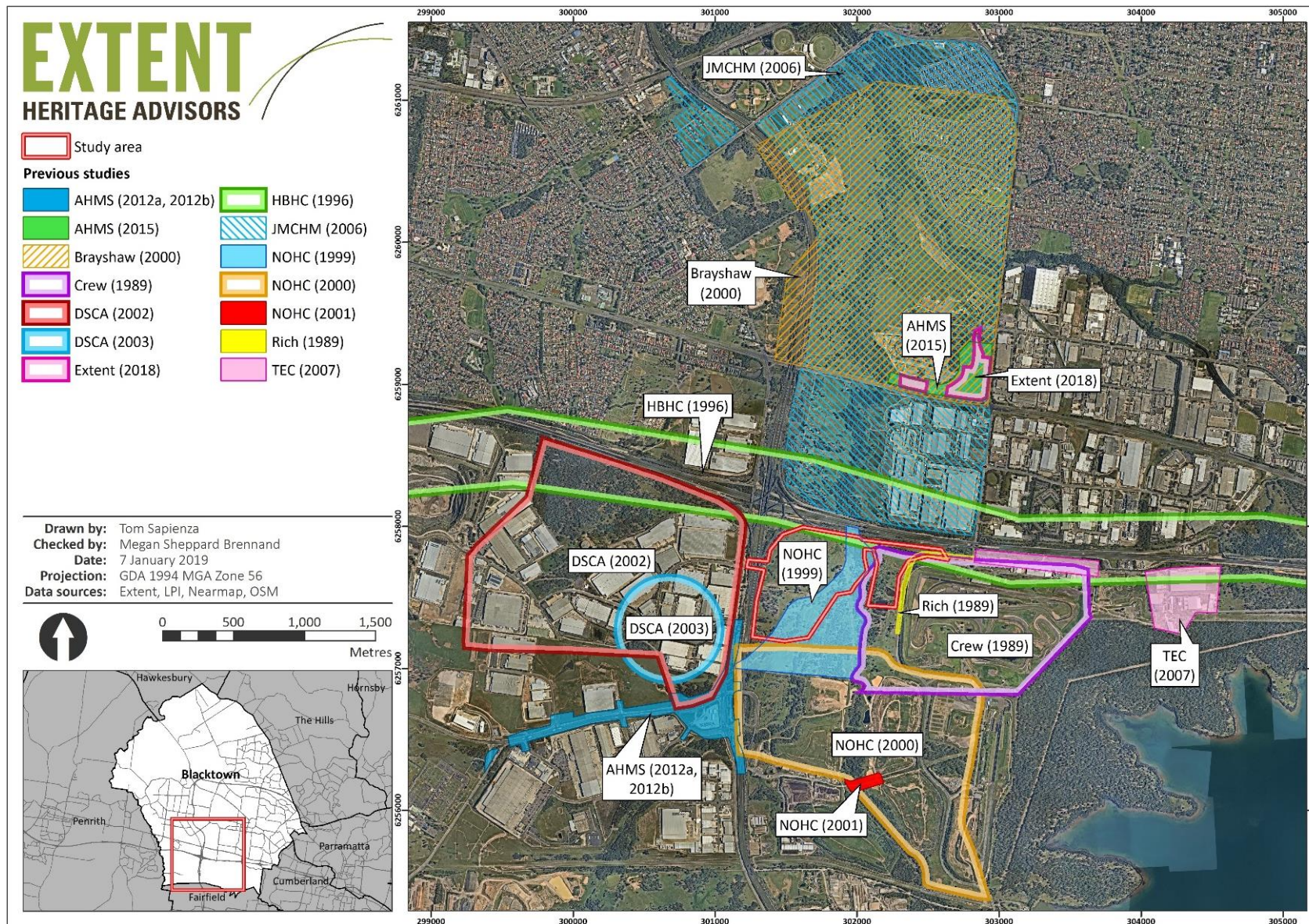


Figure 17. Previous studies undertaken in the vicinity of the study area.

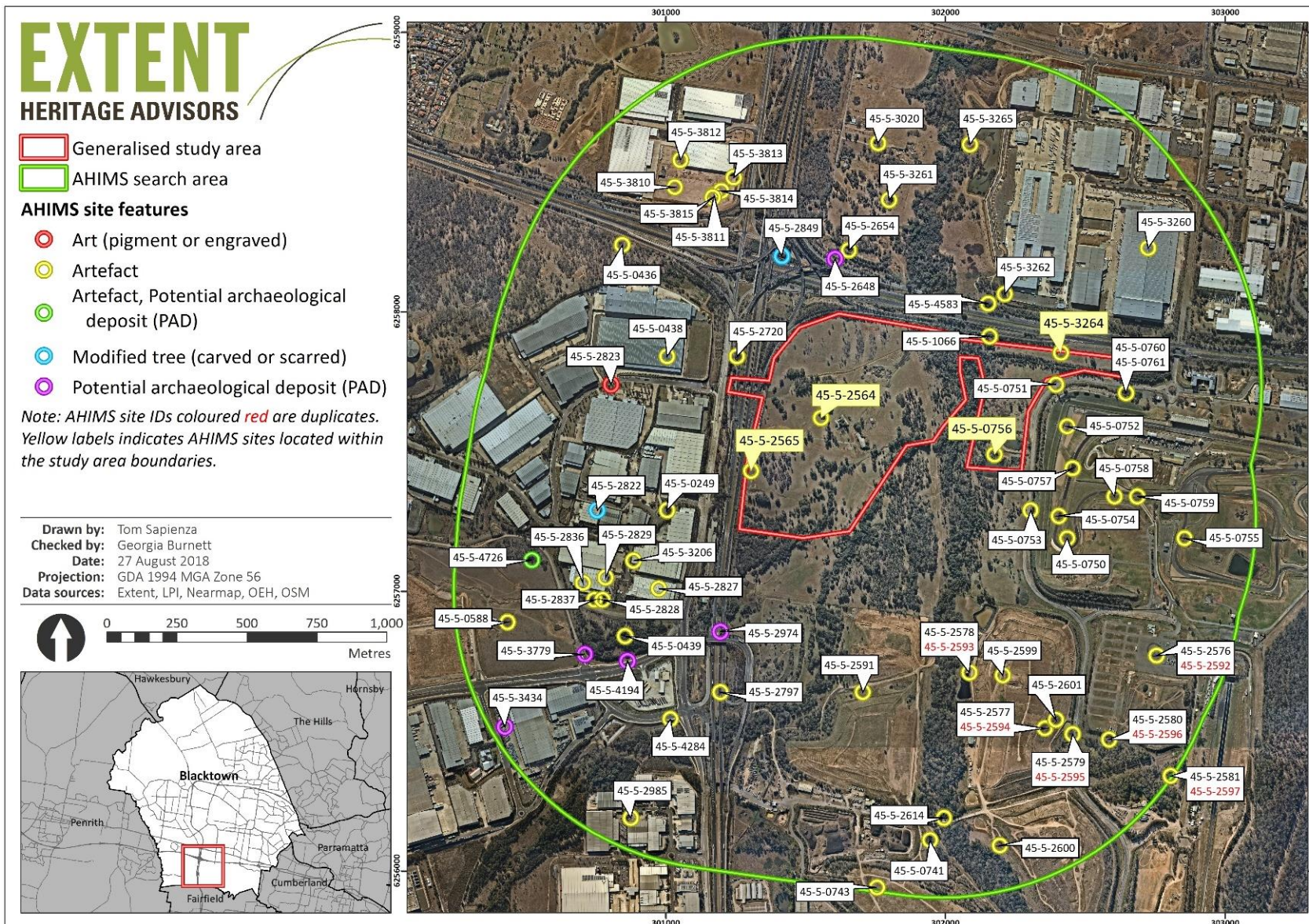


Figure 18. The study area showing registered AHIMS sites within 1km² radius, and displaying the range of site types in the nearby area.

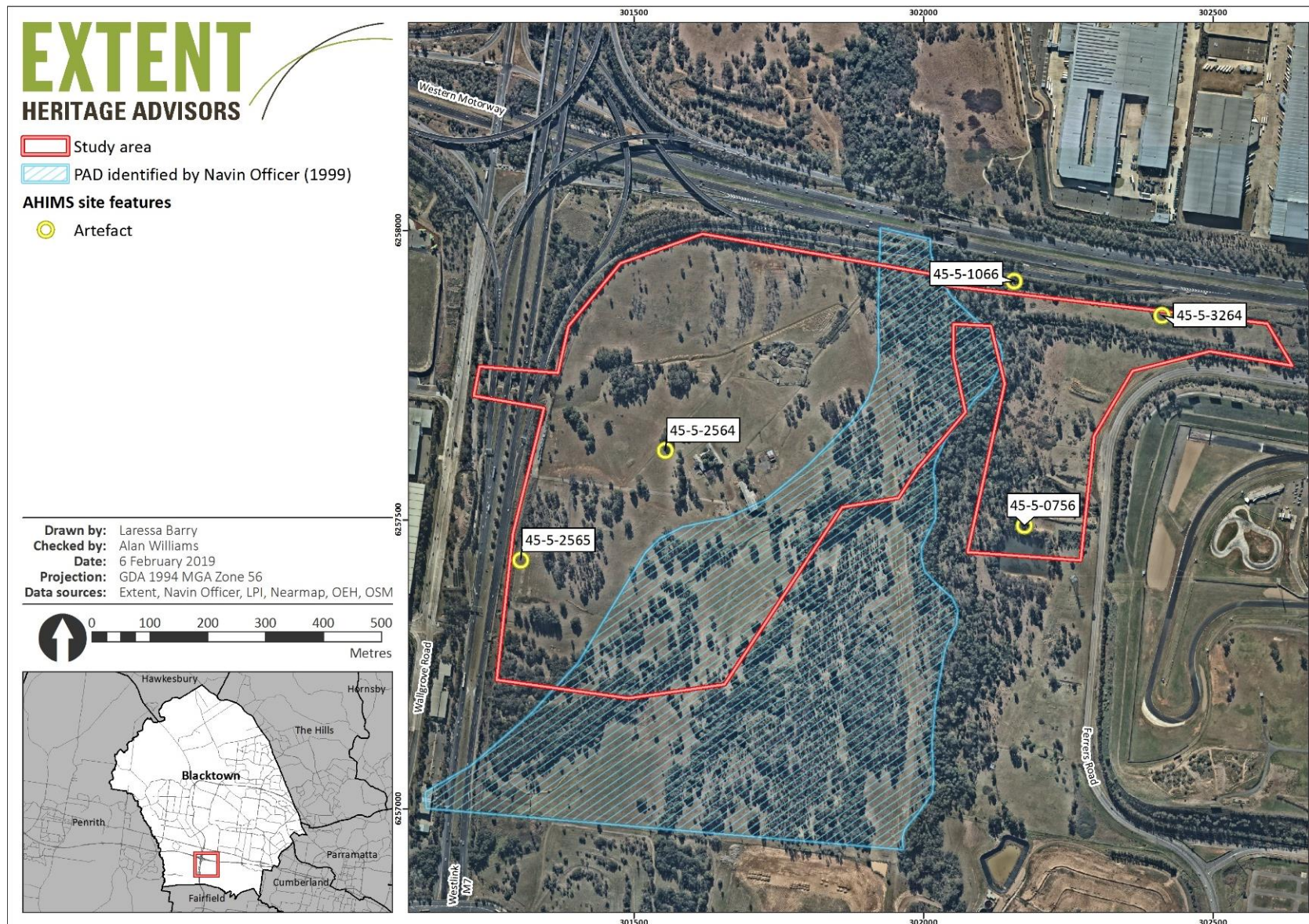


Figure 19. The study area showing AHIMS sites within and near the study area, and the PAD identified by Navin Officer (1999).

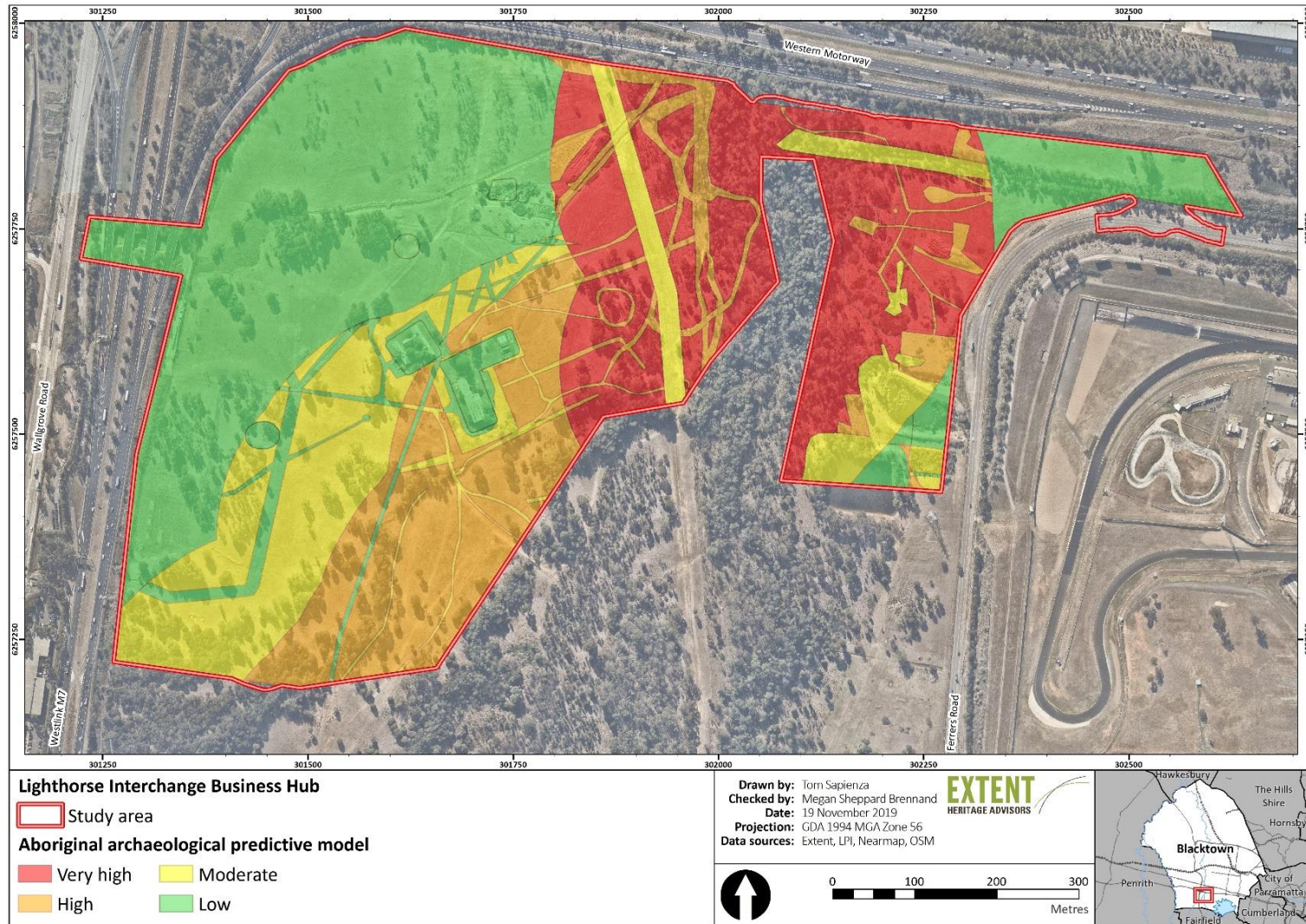


Figure 20. Predictive model of Aboriginal archaeological potential for the study area, from the desktop review to inform the on-site investigation—based on historical disturbance, regional site distribution models and registered sites in the region.

6. Field investigation

6.1 Key findings

- Documentary research, survey and archaeological test excavation resulted in the identification of Aboriginal cultural material within the study area. Systematic excavation uncovered a total of 276 lithics (253 artefacts and 23 heat shatter fragments) from 256 test pits or 66.25m², equivalent to an average artefact density of 4.17 lithics/m².
- The identified sites are predominantly small, low-density artefact scatters and isolated finds, and reflect an ephemeral or transient use of the region in the past. For the most part, they represent a low-density background of cultural material that is typical of the south western Cumberland Plain ('LHIBH BS' #XX-X-XXXX).
- Within this broader background, two discrete elevated terrace landforms along Eskdale Creek and Eastern Creek demonstrated evidence of more intensive occupation ('LHIBH Eskdale Creek terrace' #45-5-5283 and 'LHIBH Eastern Creek terrace' #45-5-5284). Both deposits were shown to contain discrete ~100m² patches of increased artefact density centred on TP151 (n=38 artefacts) and TP57 (n=50 artefacts), and are considered to reflect foci of intensive, but short-lived occupation of the study area during the late Holocene (5,000-0ka).
- Predictive modelling for the study area highlighted major third and fourth order creeklines as foci of Aboriginal occupation, and archaeological investigation broadly supports this, with some caveats. Specifically, low-lying areas adjacent to Eastern Creek and between Reedy and Eskdale Creek below ~44m AHD recovered little, if any artefactual material; these are unlikely to have been suitable for long-term occupation, likely due to periodic flooding and scouring of these deposits.
- As with other sites in the south western Cumberland Plain, excavations within the study area suggest a preference for occupation sites on locally elevated terraces above major high-order watercourses.

6.2 Archaeological survey

Archaeological survey of the study area was undertaken on 17 January 2019 by Extent Heritage archaeologists Fenella Atkinson, Rebekah Hawkins, Megan Sheppard Brennand, and Lorna Cooper, together with representatives from Deerubbin Local Aboriginal Land Council (Steven Randall), Widescope Indigenous Group (Steven Hickey), Kamilaroi-Yankuntjatjara Working Group (Stefanie Khan) and Butucarbin Aboriginal Corporation (Lowanna and Jack Gibson). The survey was undertaken in accordance with Requirement 5 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010).

The study area was divided into three survey units based on landform context for the purposes of reporting. Detailed descriptions of the survey units are included in Table 6 and Figure 21.

Table 6. Archaeological survey unit descriptions for the study area

Survey unit	Landform description	Survey unit area (m ²)	Visibility (%)	Exposure (%)	Effective coverage area (m ²)	Effective coverage (%)
1	Lower slopes generally comprising grassy areas and open paddocks; at elevations of above ~47m AHD.	243,398	20	10	4,868	2
2	Creek flats and elevated terraces above Eastern, Reedy and Eskdale Creeks	306,227	15	10	4,594	1.5
3	Creek beds of Eastern, Reedy and Eskdale Creeks	11,835	10	15	178	1.5
Average		187,153	15	12	3,213	1.67
Total		561,460			9,640	5

6.2.1 Survey results

In conjunction with the results of the desktop research, the survey resulted in the identification of six Aboriginal sites within the study area. These six sites are made up of three artefact scatters with associated Potential Archaeological Deposit (PAD) ('LIBH AS2' 45-5-5185, 45-5-3264 and 45-5-0756), one surface artefact scatter ('LIBH AS1' 45-5-5183), and two isolated finds (45-5-2564 and 45-5-2565). Two additional artefact scatters with PAD ('LIBH AS3' 45-5-5184 and 45-5-1066) were identified outside of the study area boundary. However, both sites are located on creek flat/terrace landform contexts that extend to within the study area boundary, and which have the potential to contain deposits with cultural material. This leaves a total of eight Aboriginal sites, all of which comprise flaked stone artefacts located on the ground surface, with five having the potential to retain subsurface, albeit shallow, archaeological deposit (Table 7 and Figure 22).

The survey resulted in the identification of three previously unrecorded Aboriginal archaeological sites, of which one, an artefact scatter and PAD ('LIBH AS3' 45-5-5184), is located outside of the study area. Of the remaining five previously recorded sites, three could not be relocated during the survey (45-5-2564, 45-5-3264 and 45-5-1066—the latter being the other remaining artefact scatter and PAD site outside of the study area). However, no evidence was found to indicate that these three sites had been destroyed or removed, with the exception of that part of registered AHIMS site #45-5-1066 within the M4 Motorway construction footprint, for which an AHIP for destruction has been granted.

Of the eight identified Aboriginal sites, four are located on lower slope landform contexts (Unit 1), while the remaining four are located with creek flat/terrace landform contexts (Unit 2). Most were small scatters (n=5) or isolated finds (n=2). There was only one large artefact scatter; AHIMS site #45-5-0756 (EC6 (Eastern Creek)), in Survey unit 2, which contained at least 35 artefacts in a heavily disturbed context.

Survey Unit 1

The first survey unit (Unit 1) comprises low slopes along the western and eastern margins of the study area adjacent to the M7 Motorway, the Light Horse Interchange, and Ferrers Road. These areas are typically undeveloped, partially cleared grazing land with scattered residential structures closer to the M7 Motorway. Elevations here are above ~47m Australian Height Datum (AHD).

Survey unit 1 is characterised by a series of open paddocks with low grasses (Plate 1 and Plate 2). The western portion of the survey unit is dotted with fenceposts, disused buildings associated with the former Wallgrove Army Camp, concrete roads and dirt tracks, and stormwater/sewerage and electrical infrastructure (Plate 3 to Plate 7). The eastern portion has been almost entirely cleared apart from a linear corridor along a manufactured drainage line (Plate 8); though historical photographs of the study area confirm these are recent plantings. Ground surface exposures within unit 1, primarily along dirt tracks and within stockpiled sediment, revealed a compacted and heavily eroded soil profile onto clay, with occasional ironstone and manganese gravels within the north western and eastern portions of the study area (Plate 9 and Plate 10). This eroded profile is characteristic of soils of the Blacktown soil landscape, which comprise thin topsoils that are easily susceptible to erosion as a result of livestock grazing, and which leave an exposed clay subsoil. This has not completely removed the potential for cultural material to have been left behind on the clay surface, however, and the presence of isolated finds and scatters within the western portion of the site confirms this.

Four sites were identified in Survey unit 1, comprising three previously identified sites and one newly identified site:

- 45-5-2565 (IF2). This site comprises an isolated chert flake, located along the western fence line and within long grass, on the eroded edge of a minor drainage line (Plate 18 and Plate 19). The condition of the site appeared to be similar to the condition recorded in the site card.
- 45-5-5183 (LIBH AS1). This site comprised a surface artefact scatter of three silcrete artefacts, located in an exposure some 10m south of the asphalt road leading to the RAAF transmission station complex. It was identified on the ground surface in an area of significant ground surface exposure beneath existing trees which appeared to have been subject to previous disturbance, due to erosion (Plate 20). The artefacts were observed within an eroded silty soil profile that was characterised by frequent manganese and ironstone gravels onto basal clays, and is unlikely to contain subsurface deposits (Plate 21).
- 45-5-2564 (IF1). This site comprises an isolated red-brown silcrete flake, exposed in a dirt track just west of the transmission station. The area comprises a relatively flat area covered

with low grasses, and the soil profile is a pale brown sandy soil with frequent sandstone rubble (Plate 22). The site was not relocated during the survey.

- 45-5-3264 (WSP17). This site comprises eight artefacts, located within the study area on the ground surface along a dirt track at the end of Rudders Lane and adjacent to the M4 Motorway. This track is now overgrown with vegetation and ground surface visibility was very low; and therefore, the site was not relocated during the survey (Plate 23).

Survey Unit 2

The second unit (Unit 2) comprises creek flats and terraces associated with Eastern Creek, Reedy Creek, Eskdale Creek and their tributaries. These areas are also partially cleared, though stands of vegetation exist along the riparian corridors of these watercourses; the densest of which are preserved along Eastern Creek.

Survey unit 2 is characterised by relatively flat open paddocks, with isolated stands of mature trees along drainage lines and within swampy waterlogged areas, as well as two large dams with earthen embankments in the eastern portion of the study area (Plate 11 to Plate 13). Several structures, in various stages of dilapidation, exist across this unit, including buildings associated with the former sewerage treatment works and the RAAF transmission station (Plate 14). A 30m-wide gas pipeline corridor bisects survey unit 2, running approximately north-south. Ground surface exposures within unit 2, along dirt tracks and amongst stands of trees, revealed a fine, powdery silty topsoil remaining within ~30m of Eskdale and Reedy Creeks, and is characteristic of soils of the South Creek soil landscape (Plate 15).

Four sites were identified in Survey unit 2, consisting of two previously identified sites and two newly identified sites:

- 45-5-5185 (LIBH AS2). The site comprised two indurated mudstone/tuff/chert (IMTC) artefacts on the eastern bank of a former tributary of Eastern Creek. The artefacts were visible on the ground surface within a silty clay soil profile, in an area of exposure amongst a stand of trees and some 40m west of the gas pipeline trench (Plate 24 to Plate 26).
- 45-5-5184 (LIBH AS3). This site is a small artefact scatter within a silty clay soil profile, consisting of five silcrete and IMTC artefacts. It is located on the ground surface along the eastern bank of Reedy Creek, and visible in an area of exposure along existing vehicle tracks (Plate 27 and Plate 28). The site is located on a creek flat terrace landform, and whilst outside of the study area, this landform feature may extend into the study area.
- 45-5-1066 (Eastern Creek 1). The site comprises an artefact scatter of 11 artefacts (9 silcrete, 1 chert and 1 IMTC), located on an artificial drainage line but formerly on the eastern bank of Eastern Creek (80m east). The site was identified on the ground surface in an area of ground surface exposure, and the site card notes the presence of natural topsoils in the area that have the potential for subsurface artefacts. The location recorded in the AHIMS database is outside the study area, and the site card notes that the scatter has been authorised for destruction due to M4 construction upgrades (AHIP C0002113). The recorded location was not inspected and the site was not relocated during the survey, though a similar

landform along the eastern bank of Eastern Creek, is present within the study area, and has been subjected to minimal disturbance.

- 45-5-0756 (EC6 (Eastern Creek)). This site is a heavily disturbed artefact scatter on two adjacent dam walls, which formerly would have comprised creek flats for a tributary of Eastern Creek. A total of 35 silcrete and IMTC were recorded across two ~15m exposures, from the northern wall of the southernmost dam, and the southern wall of the northernmost dam. The site card notes that a “Consent to Destroy” permit has been issued to enable the site’s destruction; however, the site is unlikely to have been completely destroyed. During the current survey three silcrete artefacts were identified on the southern wall of the northernmost dam (Plate 29 and Plate 30). Artefacts that were originally recorded on the northern wall of the southernmost dam could not be relocated during the survey.

Survey Unit 3

The third unit (Unit 3) comprises the creek beds of Eastern Creek, Reedy Creek, Eskdale Creek and their tributaries. A small portion of Unit 3 within 30m either side of Eastern Creek could not be surveyed due to impenetrably thick vegetation, and it was not possible to cross the creek at those parts of the Creekline that passed through the study area.

Survey unit 3 is characterised by the incised channels of Eastern Creek, Eskdale Creek and Reedy Creek, in addition to unnamed tributaries and ephemeral drainage lines. These watercourses have been subjected to varying levels of disturbance over the historical period. Eastern Creek has been subject to minimal disturbance, with almost impenetrable dense vegetation present within ~50m on either side of Eastern Creek. Although Eskdale and Reedy Creek have been subject to historical disturbance a dark brown silty topsoil remains within ~30m of Eskdale and Reedy Creeks (Plate 16). Eskdale Creek has undergone historic realignment. Such works may have occurred within the study area to drain or dry the surrounding floodplain and improve suitability for agricultural purposes. This alteration at the confluence with Reedy Creek would have resulted in significant change to the hydrology of Reedy Creek, which would account for the deep incision and channel widening evident along the lower reaches of Reedy Creek. It is likely that in the past Eskdale Creek was not a defined waterway rather a low lying, broad drainage depression that was highly vegetated. Although sections of these Creeks small parts of both Eskdale and Reedy Creeks still have minimal disturbance. By comparison, a former tributary of Eastern Creek in the eastern portion of the study area has been converted into two vast dams; while in the western portion of the study area a tributary of Eastern Creek has been channelised near the sewerage treatment works (Plate 17).

No previously recorded or additional sites were identified within Survey Unit 3.

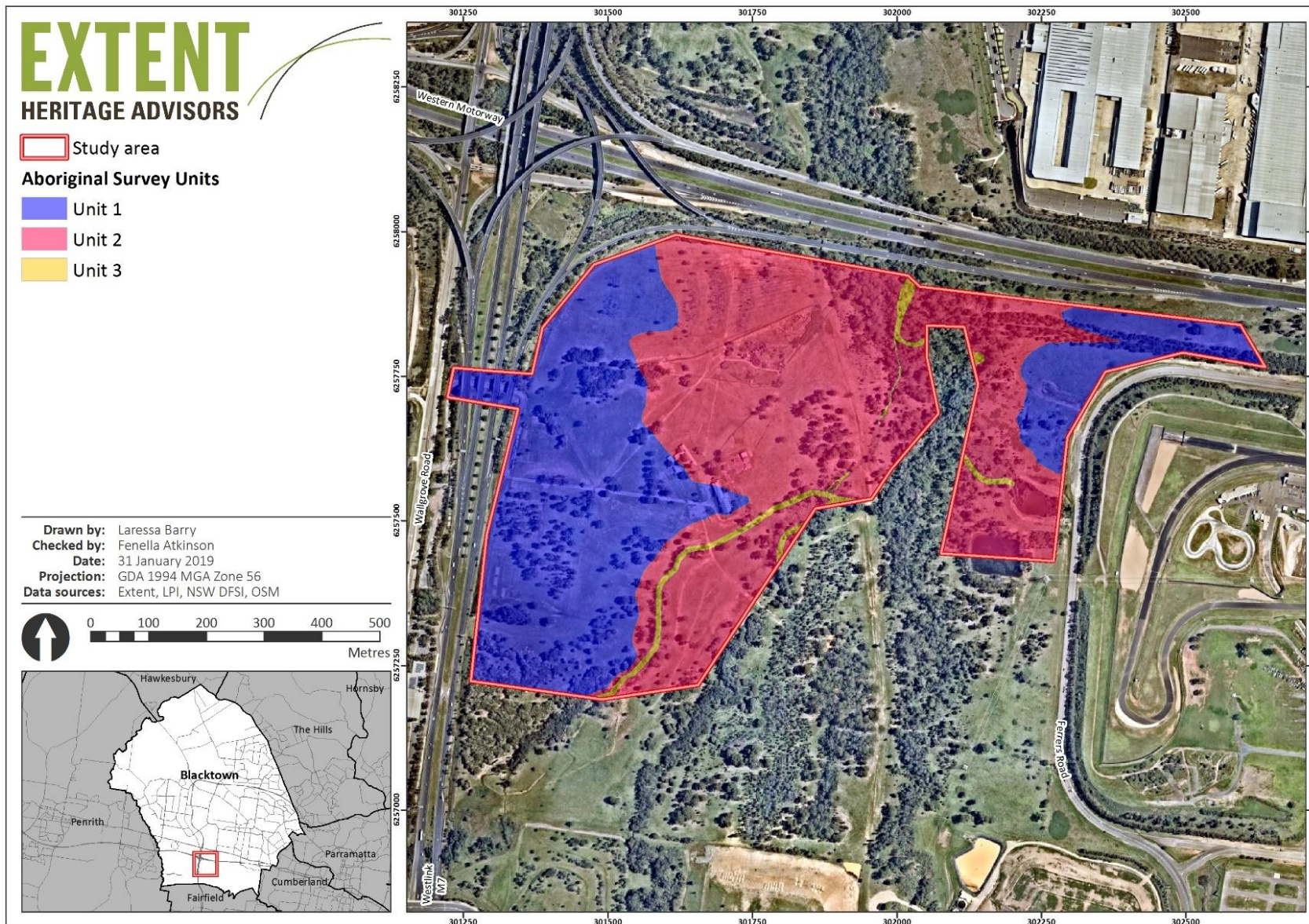


Figure 21. Survey units examined during archaeological survey.



Plate 1. Flat, cleared land within Wallgrove Army Camp, Survey unit 1, view north.



Plate 2. Fenced paddock within Survey unit 1, view northeast.



Plate 3. Exposures along paddock fencelines, Survey unit 1, view south east.

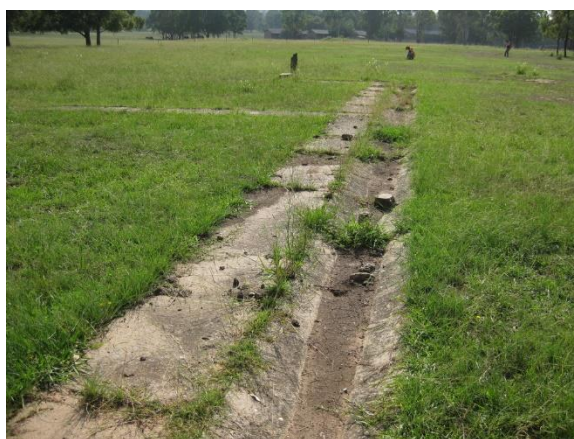


Plate 4. Drain associated with Wallgrove Army Camp, unit 1, view east.



Plate 5. Building associated with Transmission station, Survey unit 1, view northeast.



Plate 6. Sewerage vent pipe along northern site boundary, Survey unit 2, view south east.



Plate 7. Sewerage manhole cover and disturbed clay subsoils, survey unit 2, view south.



Plate 8. Regrowth vegetation along altered drainage line near north-eastern site boundary, Survey unit 1, view south.



Plate 9. Ground surface exposures in Survey unit 1, view south east.



Plate 10. Ground surface exposures along vehicle tracks in Survey unit 1, view north.



Plate 11. Vegetation along drainage lines, Survey unit 2, view south west.



Plate 12. Vegetation along drainage lines, Survey unit 2, view east.



Plate 13. Dam in south eastern corner of the study area, survey unit 2, view north.



Plate 14. Sewerage treatment works structures, survey unit 2, view south.



Plate 15. Ground surface exposures in survey unit 2 showing fine silty topsoil, view west.



Plate 16. Soils along Reedy Creek partially obscured by leaf litter, survey unit 3, view north.



Plate 17. Modified drainage line near sewerage treatment works, view northeast



Plate 18. Artefact (isolated find) 45-5-2565 along western boundary, survey unit 1, view south.

Table 7. Aboriginal archaeological sites identified within the study area. Note all coordinates are now given in GDA 1994/MGA Zone 56. Site locations are shown in Figure 23.

Unit	AHIMS #	Site name	Landform context	Coordinates (GDA 1994)	Site type/features	Description
1	45-5-2565	IF2	Lower slope	301305 6257430 N E	Isolated Find	Isolated chert flake measuring 17 x 12 x 4mm. Located along western fence line and within long grass, on eroded edge of a minor drainage line. The condition of the site is similar to the condition record on the site card from 1999.
1	45-5-5183	LIBH AS1	Lower slope	301494 6257538 N E	Artefact Scatter	Artefact scatter comprising three silcrete artefacts, measuring 10x5x3mm, 20x20x10mm and 30x20x10mm. Site is located some 10m south of the former asphalt road that leads to the transmission station. The scatter is visible in an area of significant ground surface exposure beneath existing trees, within an eroded soil profile characterised by manganese and ironstone gravels onto silt and basal clays.
1	45-5-2564	IF1	Lower slope	301555 6257620 N E	Isolated Find	Described as an isolated red-brown silcrete flake, exposed in a dirt track just west of the ex-RAAF transmission station. The area comprises a relatively flat area covered with low grasses, and the soil profile is a pale brown sandy soil with frequent sandstone rubble The site could not be relocated but is not likely to have been destroyed.
1	45-5-3264	WSP17	Lower slope	302412 6257853 N E	Artefact Scatter	Recorded as an artefact scatter comprising 8 artefacts, in a c.20x20m area. Located along a dirt track through horse-grazing property, at the end of Rudders Lane and adjacent to M4 Motorway. The area comprises a flat area covered with low grasses and visibility was poor; though generally the condition of the surrounding area is similar to the condition record on the site card from 2006. The site could not be relocated but is not likely to have been destroyed.
2	45-5-5185	LIBH AS2##	Creek flat/terrace	301876 6257644 N E	Artefact Scatter, PAD	Artefact scatter comprising two indurated mudstone/tuff/chert (IMTC) artefacts, measuring 20x20x20mm (flake) and 30x25x15mm (core). Site is located along the eastern bank of a former tributary within a stand of trees, some 40m west of the gas pipeline trench. Scatter is visible in a small area of ground surface exposure amongst trees, within a silty clay soil profile.

Unit	AHIMS #	Site name	Landform context	Coordinates (GDA 1994)	Site type/features	Description
						PAD partially corresponds with the unregistered PAD identified by Navin Officer (1999).
2	45-5-5184	LIBH AS3*	Creek flat/terrace	301834 6257369 N E	Artefact Scatter, PAD	Artefact scatter comprising five silcrete and IMTC artefacts, measuring 20x10x10mm, 10x10x5mm, 5x8x5mm, 20x10x5mm, and 15x10x5mm. The scatter is visible within exposures from existing dirt tracks that skirt the eastern bank of Reedy Creek. The is located on with the creek terrace landform, within a silty clay soil profile.
2	45-5-1066	Eastern Creek 1*	Creek flat/terrace	302157 6257912 N E	Artefact Scatter, PAD	Recorded as an artefact scatter comprising 11 artefacts (9 silcrete, 1 chert and 1 IMTC), located within very shallow topsoils (<2cm) approximately 80m east of Eastern Creek. The site is recorded to have been destroyed in 2016 by upgrade works for the M4 Motorway (authorised under AHIP C0002113). However, no consideration was given as to whether the site extended beyond the construction footprint, and into the study area.
2	45-5-0756	EC6 (Eastern Creek)	Creek flat/terrace	302175 6257489 N E	Artefact scatter, PAD	Recorded as a heavily disturbed artefact scatter on two adjacent dam walls, which formerly would have comprised creek flats for a tributary of Eastern Creek. A total of 35 silcrete and IMTC were recorded across two ~15m exposures—the northern wall of the southernmost dam, and the southern wall of the northernmost dam. The site is noted as having a “Consent to Destroy” permit to enable its destruction; however, the site is unlikely to have been destroyed. During survey, three silcrete artefacts measuring 20x10x5mm, 20x10x5mm and 20x20x15mm were observed in a ~25m2 exposure on the southern wall of the northernmost dam.

* These sites, whilst not located within the study area, are located on landforms that extend into the study area and are thus discussed here because they provide greater context to the analysis of site types, distribution and density.

The PAD partially corresponds with the unregistered PAD associated with 45-5-2564 and 45-5-2656, and identified by Navin Officer (1999).

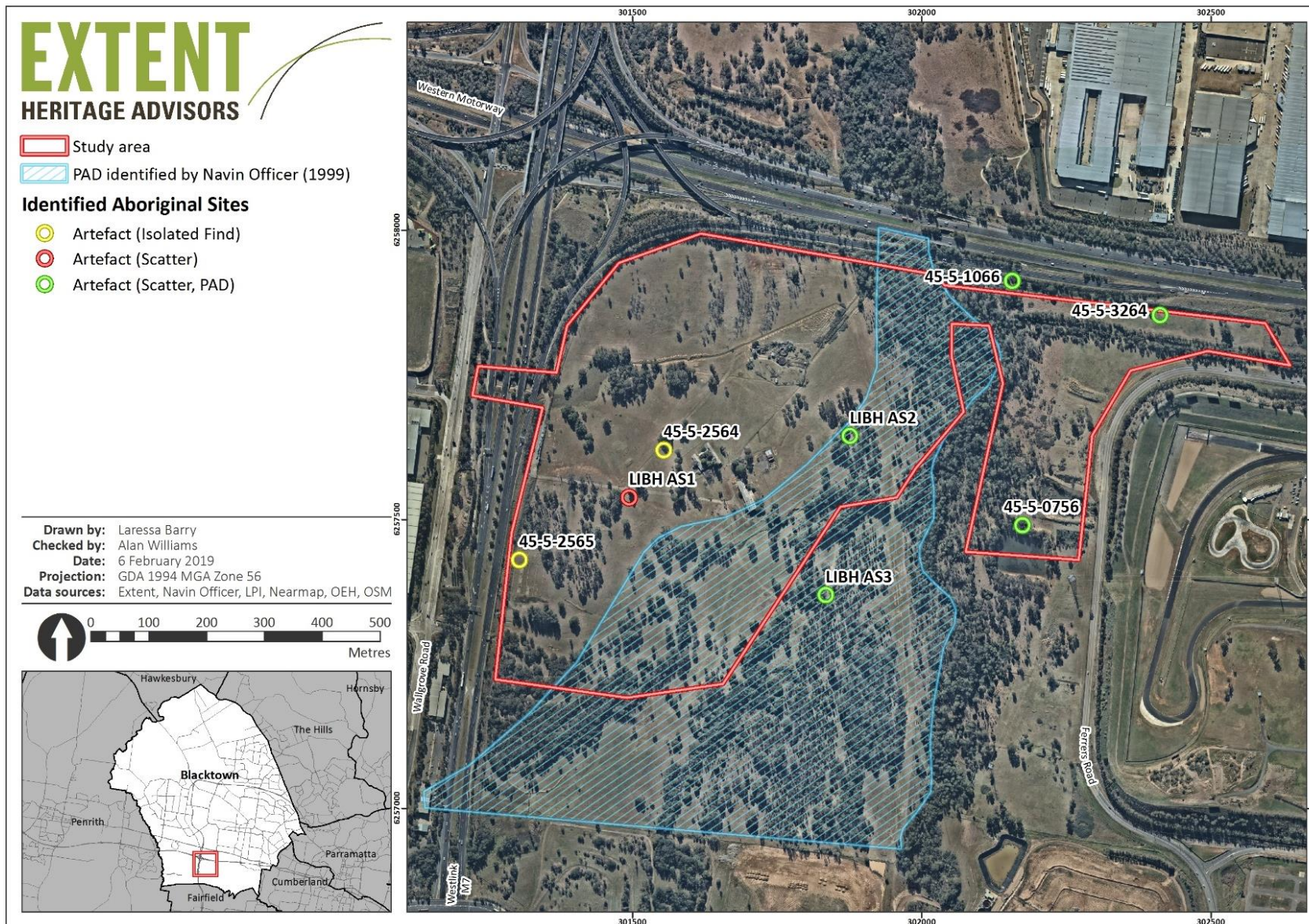


Figure 22. Previously registered and newly identified sites within the study area.



Plate 19. Detail of IMTC flake 45-5-2656.



Plate 20. Artefact scatter site 'LIBH AS1' 45-5-5183, survey unit 1, view north.



Plate 21. Detail silcrete artefact from 'LIBH AS1' 45-5-5183.



Plate 22. General location of artefact (isolated find) site 45-5-2564, survey unit 1, view south east.



Plate 23. General location of artefact scatter site 45-5-3264, survey unit 1, view east.



Plate 24. Artefact scatter site 'LIBH AS2' 45-5-5185, survey unit 2, view north.



Plate 25. Detail artefact from 'LIBH AS2' 45-5-5185.



Plate 26. Detail IMTC core from 'LIBH AS2' 45-5-5185.



Plate 27. Artefact scatter site 'LIBH AS3' located outside of the study area, view west.



Plate 28. Detail artefacts from 'LIBH AS3' 45-5-5184.



Plate 29. Artefact scatter site 45-5-0756 along southern wall of northernmost dam, survey unit 2, view east



Plate 30. Detail silcrete artefact eroding from dam wall of 45-5-0756, survey unit 2.

6.3 Archaeological test excavation

Archaeological test excavation of the study area was undertaken between 13 May and 12 June 2019, and in accordance with Requirements 16 and 17 of DECCW's *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*. The excavation was directed by Laressa Barry (Extent Heritage Senior Heritage Advisor), with the archaeological team consisting of Megan Sheppard Brennand, Coral Hardwick, Matthew Byron, Jonathon Love, Cameron Neal, Ben Calvert and Molly Quinn. A number of stakeholder groups were represented throughout the course of the excavation program, and included Deerubbin Local Aboriginal Land Council, Darug Custodian Aboriginal Corporation, Darug Land Observations, Butucarbin Aboriginal Corporation, Kamilaroi-Yankuntjatjara Working Group and Widescope Indigenous Group.

Archaeological test excavation comprised 256 test pits, which included 253 0.25 m² (50 x 50 cm) test pits and three expanded 1 m² (100 x 100 cm) test pits—TP57, TP137 and TP151 (in total, 265 50 x 50cm squares, or 66.25m² was excavated). These were aligned in a 40-60m grid across the study area (Figure 27). Of the originally proposed test pits, 15 were shifted from their grid alignment to avoid existing structures, road surfaces, creek beds, dense and impenetrable vegetation and other significant disturbances, and 14 were not excavated. An additional 11 test pits were positioned in areas of interest identified during the testing program—namely, four additional test pits were positioned around TP151; six additional test pits were positioned around TP57; and one additional test pit was positioned in the vicinity of the registered location of LIBH AS2 (AHIMS #45-5-5185).

All excavations were undertaken to the base of cultural artefact bearing soil units. Typically, these were the underlying heavy clays of the Blacktown and South Creek soil landscapes. Several test pits were undertaken into fine sandy clay and silty clay alluvium, located on an elevated terrace of Eskdale Creek (TP135-137 and TP151-152) and its confluence with another tributary (TP198-200, TP209-212), and in a similar deposit on the eastern bank of Eastern Creek (TP57, TP260-263 and TP269-270). These excavations confirmed the deepest parts of the alluvial deposit(s) were culturally sterile (see below for further discussion).

All excavation was undertaken manually, using shovels, mattocks and trowels, by a team of archaeologists and Aboriginal stakeholders. Excavations were undertaken in 10 cm spits. Each test pit was dug discretely, with AHD heights being obtained at the start and base of each test pit. Each test pit was given an alpha-numeric label for identification purposes (with individual 50 x 50 cm squares of expanded test pits being labelled as A, B, C and D respectively). A standard site recording form was used for each spit of each excavation unit. Details included 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.

Sediment from each 10 cm spit was collected separately and wet sieved through a 5 mm aperture mesh. All Aboriginal objects recovered from the sieved sediments were retained in plastic bags with the relevant pit alpha-numeric code written upon them, and subsequently transferred to the archaeologist's offices for analysis.

A range of soil and chronological samples were taken during the excavation program. These consisted of column samples of sediment, which were later sub-sampled for relevant

environmental and sedimentological analysis (Appendix 4-1). Optically Stimulated Luminescence (OSL) samples were also taken in areas where high densities of Aboriginal objects were found (TP57 and TP151), and generally tried to bracket the artefact-bearing deposits (to provide a maximum and minimum age) (Appendix 4-2).

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

6.3.1 Test excavation results

This section provides a summary of the excavations and subsequent analysis, with further detail provided in Appendices 4-1 (sedimentological information), 4-2 (OSL report), 4-3 (detailed lithic report and catalogue), 4-4 (plans and sections), and 4-5 (photographic record).

Archaeological excavation across the study area covered 66.25m² in area, with the average depth of excavation being 25cm below the ground surface. A total of 664 spits were excavated, from which 16.6m³ of soil matrix was recovered and sieved (Figure 28).

Three soil profiles were identified across the study area. Much of the land in the north-west and south-west contains a shallow duplex soil that is consistent with the Blacktown soil landscape (Plate 33 and Plate 34). Typically, this profile is characterised by thin, brown, silty clay topsoil, which formed over mottled orange/brown, medium to heavy clay (Plate 35 and Plate 36). In some test pits, erosion promoted by cattle grazing had completely removed the topsoil, revealing the subsoil clay at the ground surface (Plate 37). Where this was the case, a distinct boundary was observed between the silty clay topsoil and medium clay subsoil, at depths of between 10 and 20 cm below the ground surface.

Two distinct soil profiles were observed along major drainage channels:

1. Yellow-brown fine sandy clay alluvium of varying thickness on an elevated terrace of Eskdale Creek; and
2. A similar alluvial deposit was identified elsewhere within the study area; on an elevated flat terrace adjacent to the eastern bank of Eastern Creek.

The deposit at Eskdale Creek comprised shallow brown silty clay topsoil, overlying fine sandy clay, transitioning to medium clay with increasing ironstone staining at the base (Figure 23; Plate 38 and Plate 39). The excavations indicated that the extent and depth of this deposit is heavily influenced by landform type and distance to the creek's edge (Plate 40 and Plate 41). At its deepest point, and immediately closest to the creek's edge at its confluence with Reedy Creek, the deposit is some 90 cm deep, but the terrace deposit thins (<60 cm) to the north east (TP137) and south west (TP165). The buildings of the former RAAF transmission station are situated upon the alluvial terrace.

The depth of the deposit near Eastern Creek was relatively uniform in the excavated test pits (Plate 42 and Plate 43). It comprised a shallow brown silty clay topsoil unit (10 cm), overlying pale brown-grey fine sandy clay with frequent pisoliths (to 40 cm) and yellow-brown indurated medium clay, and with few ironstone inclusions (Figure 24; Plate 44).

The excavation program was designed to avoid areas of significant ground disturbance resulting from historic-period development such as building construction, drainage line modification and services/infrastructure installation. As such, few test pits revealed stratigraphy showing evidence of soil profile disturbance. Notably, evidence for disturbance was most prevalent, in the form of demolition and construction fills, in close proximity to the former Wallgrove Army Camp (TP182, TP161), RAAF Transmission Station (TP118, TP133) and Sewerage Treatment Works (TP45, TP46). These test pits contained fragments of concrete, sheet metal, ceramic pipe and asbestos fragments, as well as mottled plastic clay fills (Plate 45–Plate 48).

Lithics

Overall, 276 lithics, comprising 253 artefacts and 23 heat shatter fragments, were recovered during archaeological excavations. This represented an average artefact density of 4.17 lithics/m².

The highest number of artefacts was recovered from TP57 (n=50, density of 50/m², and 17.8% total excavated assemblage), followed by TP151 (n=38, density of 38/m², and 13.4% total excavated assemblage), TPs 198, 199 and 160 (each n=7, extrapolated density of 28/m², and 2.5% total excavated assemblage), and TPs 136, 124 and 260 (each n=6, extrapolated density of 24/m² and 2.2% total excavated assemblage).

A total of 159 test pits (62.1%) contained no artefacts or heat shatter fragments.

The nature of the artefact assemblage varied considerably, and this appears to be related to landform and soil unit composition. Very low artefact densities (<10 lithics/m²) were identified within the shallow duplex soils of the Blacktown and South Creek landscape, with their completely absent or thin silty clay topsoils. Here, the assemblages found typically comprised low-density artefact scatters and isolated finds; all of which were either on the ground surface, or within the first two spits (<20cm). The distribution of cultural material in these duplex soils is typical of the ‘background scatter’ present across much of the Cumberland Plain.

In contrast, high densities of artefacts were recovered from within two discrete ~100m² locales on elevated terrace landforms adjacent to Eskdale and Eastern Creeks. Within the moderately deep, alluvial silty clays of Eastern Creek, an artefact density of 50 lithics/m² was identified in TP57. Artefact concentrations typically occurred between 0 and 40 cm below the current land surface (between 45.1 and 44.7 m AHD), with peaks at 20 and 30 cm below ground surface. These levels broadly date to within the last 4,000 years.

A high density of artefacts (38/m²) was also recovered from TP151, within deep alluvial sandy clays associated with the elevated terrace above Eskdale Creek, at its confluence with Reedy Creek. The depth of the artefact-bearing deposit was variable, since the terrace deposit thins to the north and west. Here, the main artefact concentrations typically occurred between 10 and 50 cm below the ground surface (i.e., between 46.3 and 45.9 m AHD), with peaks at 20 and 30 cm below ground surface. These levels broadly date to within the last 3,000 years.

Lighthorse Interchange Business Hub, Eastern Creek, NSW
Aboriginal Archaeological Test Excavation 2019
TP 151 - north section

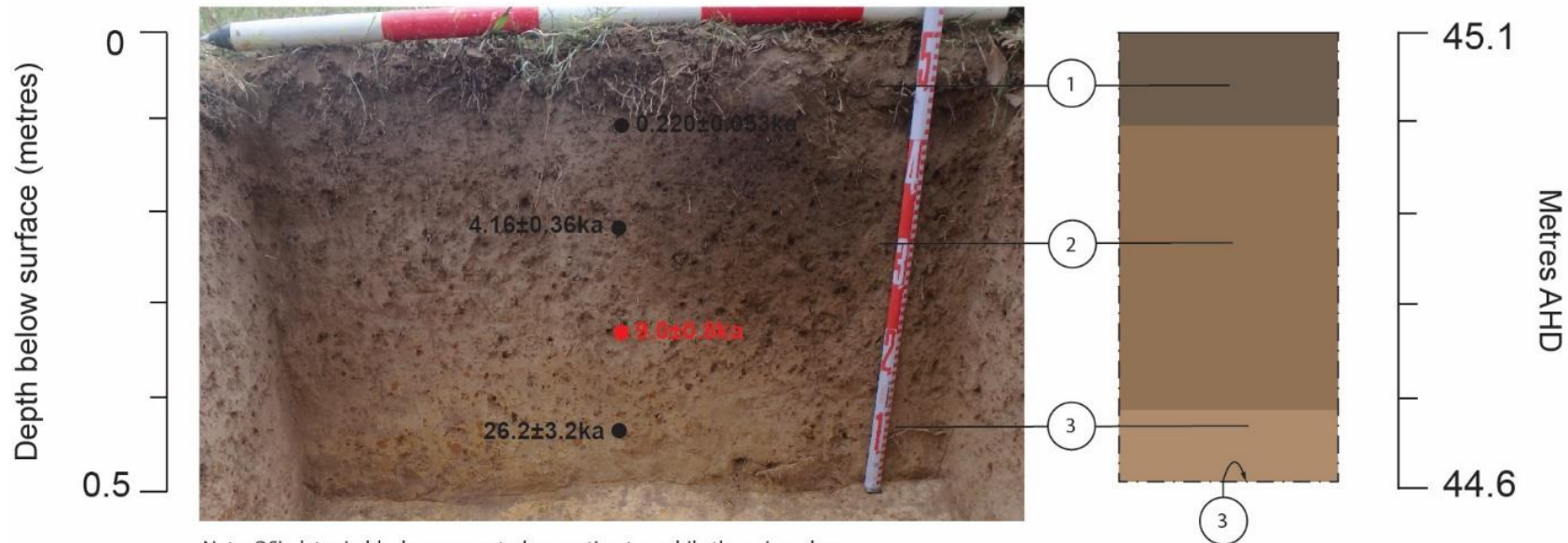


Legend

- ① Mid brown (7.5YR 4/3) friable, weakly compacted silty clay loam; topsoil.
- ② Yellow-brown (7.5YR 4/4) friable fine sandy clay alluvium, with few roots and few ironstone inclusions; alluvial terrace deposit.
- ③ Yellow-brown (7.5YR 4/6) medium clay, with increasing ironstone staining at base; basal clay unit, culturally sterile.

Figure 23. Stratigraphic units within Eskdale Creek terrace landform and their chronological age, from TP151.

Lighthorse Interchange Business Hub, Eastern Creek, NSW Aboriginal Archaeological Test Excavation 2019 TP57 - north section



Note: OSL dates in black are accepted age estimates, while those in red are estimates with caveats, and should be accepted tentatively.

Legend

- ① Mid brown (7.5YR 4/3) friable, weakly compacted silty clay loam; topsoil.
- ② Pale brown-grey (7.5YR 5/3) friable fine sandy clay alluvium with frequent pisoliths and ironstone inclusions; alluvial terrace deposit.
- ③ Yellow-brown (7.5YR 6/4) medium clay with few ironstone inclusions at base; basal clay unit, culturally sterile.

Figure 24. Stratigraphic units within Eastern Creek terrace landform and their chronological age, from TP57.

The lithic assemblage is dominated by fine-grained silcrete artefacts (n=188) with smaller counts of medium-grained silcrete (n=34), tuff (n=22), fine-grained siliceous (n=4), milky quartz (n=2) and silicified wood (n=2). Two types of raw material sources were used: paleo-channels (only the fine-grained and medium-grained silcrete), and secondary material from a waterway (tuff, silcrete, milky quartz).

A total of 17 cores and five core fragments were found. A relatively high number of tools (n=19) were also found. Most of the tools were made on complete flakes (n=9). Considerable evidence for burning was seen in the presence of the heat shattered artefacts and heat shattered fragments. A low frequency of broken flakes is shown by the ratio of broken to complete flakes (2.2:1). This result suggests the assemblage is not highly fragmented, except for those identified in spit 1 (0–10 cm). Broken flakes may be a result of breakage during manufacture, post-depositional breakage (ploughing, treadage or heat-shattering) or the deliberate snapping of complete flakes during the manufacturing of particular tools, such as geometric microliths.

The cores show some evidence of platform preparation i.e. overhang removal or faceting. In general, the cores are either highly reduced or abrupt failures after attempts to remove flakes resulted in step or hinge terminations. The small sizes of the cores suggest that they were anvil-rested and flaked using a bipolar technique. Evidence of some systematic core reduction along the Eastern Creek bank is seen in the presence of three atypical burin–blade cores, a sub-prismatic core and alternate-blade cores (Plate 31). Two further strategies were used to manufacture elongated flakes used for backed artefact manufacture; the alternate-blade core (e.g. IDs=21, 31) and prismatic blade core (ID=199). These strategies were all found in and around TP57 (TP 57c and TP 57d).

The tools are dominated by finished Bondi points and broken backed-artefact fragments, though other notable tools included straight- and end-scrapers, a geometric microlith, Elouera, notched tools and a drill (Plate 32). Given the relatively high frequency of backed artefacts and the appearance of unfinished tools, it is likely that these were systematically made on-site in the vicinity of Eastern Creek (TP57). The presence of backed artefacts, and the predominance of silcrete indicate that this place was occupied during the mid to late Holocene (c. 5,000 BP–present; e.g. Doelman et al., 2015:497; Kohen 1986). This age estimate correlates well with the OSL ages obtained during excavation (see discussion below). In summary, the assemblage suggests that occupation was likely short-term, single events, but repeated over time—as displayed by the different areas of tool use, artefact colours and raw material types.

The excavation results were compared with those obtained from similar sites within the region. A summary of several key assemblage attributes is presented in Table 8. The density of artefacts at this site is much lower when compared to other sites along Second Ponds, Ropes and Eastern Creek (e.g., RH/SP17, RH/SP9 and RH/CC2). However, the frequency of cores to complete flakes within the study area is much higher when compared to the other sites. This result reflects the influence of the assemblage at and around TP57. The study area also has a high frequency of tools and most of these are broken backed artefacts, and generally lower amounts of cortex when compared to most other sites.

The majority of identified sites are small, low-density artefact scatters and isolated finds, and reflect an ephemeral or transient use of the region in the past. For the most part, they represent

a low-density background of cultural material that is typical of the south western Cumberland. Elevated terrace landforms adjacent to Eskdale and Eastern Creek demonstrated evidence for more intensive occupation with discrete patches of increased artefact density, yet both are ultimately comparable to other sites along major waterways in the south western Cumberland Plain (Figure 29).

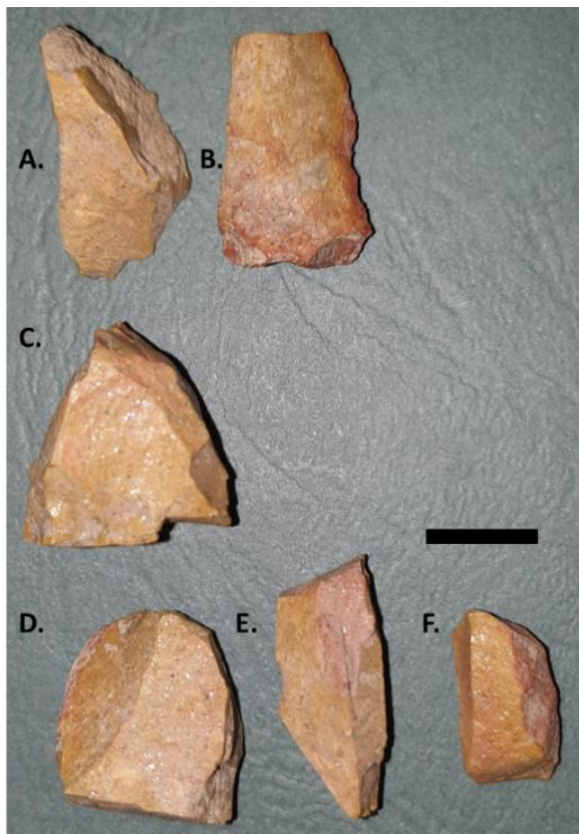


Plate 31. Cores in the lithic assemblage. Atypical Burin-blade cores, A. Id=19, TP57c, spit 2, and B. Id=21, 57d, spit 4; Sub-prismatic blade core, C. Id=199, TP57, spit 1; Alternate-blade core, D. Id=254, TP57c, spit 3, E. Id=31, TP57c, spit 2, and F. Id=252, TP57, spit 1.

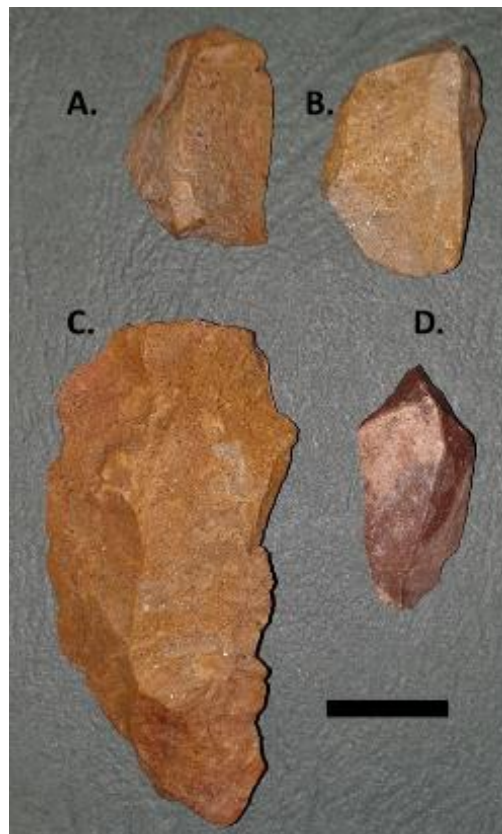


Plate 32. Examples of other tool types in the lithic assemblage. Scrapers A. Id= 60, TP57c, spit 2 B. Id=12, TP57, spit 2; Notch Id=56, TP189, spit 3; Drill Id=144, TP73, spit 1.

Table 8. Comparative data for other assemblages in the Cumberland Plain

	The study area	RH/SP17	Caddies Creek	Riverstone West	Western Orbital (Zone 1)	Cowpasture Road (AHMS)	RH/SP9	RH/CC2	Greenway Drive, Austral	Oran Park and Turner Road	HPR
Density per m2	4.17	54	13.5	6.5	1.0	15	79	84.9	14.9	7.4	4.0
Material (% of silcrete)	88.1	92.8	79.6	83.2	92.0	83.0	60.3	58.3	63.2	70.2	47.5
% of silcrete artefacts with no cortex	73.0	75.6	52.0	52.0	53.3	90.9	89.7	93.4	82	*	84
Mean flake length (mm)	15.6	*	13.1	15.1	12.6	9.3	*	*	9.8	*	18.7
Ratio of complete flakes to cores	3.2:1	6.6:1	6:1	12:1	35:1	20:1	*	*	24:1	12:1	6:1
% of tools	6.9	4.4	7.9	2.7	1.3	7.2	2.0	2.0	4.3	4.9	3.2

Chronology

To provide a chronology of the deposits, a large number of samples were collected for Optically Stimulated Luminescence (OSL) dating. These samples were strategically selected to provide a general understanding of the stratigraphic units, as well as to provide a higher resolution of dating through key sequences, which contained significant cultural materials.

All sampled were processed by Professor Zenobia Jacobs at the University of Wollongong, and are reported upon in detail in Appendix 4-2. The samples were processed using the single-grain technique.

The results of the OSL ages are presented in Table 9. Six samples (OSL3 to OSL8) were taken from TP151, and four samples (OSL9 to OSL12) were taken from TP57. The rationale for these samples was to provide further information on the age of the deposits containing cultural material, given that very little archaeological work had been undertaken.

With regards to TP151, OSL7 ($26.9 \pm 1.4\text{ka}$) and OSL8 ($24.6 \pm 1.4\text{ka}$) from near the base of the soil profile date to the Last Glacial Maximum (LGM), and provide a useful benchmark for the formation history of the terrace in this location. The LGM was characterised as much drier, cooler and windier (Williams et al., 2015), and can account for the finer sediments observed in the excavations—resulting from aeolian and alluvial processes re-working exposed parts of the Eastern Creek floodplain. Periodic flooding likely occurred as a result of summer melting of glaciers and snowfall present across the Blue Mountains during this time, and this is likely to have sent significant volumes of water into the western Sydney Basin (Williams et al., 2013). Indeed, the identification of some of the individual sand grains dating to 30.7 ± 2.5 within the OSL5 sample suggests that there is some evidence of older deposits from the river system being encompassed within the soil profile through the above processes.

Samples OSL3 to OSL6 bracket the archaeological assemblage at TP151, though due to bioturbation and considerable mixing, conservative maximum and minimum age estimates spanning some 20,000 to 30,000 years were provided for each sample. When considering only the minimum age estimate supplied for each sample, the data suggests that visitation of the region occurred initially in the late Holocene $\sim 3,000$ years ago, and continued through to within the last hundred years before present (Min. equivalent date estimates of $0.132 \pm 0.054\text{ka}$ (OSL3), $0.601 \pm 0.087\text{ka}$ (OSL4), $1.38 \pm 0.15\text{ka}$ (OSL5) and $3.18 \pm 0.03\text{ka}$ (OSL6)).

Similar results were obtained from OSL samples taken from the eastern bank of Eastern Creek, at TP57. OSL12 ($26.2 \pm 3.2\text{ka}$), taken from near the base of the soil profile, suggests a formation history that also began in the LGM. The maximum age for OSL10 ($4.16 \pm 0.36\text{ka}$) again supports the assumption that visitation of the region began in the late Holocene, and continued until a few hundred years ago ($0.220 \pm 0.053\text{ka}$).

Chronological data, lends support to the notion that the terraces and associated alluvial deposits within the study area first began forming in the LGM, with little evidence of occupation until the late Holocene, as the soil profile developed (i.e. turned to topsoil) and population intensified with improved climate. The data is correlated by the artefact typology of the assemblage. Comparisons with other sites also support this age, with the majority of sites in the south western Cumberland Basin dated to within the last 5,000 years.

Table 9. Summary of OSL ages.

Test Pit	Depth (cm below ground surface)	Elevation (m AHD)	Lab Code	Max1	Max	Min	Notes
151	15	46.24	OSL3	17.3±2.1	4.1±0.5	0.132±0.054	The artefactual assemblage from these depths is characteristic of a middle Bondaian phase, which would lend support to a late-Holocene age.
151	30	46.09	OSL4	25.3±2.3	9.7±0.8	0.601±0.087	
151	45	45.94	OSL5	-	30.7±2.5	1.38±0.15	
151	60	45.79	OSL6		27.7±1.7	3.18±0.03	
151	75	45.64	OSL7	26.9±1.4	9.1±0.7	3.48±0.49	
151	90	45.49	OSL8		24.6±1.4	4.4±2.9	
57	10	44.98	OSL9		2.53±0.25	0.220±0.053	The artefactual assemblage indicates a late-Holocene age
57	20	44.88	OSL10	11.5±1.2	4.16±0.36	0.344±0.058	
57	30	44.78	OSL11	20.2±1.8	9.0±0.8	0.541±0.075	
57	40	44.68	OSL12		26.2±3.2	0.818±0.090	

Note: 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.

Sedimentology

In addition to visual observations in the field, soil column samples were collected from TP57 and TP151. These were subjected to ITRAX analysis at ANTISO, which resulted in sub-centimetre information of major trace elements and magnetic susceptibility, as well as providing an archival record of the soil profile (Appendix 4-1).

In relation to the trace elements, initially a principal component analysis was undertaken to identify the trace elements that closely correlated with the artefacts recovered. This showed that magnetic susceptibility was closely positively correlated, while a range of other elements, including P (Phosphorous), Ca (Calcium), Cl (Chlorine), S (Sulphur), Si (Silicon) and Ti (Titanium) were inversely correlated. These are presented by soil column sample in Figure 25 and Figure 26.

The use of ITRAX data in archaeology is still fairly new (Theden-Ringl and Gadd 2017), and the interpretation of the specific trace elements and their relationship to human activity is not always well understood. Of note in our data is the close correlation of the magnetic susceptibility to the number of artefacts recovered. Commonly, magnetic susceptibility is considered to reflect increasing fire within the landscape, which affects the iron composition in the soil (e.g. Lowe et al. 2017). It is not inconceivable that the data is reflecting small hearth fires, however it is equally possible that the magnetic susceptibility is responding to broader anthropogenic landscape disturbance (e.g. Jiménez-Moreno et al. 2013). These activities may include localised fires, but may reflect other forms of site disturbance, such as vegetation and tree removal and/or repeated trampling of the same area, resulting in soil erosion/degradation. Increasing discard of material culture from such activities may also play a role. It is also worth noting that the magnetic susceptibility at the base of TP 57 and 151 encompassing culturally sterile deposits is very low, and further highlights the relationship between human activity and this index. Regardless of the cause, the important factor is the close correlation between the two indices, with the magnetic susceptibility providing an independent proxy that people were within the study area through the late Holocene. Further, the increased resolution of the ITRAX data suggests numerous isolated peaks in the magnetic susceptibility that may indicate discrete pulses of human activity within the study area, especially at TP151, and at least some of which align with peaks in artefact discard. Although, it is acknowledged some of these peaks correlate with other trace elements, and may also be responding to broader environmental change.

With respect to the remaining trace elements, there is only weak correlation with the artefact dataset, and they are more likely responding to broader environmental conditions. Of note is Cl (Chlorine) and Ca (Calcium), which are considered to reflect an index of flooding and/or site submergence (e.g. Hennekam and de Lange, 2012), and which (along with other trace elements), show major events during the early Holocene thermal maxima (8-5ka) (TP57) and during El Nino Southern Oscillation (ENSO) intensification in the late Holocene (4-2ka) (TP151). A range of trace elements appear to have a step-wise increase through the Holocene (including S (Sulphur), Zn (Zinc), P (Phosphorous)) and are likely responding to external climate influences. Although it is acknowledged that the movement of trace elements through the soil profile is poorly understood at the site, and as such taphonomic processes may play a role in these results. Occasional peaks associated with Cl and Ca may also reflect influxes of organic material from flooding events. P (Phosphorous), Zn (Zinc) and Cu (Copper) are shown to relate to human activity (Theden-Ringl and Gadd, 2017), but there appears little correlation in the

dataset; although the increase in Cu and Zn in TP151 within upper soil units, may indeed hint at industrialised human activity within this locale in the last 150 years.

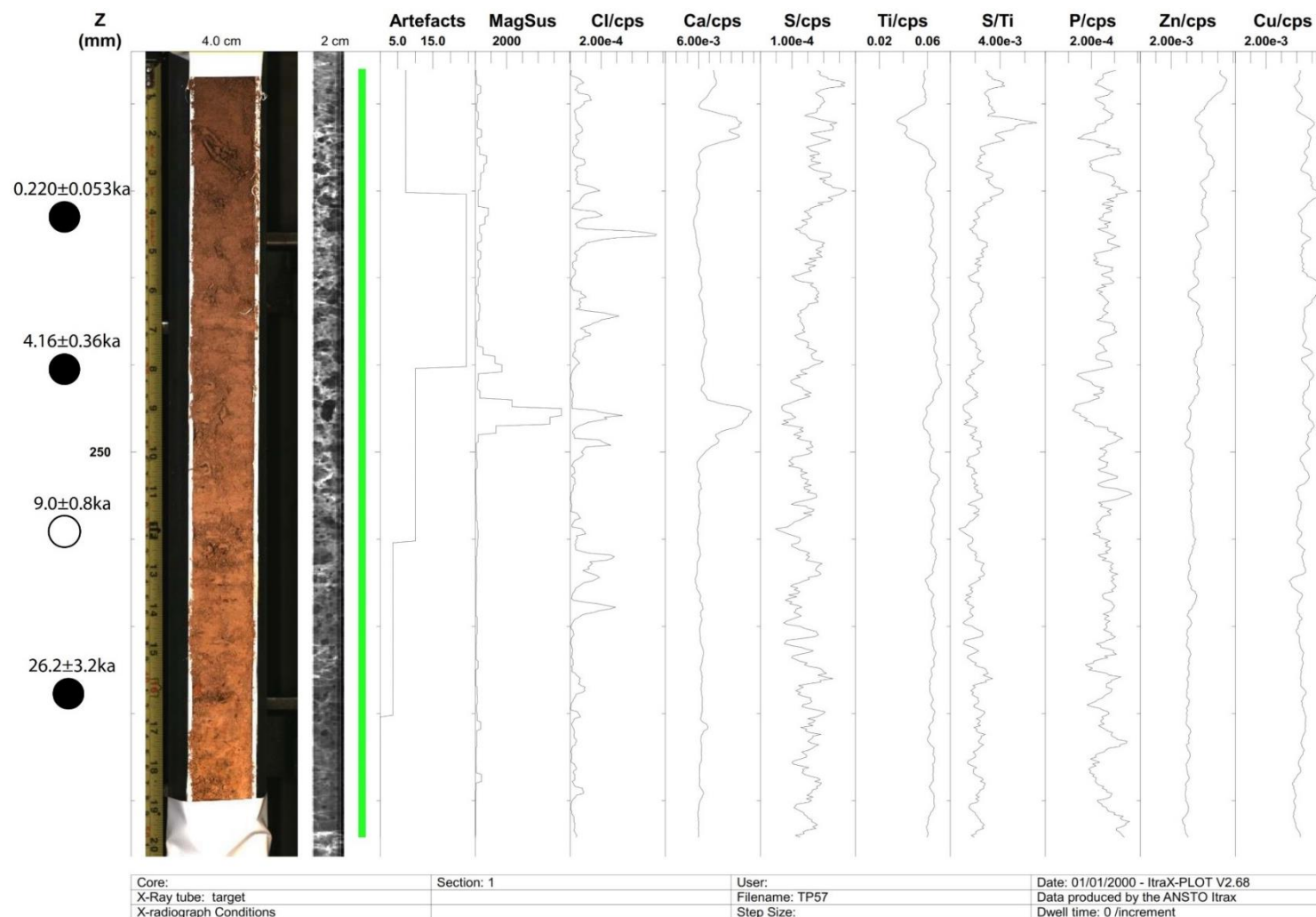


Figure 25. Trace element analysis of a soil column from TP57. This includes a chronological, photographic and radiographic record of the core, along with trace elements shown to respond to human activity and/or have a correlation or inverse correlation with the cultural assemblage.

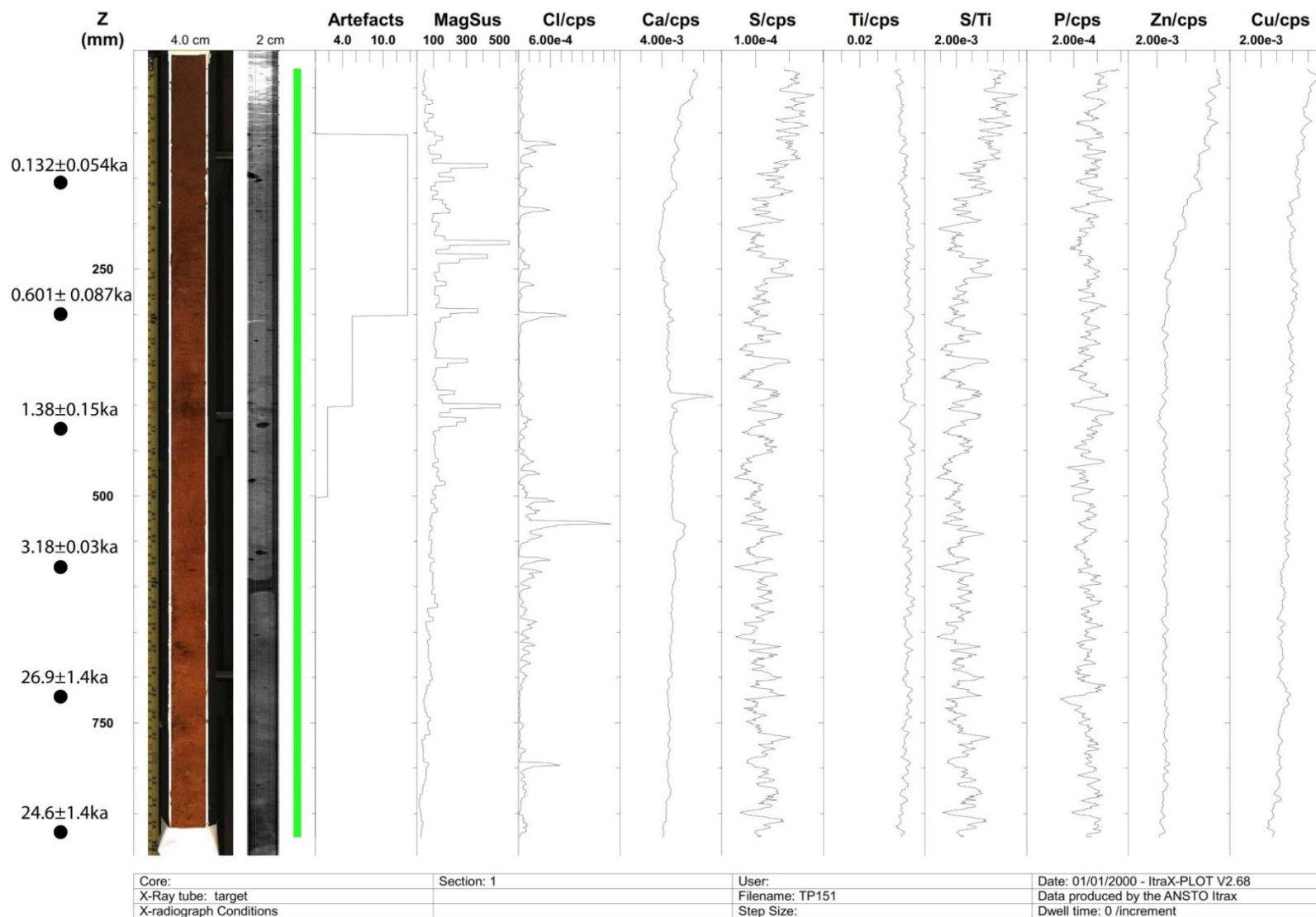


Figure 26. Trace element analysis of a soil column from TP151.

6.3.2 Response to research questions

As part of the justification for undertaking archaeological test excavation at this site, a research design was prepared to define a set of specific questions about the past that might be answered by analysis of the excavation results. This section provides responses to these questions where they can be resolved through the works undertaken.

- Source Information. Which raw stone material resources were used by Aboriginal people who crossed this land in the past?

The stone artefact assemblage was dominated by objects made of fine-grained silcrete. Two types of raw material sources were used: paleo-channels (from which only the fine-grained and medium-grained silcrete were obtained), and secondary sources from a waterway (tuff, silcrete, milky quartz). It is possible that the silcrete sources were subject to considerable damage, through bush fires or other farming activities. Fire may either have damaged the naturally occurring silcrete cobbles prior to flaking, or may have damaged the artefacts after discard. Although red silcrete is known to occur close to primary sources, the frequency of this colour is low. Most of the cobbles at primary sources are yellow. Colour change is known to occur when silcrete is heated (changing from yellow to red). The high frequency of red artefacts in the study area is unusual in this regard. It is likely that controlled heat treatment of cores/large flakes occurred, and that these artefacts were subsequently transported. This may also account for the presence of flakes with crazed platforms.

The small size (dimensions) of artefacts within the assemblage reflect both distance from the source, and the reduction strategies employed. The closest known source of silcrete is at Dean Park, some 8km north of the study area along Eastern Creek. However, it is predicted that silcrete may occur closer, as it is known to occur along the 60asl contour line (Doelman et al. 2015).

Small numbers of silicified wood, milky quartz and tuff artefacts were also found during the excavation.

- Stone reduction technology. How was the stone worked and used? Can the function of the site be inferred from the artefact assemblage?

Little evidence for initial core acquisition, preparation or reduction was identified in the study area. Cores were very small and generally had little cortex. Evidence for 'systematic' reduction of cores on site was identified, specifically centred around TP57, in the form of the manufacture of elongated/blade flakes from prepared cores. The presence of atypical burin-blade cores represents a systematic core reduction similar to the Redbank A strategy observed by Hiscock (1993) in the Hunter Valley. This strategy was also indicated by a number of other artefact characteristics, e.g. faceted platforms, overhang removal and flakes with a blade/elongated form. Most of the cores represent a late stage failure and discard. In other words, the cores found here were at the end of their useful life. Given the size of cores it is likely they were flaked using an anvil-rested, bipolar technique. Cores were also made on blocky, heat damaged fragments; and likely represent an opportunistic use of available material. Heat treatment not only helps when flaking cores, but also assists in the production of geometric microliths and backed artefacts.

The tools are dominated by finished Bondi points and broken backed fragments. Only one complete geometric microlith and a single elourea were found, both of which indicate random loss or

unintentional discard. The presence of unfinished backed artefacts at TP57 is strongly suggestive of the on-site manufacture of backed artefacts in this locale.

The small numbers of tuff artefacts were produced from a variety of reduction activities. These flakes are expanding in form; and are either retouching flakes used to manufacture a working edge of a scraper, or from overhang removal.

- Post-depositional influences. What post-depositional influences have impacted on the assemblage?

Evidence for heat damage from fire was observed across the majority of test pits, with notable concentrations of heat damage centred on TP151. Given its location near buildings (the transmission station), it is likely that at least parts of the upper soil profile and associated artefacts were impacted by post-depositional burning. Within TP151, heat has shattered some of the artefacts after discard, and may partially account for increased artefact numbers at the site. Ploughing may also be responsible for a higher number of broken artefacts.

It is likely that there has been some movement of artefacts within the assemblage, however there is no evidence of size sorting across the study area. Three sets of conjoining artefacts were identified in TP261 and TP211; and a concentration of cores, flakes and unfinished backed artefacts made from the same yellow silcrete material were recovered from TP57.

- Site chronology. When was the site occupied? Was the assemblage the product of repeated occupations or a single event? Does any spatial patterning occur in the assemblage?

Based on the artefact typology, which is dominated by silcrete material and backed artefacts, occupation of the study area likely occurred in the late Holocene (<5,000 years ago). OSL samples from the excavation support this assumption, and indicate that the broader site (and indeed two elevated terrace landforms along Eskdale and Eastern Creek) were occupied between ~4,000–100 years ago. It is likely that occupation was short-term, single events but repeated over time—as seen in the various areas of tool use, and limited raw material types. TP57 demonstrated a large concentration of artefacts manufactured from a single type of yellow silcrete material—possibly the same core—and may possibly reflect a single discard event (though further conjoin analysis would be required). In this area the largest concentration of cores and tools also occurs; and likely represents an artefact manufacturing site. This area warrants further investigation.

When considering the study area as a whole, the testing program indicates that tool manufacturing activities were concentrated in two discrete locations on elevated terrace landforms above Eastern and Eskdale Creek. Across the remainder of the study area, there was a low-density distribution of artefacts present, and this is typical of the background of cultural material present across the south western Cumberland Plain.

- Comparative Analysis. How does this site compare with others in the surrounding region?

When compared to other sites along Eastern Creek in the Cumberland Plain, the assemblage recovered from the study area has a high frequency of cores and tools, but a relatively low artefact density overall and is comparatively small. Two elevated terrace landforms of more intensive occupation were identified along Eastern Creek and Eskdale Creek, and within which two ~100m²

discrete patches of increased artefact density were observed. Similar sites have been identified elsewhere along Eastern Creek in Riverstone (e.g. AHMS 2016). Importantly, the assemblage shows evidence of heat treatment along Eskdale Creek (TP151), and manufacture and production of backed blades, elongated flakes and other tools along Eastern Creek (TP57).

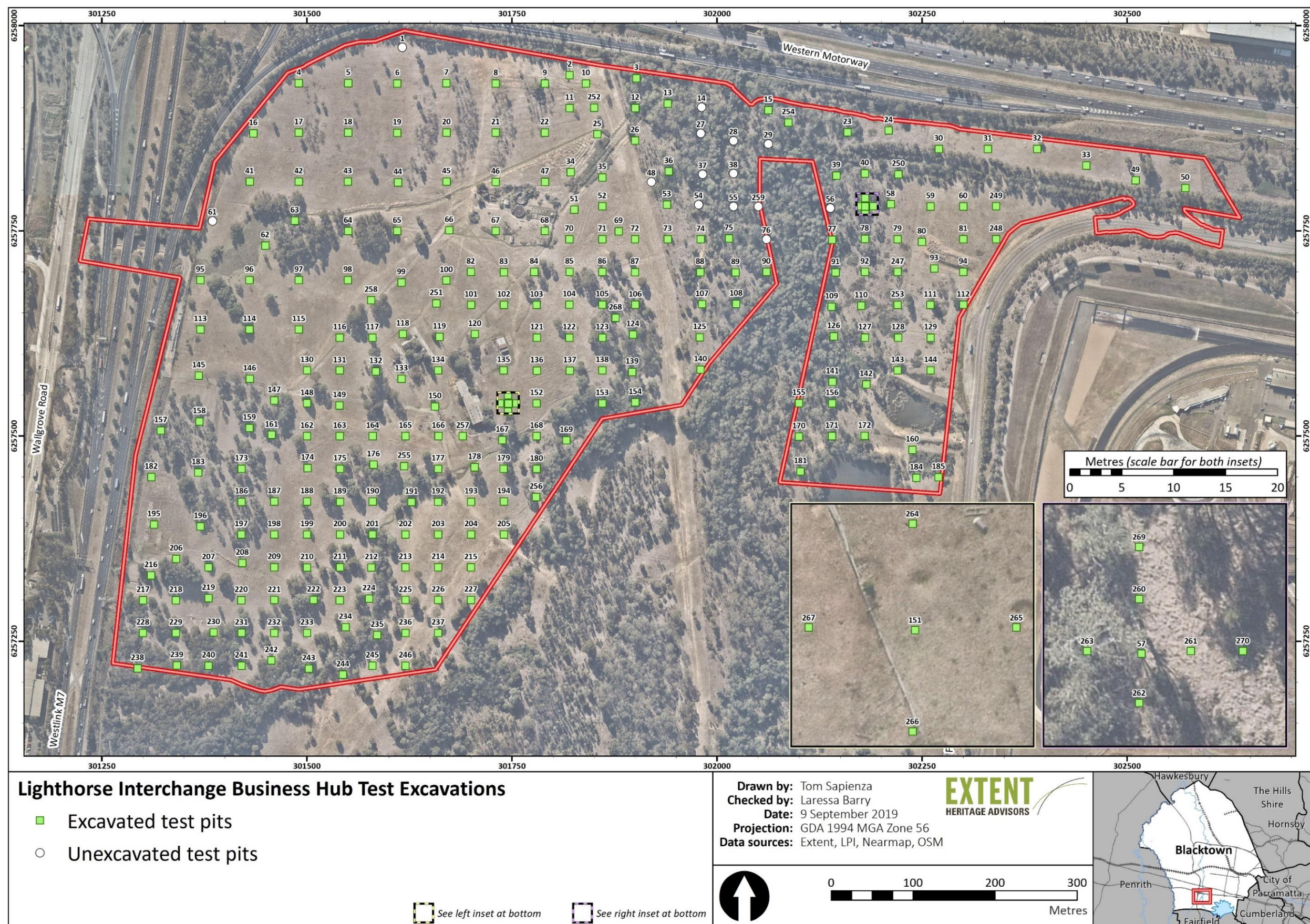


Figure 27. Excavated and unexcavated test pits within the study area. Note TP137, as well as TP151 and TP57 (inset map) were excavated as 1m²; the remaining pits were 0.25m².

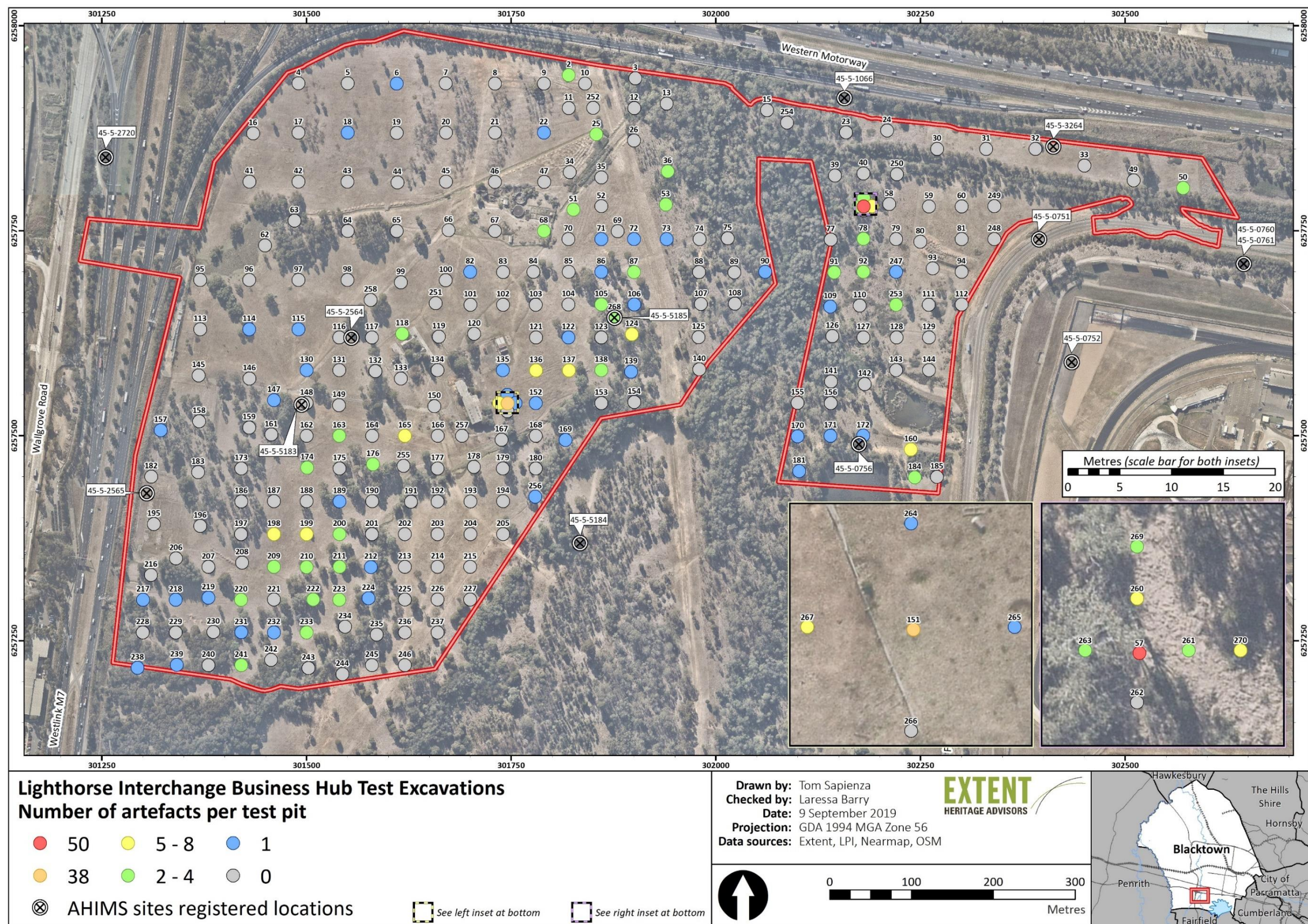


Figure 28. Summary of the cultural assemblage (number of artefacts) recovered from the test excavation program, as well as locations of previously registered AHIMS sites. Note TP137, 151 and 57 were excavated as 1m² test pits.

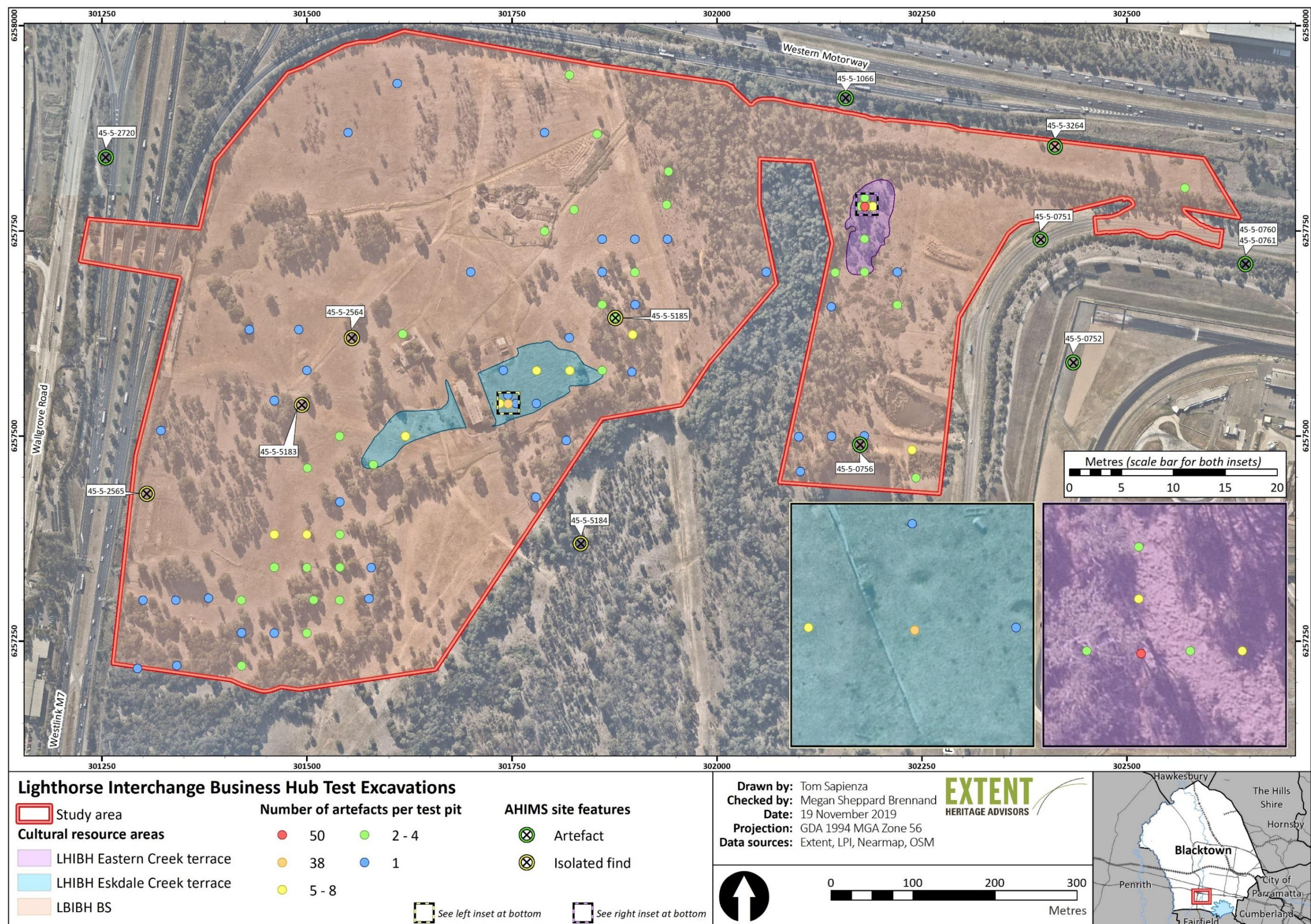


Figure 29. Summary of Aboriginal archaeological material recovered during excavation. Note, two elevated terrace landforms 'Eskdale Creek terrace' and 'Eastern Creek terrace' were identified (respectively, blue and purple shading), within which discrete ~100m² patches of high-density material (inset, around TP151 and TP57) were recovered, and formed foci of Aboriginal occupation.



Plate 33. General location shot of western half of study area, containing shallow duplex soils.



Plate 34. General location shot of north western half of study area, containing shallow duplex soils.



Plate 35. Shallow duplex soil comprising silty clay over medium clay, TP98 east section.



Plate 36. Duplex soil, TP8 south section.



Plate 37. Overview of TP158, showing test pit straight onto basal clay.



Plate 38. Eskdale Creek terrace landform in the vicinity of TP151, view west.



Plate 39. Eskdale Creek terrace landform looking back towards transmission station buildings, view south.



Plate 40. Eskdale Creek terrace landform deposit, TP151, total depth 90cm.



Plate 41. Eskdale Creek terrace landform deposit, TP137, total depth 50cm.



Plate 42. Eastern Creek terrace landform in the vicinity of TP57, view north



Plate 43. Eastern Creek terrace landform, view west.



Plate 44. Eastern Creek terrace landform deposit, TP57, total depth 50cm. OSL samples 9 to 12 are shown.



Plate 45. Clay plug/fill in TP182, associated with former Wallgrove Road Army Camp.



Plate 46. Clay plug/fill in TP161, associated with former Wallgrove Road Army Camp.



Plate 47. Fill in TP45, west section.



Plate 48. Fill in TP45, south section.

7. The archaeological and cultural resource

Based on regional studies, the Aboriginal archaeological resource of the Cumberland Plain is dominated by stone materials (artefact scatters and/or isolated finds), followed by potential archaeological deposits, grinding grooves and culturally modified trees. Proximity to water is considered an important factor in archaeological patterning across the Cumberland Plain, with sites generally found within 100m of water, and larger, more complex and more densely clustered along high-order and permanent water sources.

Extensive archaeological investigations over the past thirty years throughout the south western Cumberland Plain have further refined this model. These studies (e.g. AHMS 2016) suggest that the archaeological record is dominated by low-density artefact scatters and isolated finds, but that elevation plays a key role in site patterning and frequency, with lower densities of artefacts and fewer sites being found closer to local watercourses such as Eastern, Reedy, South and First and Second Ponds Creeks. This is not to say that there is a total absence of sites in close proximity to high-order watercourses; but rather, that sites are typically denser and more frequent with elevation. This is likely due in part to the scouring effects of such watercourses, whereby sediment and any cultural material is removed in periodic high-energy flooding events, or possibly indicates a preference for avoiding low-lying areas in favour of drier, more elevated positions above flood zones. The predominant raw stone material observed in cultural assemblages across the south western Cumberland Plain appears to be silcrete, and this, coupled with the prevalence of backed artefacts in cultural assemblages is strongly indicative of a late Holocene occupation of the region in the last 5,000 years.

Based on the archaeological investigations undertaken to date, the archaeological resource of the study area conforms well with the model of Aboriginal occupation for the south western Cumberland Plain. Systematic archaeological excavation identified several Aboriginal archaeological sites within the study area and recovered 276 lithics (made up of 253 artefacts and 23 heat shatter fragments) from the excavation of 66.25m². The study area is dominated by a low-density distribution (<10 artefacts) of cultural material across the site on a variety of upper, mid, and lower slope landforms. Cultural material is present both on the ground surface or in shallow duplex topsoils. This background reflects an ephemeral or transient use of the region in the past. For management purposes, this background scatter has been registered as a single AHIMS site on the DPIE AHIMS database, 'LHIBH BS' (AHIMS ID#45-5-5285) and incorporates a large proportion of the low-density scatter sites and isolated finds, and artefacts recovered from test excavation, within the study area (see Table 10).

Within this broader background, two landforms of archaeological interest were identified along elevated terrace landforms adjacent to Eskdale and Eastern Creeks, and have subsequently been registered as AHIMS sites on the DPIE AHIMS database ('LHIBH Eskdale Creek terrace' #45-5-5283 and 'LHIBH Eastern Creek terrace' #45-5-5284). Overall when considering these landforms an artefact density was identified that is broadly comparable with the wider study area (<10 artefacts). However, two discrete and highly localised ~100m² patches of increased artefact density were identified at each location, centred on TP151 and TP57 respectively.

These sites are considered to reflect foci of intense, but perhaps short-lived, visitation of the study area in the past.

These two high-density artefact foci provide a number of interesting observations about the past use of the region. Of note is the dominance of silcrete raw materials and the presence of backed artefacts, which is suggestive of a late Holocene occupation; as well as evidence for heat treatment along Eskdale Creek (TP151) and manufacture and production of backed blades, elongated flakes and other tools along Eastern Creek (TP57). A suite of OSL ages from both sites suggest that formation of the terrace deposits likely began in the LGM approximately 26,000 years ago; but with little evidence of occupation until the late Holocene (3-4,000 years ago), as the soil profile developed and human populations intensified with improved climate relative to that prevailing during the early-mid Holocene.

Unsurprisingly, the sites located and excavated during the fieldwork program conform well to the accepted site patterning of the south western Cumberland Plain, and the predictive modelling for the site is broadly in agreement with the accepted model of settlement, but with some caveats. Predictive modelling undertaken before excavation highlighted areas within 200m of major third- and fourth-order creeklines as having high and very high archaeological potential; and that sites of increased density and complexity would be located within these zones. However, targeted archaeological excavation undertaken for this project found that low-lying areas adjacent to Eastern Creek, and at the confluence of Reedy and Eskdale Creek below 44m AHD recovered little, if any, artefactual material. It is plausible that areas below 44m AHD were subjected to periodic, high-energy flooding rendering them periodically unsuitable for occupation. Alternatively, it may have been the case that the soil deposits below these elevations—and which may have contained physical remains of Aboriginal occupation—have been scoured away by flooding. Other studies have noted a preference for more complex and extensively used sites on elevated terraces and levees above major watercourses, and we suggest here a tangible elevation of 44m AHD as an appropriate flood consideration benchmark for future studies in the Eastern Creek locality. In addition to the low-lying areas of Eskdale Creek not being conducive to occupation, there has been disturbance to this creek line in the past to allow for the surrounding floodplain to drain or dry and therefore improve its suitability for agricultural purposes. This alteration would have resulted in significant change to the hydrology of Eskdale and Reedy Creeks, which would account for the deep incision and channel widening evident along the lower reaches of Reedy Creek and the establishment of Eskdale Creek as a more permanent waterbody.

Table 10. The Aboriginal archaeological and cultural resource of the study area.

AHIMS #	Site name	Site type/features	Description
45-5-5285; (incorporating 45-5-2565 (IF2); 45-5-2564 (IF1); 45-5-5183 (LIBH AS1); 45-5-5185 (LIBH AS2); 45-5-0756 (EC6 (Eastern Creek)); and 45-5-3264 (WSP17)).	LHIBH BS	Small, low-density artefact scatters and isolated finds	<p>Low-density distribution (<10 artefacts/0.25m²) of cultural material across the study area, present on a variety of upper, mid, and lower slope landforms, and occasionally in association with low-order drainage lines and tributaries of Eastern, Eskdale and Reedy Creek. Cultural material is present both on the partly-eroded ground surface, or in shallow, duplex topsoils of the Blacktown and South Creek soil landscapes. Historical development, drainage management works and erosional processes have caused localised disturbance to underlying soils, but has not completely removed evidence for Aboriginal occupation.</p> <p>This low-density distribution of background material reflects an ephemeral or transient use of much of the study area in the past.</p>
45-5-5283	LHIBH Eskdale Creek terrace	Artefact, PAD	<p>Elevated terrace of varying depth (between 50 and 90cm) above Eskdale Creek, characterised by deep, fine sandy clay alluvium overlying fine sandy clay with increasing clay content and ironstone staining at depth. Artefact densities within the Eskdale Creek terrace are broadly comparable with the rest of the study area; however, a discrete, highly localised ~100m² patch of increased artefact density centred on TP151 was identified. The main artefact concentrations typically occurred between 10 and 50 cm below the current land surface (between 46.3 and 45.9 m AHD), with peaks at 20 and 30 cm below ground surface. These levels broadly date to within the last 3,000 years.</p> <p>The localised patch is considered to reflect a focus of intense, but perhaps short-lived, visitation of the study area in the past, within which heat treatment of raw materials occurred.</p>
45-5-5284	LHIBH Eastern Creek terrace	Artefact, PAD	<p>Elevated, flat terrace above Eastern Creek, characterised by moderately deep, fine sandy clay alluvium, to depths of 50cm. Artefact densities within the Eastern Creek terrace are broadly comparable with the rest of the study area; however, a discrete, highly localised ~100m² patch of increased artefact density centred on TP57 was identified. Artefact concentrations typically occurred between 0 and 40 cm below the current land surface (between 45.1 and 44.7 m AHD), with peaks at 20 and 30 cm below ground surface. These levels broadly date to within the last 4,000 years.</p>

AHIMS #	Site name	Site type/features	Description
			The localised patch is considered to reflect a focus of intense, but perhaps short-lived, visitation of the study area in the past, where the manufacture of stone artefacts occurred.

8. Significance assessment

The management of heritage places is based on an understanding of the values of those places. The framework and criteria for significance assessment are discussed in detail in Appendix 5. DPIE specifies that heritage significance should be assessed according to four criteria, as outlined in the Burra Charter; social/cultural or spiritual, historic, scientific (archaeological) and aesthetic (DPIE 2011:7; Australia ICOMOS 2013). The significance of the archaeological and cultural resource of the study area is summarised in Table 11.

8.1 Statement of significance

Systematic archaeological survey and test excavation of the study area provides an 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 demonstrated the presence of two source-bordering alluvial terraces along Eskdale and Eastern Creek, within which discrete ~100m² patches formed key locales of Aboriginal visitation and occupation over the last 4,000 years. The nature of the cultural assemblage suggests intense but short-lived occupation, with a focus on the exploitation of locally available stone resources for artefact and tool production. Certain raw lithic material improvement strategies in the form of heat treatment were also employed on site, especially along Eskdale Creek. Though both source-bordering terrace landforms began forming in the LGM, in drier and windier conditions, the findings demonstrate little evidence for Aboriginal occupation until the late Holocene, as the soil profile developed and population intensified with improved climatic conditions.

Along with other regional findings of work at Riverstone (AHMS 2016), the assemblage here lends strong support to Aboriginal populations exploiting and using levee banks and locally elevated areas along the Eastern Creek corridor from the late Holocene (<5,000ka); and it is therefore considered these deposits, while unique, are ultimately representative of other similar sites in the region. It is considered, however, that additional information on the nature, size and integrity of these foci of occupation may be obtained through further investigation and analysis of the material evidence of these sites, and as such these discrete ~100m² areas are still considered to contain significant research potential. In addition, despite the modification of the study area by Defence in the past, these source-bordering terrace deposits are on the banks of some of the few permanent and large rivers within the Cumberland Plain, and have aesthetic significance not typically found for these types of site.

In contrast, the remainder of the study area is dominated by a low-density distribution of cultural material (<10 artefacts) in the form of small artefact scatter sites and isolated artefacts, and reflects an ephemeral or transient use of the wider area in the past. Such sites have limited research potential (typically restricted to only the technological attributes of the artefact assemblage), limited stratigraphic integrity, and are representative of other sites in the south western Cumberland Plain; and as such are considered of low archaeological significance.

While no formal written feedback from the Aboriginal stakeholders has been received regarding cultural significance to date, several on-site discussions identified the discrete patches of high-

density cultural material as being of importance to the Registered Aboriginal Parties. More broadly, sites of increased artefact density and/or complexity are frequently identified as being of cultural significance to local Aboriginal stakeholders.

Table 11. Summary table of significance of the cultural resource of the study area.

AHIMS no.	Site name	Social/ cultural	Historic	Scientific	Aesthetic	Overall significance
45-5-5285	LHIBH BS	Low	Low	Low	Low	Low
45-5-5283	LHIBH Eskdale Creek terrace	High	Low	High	Moderate	High
45-5-5284	LHIBH Eastern Creek terrace	High	Low	High	Moderate	High

Incorporating 45-5-2565 (IF2); 45-5-2564 (IF1); 45-5-5183 (LIBH AS1); 45-5-5185 (LIBH AS2); 45-5-0756 (EC6 (Eastern Creek)); and 45-5-3264 (WSP17)).

9. Impact assessment

9.1 Proposed development

Western Sydney Parklands Trust intends to redevelop the study area to accommodate industrial and light industrial land use activities. This is in accordance with the *State Environmental Planning Policy (Western Sydney Parklands) 2009*, the Western Sydney Parklands Trust Plan of Management 2030 and the Western Sydney Parklands Trust Plan of Management 2020 supplement.

An indicative concept masterplan and subdivision plan have been prepared for the study area and illustrates indicative building development areas and site works. Key features of the concept proposal are:

- **Land use and built form:** indicative building envelopes are provided for the future construction of largescale industrial-style buildings including:
 - Approximately 157,000m² floorspace to accommodate a range of industrial and light industrial land use activities, which could include advanced manufacturing, freight and logistics and warehouse and distribution facilities.
 - Approximately 8,000m² floorspace comprising ancillary offices to support the primary industrial and light industrial use.
- **Landscaping:** the front setbacks of the future industrial lots will be landscaped to complement the architectural design of the future industrial buildings and present an attractive appearance within the streetscape. Additional landscaping will be provided within the rear and side setbacks where required to provide visual screening of the proposed buildings from the surrounding road network.
- **Transport, access and car parking:** primary vehicle access to the development site is proposed from Ferrers Road. Any new roads and road improvement works required to service the proposed development will be designed to address Blacktown City Council requirements and facilitate their dedication as part of the industrial subdivision. A secondary access point for lighter vehicles (i.e. excluding B-double trucks) may be provided via the existing Wallgrove Road entry/exit driveway, however this is for emergency only.
- **Stormwater management and flooding:** a comprehensive stormwater management system will be provided to manage the quality and quantity of water flows across the site, including mitigation measures to address potential flooding risk and avoid adverse impacts to the development potential of the upstream and downstream properties.
- **Biodiversity:** the site contains scattered trees and more concentrated areas of vegetation along the riparian corridors and within the south-western corner which will be assessed in further detail during the preparation of the SSDA. The final concept masterplan, the EIS and

the BDAR address the removal of vegetation, including any biodiversity off-set requirements.

- **Bushfire protection measures:** the site is identified as Vegetation Category 2 bushfire prone land and the final concept masterplan and EIS addresses the required bushfire protection measures to avoid risk and provide adequate safety for future building occupants and fire-fighting personnel (Peterson Bushfire 2019). This involves including defendable space, consideration of ember protection for building works, access and egress for emergency response, perimeter access and internal roads, and accessibility of reticulated water supply and hydrant provisions for fire-fighting.
- **Utility services:** the final siting and design of the proposed industrial subdivision will incorporate the existing easements for high-pressure gas and sewer, as well as any required augmentation of existing utility services to service the proposed development.

The detailed proposal will include the following early site works:

- **Demolition and remediation:** removal of existing buildings and structures and completion of any site remediation works required to ensure the site is suitable for its intended use as a business hub.
- **Bulk earthworks:** cut and fill details for the future building pad sites to facilitate the future development of the site as an industrial business hub.
- **Infrastructure:** provision of roads, utility services, stormwater works and flood mitigation(if required) measures required to facilitate the future development of the site as a business hub.
- **Subdivision:** creation of development lots, public roads, easements/restrictions, etc to facilitate the leasing and development of individual lots to accommodate industrial and light industrial land use activities, including freight and logistics and warehouse and distribution centres.

9.2 Potential Aboriginal heritage impact

The potential heritage impact of development in accordance with the concept masterplan is outlined below (Table 12 and Figure 30). Development for uses in accordance with the plan will likely result in impacts to the ground surface resulting from demolition works, cutting, levelling and fill works, installation of services and infrastructure, as well as landscaping and revegetation works. These works, with perhaps the exception of some minor landscaping and revegetation works, would likely result in the removal of much, or all, of the upper soil profile.

Based on the proposed development above, the greatest impacts to the Aboriginal cultural resource of the study area would result from the construction of large-scale industrial style buildings and associated roads and landscaping, in the western half of the study area between the Westlink M7 and Eskdale Creek. This would include impacts to 100% of the Eskdale Creek terrace landform (equivalent to 12,851m²) and its associated patch of high density cultural material, and would also include impacts to a large portion of the low density background

scatter, which is present across much of the rest of the study area. Recommendations for the management of these impacts are outlined in Section 10.1.

It was initially considered that there would be considerable impacts to the Aboriginal cultural resource of the eastern half of the study area, from the proposed construction of the flood mitigation infrastructure. However through design progression the eastern portion of the study area has been largely avoided. Therefore there will be no impact to the Eastern Creek terrace landform (equivalent to 4,798 m²) and its associated patch of high density cultural material. .

Other proposed works within the study area have the potential to cause localised impacts to the low density background scatter present across the site. These include construction of an OSD basin and access road (northern boundary), and realignment of Eskdale Creek.

At present, there is potential for small portions of the background scatter (equivalent to 157,487m² or 29% of the deposit) to be conserved as part of the proposed development, in areas designated as passive open space, environmental conservation, and/or riparian corridor.

Table 12. Potential archaeological impacts from the proposed development.

AHIMS #	Name	Total area within study area (m ²)	Significance (overall)	Area of harm—m ² (%)*	Degree of harm	Consequence of harm	Management requirements
45-5-5285	LHIBH BS	546,288	Low	391,663 (71%)	Partial	Partial loss of value	No further mitigation required.
45-5-5283	LHIBH Eskdale Creek terrace	16,969	High	16,969 (100%)	Whole	Total loss of value	Mitigation measures required (see Section 10.1)
45-5-5284	LHIBH Eastern Creek terrace	4,798	High	0 (0%)	None	No loss of value	No further mitigation required.

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

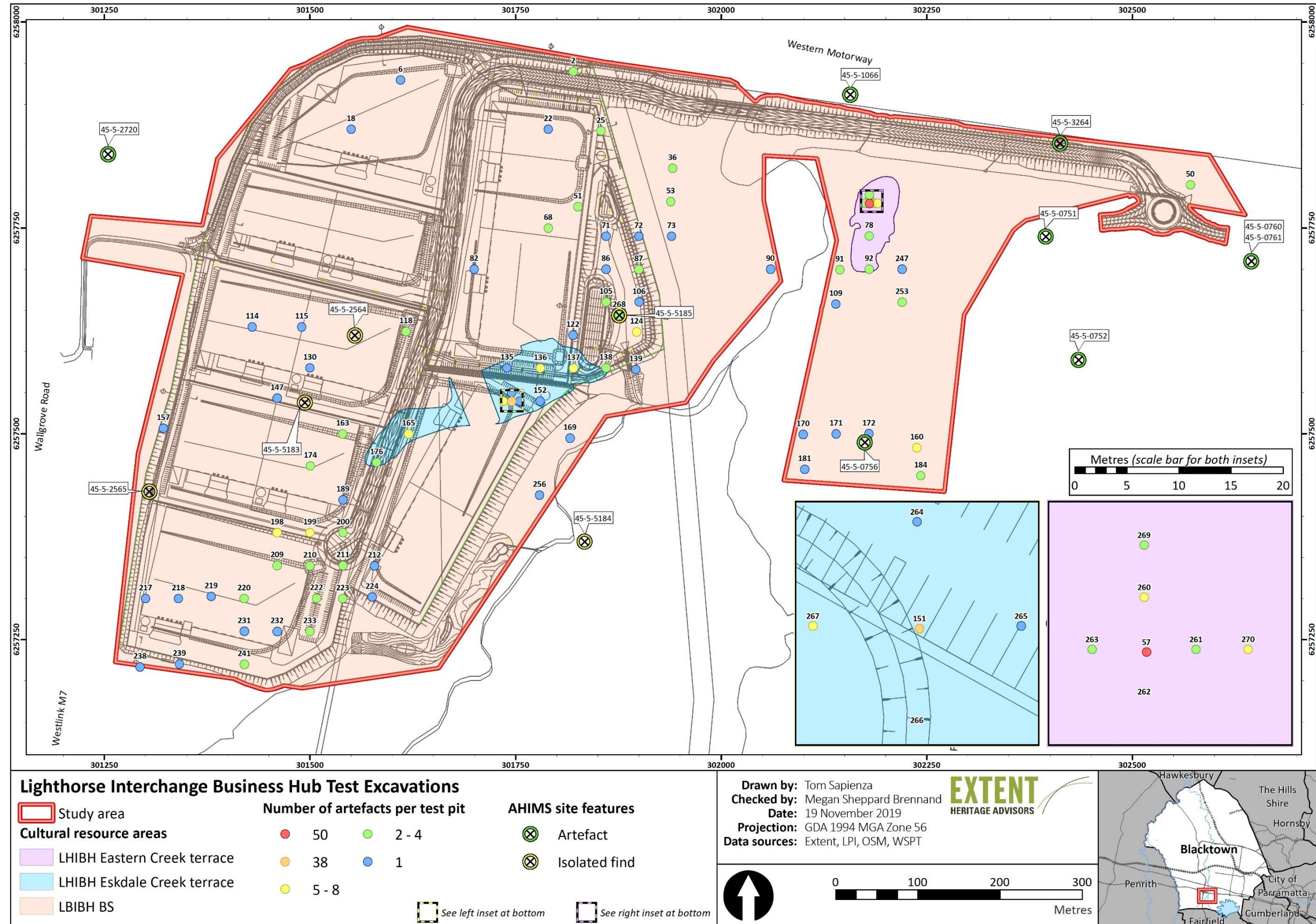


Figure 30. Identified Aboriginal sites and areas of archaeological potential overlain with the proposed concept masterplan.

10. Conclusions and recommendations

10.1 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. These strategies have been developed based on the results of the test excavation taking into consideration consultation with the RAPs.

In general, avoidance of impact must be recommended as the first or best option for the management of heritage values for any given study area. Based on discussions with WSPT design progression in the eastern portion of the study area has resulted in the Eastern Creek terrace being completely avoided. This is a form of conservation *in situ*. Due to this progression the only development works in relation to the eastern portion of the study area are the access road and roundabout, which do not impact the Eastern Creek terrace landform. However, the following management strategy has been prepared based on discussions with WSPT in relation to the proposed development impact to identified Aboriginal heritage values in relation to the Eskdale Creek terrace landform. In situations where conservation *in situ* is not feasible, alternative mitigation measures, commonly conservation *ex situ*, is recommended.

The archaeological excavations identified three main archaeological landscapes across the study area, comprising two elevated alluvial terraces along Eastern and Eskdale Creeks, as well as a low-density background of cultural material (characterised by low-density scatters and isolated finds within shallow duplex soils) across the remainder of the site. The significance of the two Eskdale and Eastern Creek terrace deposits is associated with the high densities of Aboriginal objects recovered from within two discrete ~100m² locales, and for their ability to provide insights into local site patterning and distribution, site use and tool production activities.

Based on a review of the proposed impact footprint for the development as it currently stands, 100% of the Eskdale Creek terrace deposit will be affected by proposed development. Given this level of impact to a deposit considered to be of high archaeological significance, it is recommended that archaeological mitigations are implemented. Specifically, that the high-density concentration of cultural material in the vicinity of test pit 151 is subject to careful archaeological salvage excavation prior to development.

The remainder of the study area frequently exhibited heavily disturbed or heavily truncated and shallow duplex soils. With few exceptions, Aboriginal objects within these areas was low, and where present rarely had any stratigraphic integrity. The cultural resource is considered to reflect a background of cultural material that is representative of other sites in the region, is incredibly common, and characterised by low-density artefact scatters and isolated finds with little research potential. Based on these findings, it is not proposed that any further investigation or recovery of these deposits (LHIBH BS) is considered necessary prior to development.

10.1.1 Salvage excavation rationale

Following the assessment and its findings, it is considered that additional archaeological mitigations are warranted within the Eskdale Creek terrace landscape that may be impacted by the proposed development. The proposed development would impact a substantial proportion of this deposit, considered of high significance. This deposit provides tangible evidence of a foci of Aboriginal occupation dating to the last 5,000 years, and provides an insight into local site patterning, use and tool production activities along major waterways in the south western Cumberland Plain.

It is considered that the level of archaeological test excavation has been adequate to characterise and assess the impact of the development footprint in relation to Aboriginal cultural materials; but is insufficient to appropriately document the nature, extent and significance of the ~100m² foci of Aboriginal occupation if it was to be impacted or destroyed. Given the nature of the development, it is unlikely that burial *in situ*, or conservation of this deposit is feasible, and as such archaeological salvage—conservation *ex situ*—is the only viable alternative.

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 of one discrete high-density locale is proposed so as to undertake a more detailed recovery and recording of cultural deposits within the impact footprint; 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 further contribute to the body of knowledge on past Aboriginal people's activities and occupation of elevated terrace and levee landforms of the Eastern Creek area, would further contribute to the archaeological literature and would provide an important source of information for the Aboriginal community to draw on. It would further resolve the research questions posed, many of which have only been partially answered through the test excavations (Section 6.3.2). It would also result in greater interpretive and educational outcomes for the local and regional community, and to the 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.

10.1.2 Research aims

The aims of the proposed salvage excavation include:

- Using fine resolution excavation and environmental analyses to further characterise the archaeological deposits relating to the past Aboriginal occupation of the Eskdale and Eastern Creek alluvial terraces. 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 development footprint 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 further supplement the existing knowledge of past Aboriginal activities along this portion of the Eastern Creek corridor.

10.1.3 Archaeological salvage program

Overall, we propose to undertake up to 100m² of open area excavation, with a series of hold points, in the Eskdale Creek terrace landform within the impact footprint. This number provides an equitable balance between the volume of archaeological material that may be recovered, compared with the costs and time to undertake such works.

The area would be up to 10 x 10m in size (equating to a maximum of 100m²) and centred on TP151. It is considered that this approach is similar in extent, approach and methodology 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; O'Connell Street Public School site (undertaken as part of a SSD [SSD 15/7372], Extent 2018), Moorebank Intermodal Terminal (also a SSD [SSD 6766], Extent in prep), Fernadell Precinct, Pitt Town (AHIP # 1129099; Williams et al., 2014), Tarro-Beresfield water main renewal (AHIP #C0000616) and 21 Hassall Street, Parramatta (AHIP #C0001505).

It should be noted that an assessment conducted by Ecoplaning (2019) reported a low contamination risk across the site (EIS). The Eskdale Creek terrace landform is located ~50m southeast of a hydrocarbon leak detected from two underground storage tanks in the former army compound. The horizontal extent of the leak is constrained to the immediate surrounds of the tanks (<2m) due to the high plasticity clay soils. Additionally, there was bonded asbestos containing material detected at the former army compound, and in topsoil around the impacted buildings. There was no asbestos noted during the excavation of TP151 (within the Eskdale Creek landform) in the test excavation, and there is little potential for it to be present in this wider area, which is located ~35m from the nearest structure with asbestos recorded. The Eskdale Creek terrace is located outside the area of concern assessed by Environmental Earth Sciences in 2018, and there appears to be no threat of contamination within the salvage area.

The excavation would be conducted with a series of hold points to determine whether to continue expanding the salvage area, or whether to cease the archaeological program. For this consideration, the following criterion will be adopted:

- The identification of any features of archaeological interest, such as hearths, burnt clay features, shell middens or burials;
- The potential to recover significant artefact densities reflective of occupation must be obtainable. Based on regional information above, it is considered that >30 artefacts/m² on

average would be needed to achieve these aims, and as such this is the limit at which further archaeological works would be considered.

- Artefacts of potential great antiquity, typologically dated to the Pleistocene (>10,000 years ago (ka));
- Artefacts manufactured of unusual or rare raw stone materials—those exotic to the region, and which may provide further information on trade and exchange between Aboriginal populations;
- Unusual or rare artefact tool types and formal tools, such as Bondi points, shell artefacts, core tools, burin blades, hammerstones, ground edge implements etc, or those with potential to retain usewear/residue for further analysis; and/or
- Aboriginal objects made during or shortly after the period of European contact, such as worked glass, worked flint etc.

It will be for the Excavation Director in consultation with RAPs and WSPT to determine whether these thresholds are met and prompt the requirement for further expansion of archaeological works.

The proposed salvage works would adopt the following methods:

- Excavation would consist of contiguous 1m² test pits totalling up to 100m² of targeted manual excavation undertaken as a series of hold points. At each hold point, the above criteria would be considered, and only where the triggers continue to be met would work proceed. The decision to continue would be made by the Excavation Director, in consultation with RAPs and WSPT. The initial hold point would be at 25m² (5 x 5 m) centred on the area of archaeological interest, the next hold points would be at 36m², 49m², and 81m².
- All excavation would be undertaken manually, using shovels and trowels, etc, by a team of archaeologists and Aboriginal stakeholders.
- Excavations would be undertaken in 5cm spits, with Australian Height Datum (AHD) heights being obtained every fourth spit, to ensure vertical integrity. Excavations would extend to either the geological substrate, or until three consecutive cultural sterile spits are encountered.
- 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 (1m²). Details would include site name, date, site recorder, spit number and depth, description of finds, description of soil, sketch plan of excavation (if relevant to show features) and a bucket tally.
- Sediment from each 5cm spit would be bucketed separately and wet-sieved through 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.

- Soil samples may be collected for description, sedimentological, palaeo-environmental and chronological analysis where such analysis is considered likely to contribute significant information. 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), as well as provide further understanding on the formation history of the deposits. Material for radiocarbon analysis may also be undertaken opportunistically if archaeological features containing charcoal or other dateable material are evident.
- If dangerous material, such as asbestos or contaminated soils, was encountered the extent of the salvage could be amended. This would be at the discretion of the Excavation Director, in consultation with the RAPs and WSPT.

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.

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

10.1.4 Post-excavation analysis and recording

The post-excavation analysis would be designed to address the research objectives and specific research questions, 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 may 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 may also be considered.
- Geomorphology: collection of soil samples excavation to assist in understanding the site formation and post-depositional disturbance.
- Palaeo-environmental: 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 during the program, and should bracket any cultural materials recovered from each open area excavation to provide a strong chronology for the deposit.

The aim of this work is to both adequately document, analyse 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 any future development consent conditions in relation to the archaeological salvage, to provide input into management plans (if required) and any interpretive outcomes from the project. The report would be developed in accordance with DPIE's guidelines (as current best practice), and may 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 long term 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 DPIE at completion of the project.

All Aboriginal objects recovered will be securely stored at the archaeologists' office for analysis, pending a decision on the long term management of the Aboriginal cultural resource. The curation of the assemblage would be undertaken following the post-excavation analysis and reporting by WSPT in consultation with the Aboriginal stakeholders.

10.2 Recommendations

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

- An Aboriginal cultural heritage management plan (ACHMP) must be developed, in consultation with the RAPs and consent authority, to provide the post-approval framework for managing Aboriginal heritage within the study area. The development of this management plan has been recommended by DPIE. The ACHMP should make specific reference to:
 - Processes, timing, and methods for maintaining Aboriginal community consultation through the remainder of the project.
 - Descriptions and procedures for development impact mitigation, including archaeological salvage, to be undertaken in advance of proposed development.
 - Description and methods of post-excavation analysis of chronological, soil, and environmental samples that will be recovered as part of the archaeological mitigation of development impacts.

- Procedures for the long-term curation of Aboriginal cultural materials recovered as part of the project.
- Processes for reviewing, monitoring, and updating the ACHMP as the project progresses.
- Prior to construction, mitigation measures (archaeological salvage) should be implemented in accordance with the approaches and methods outlined in Section 10.1 of this report. No construction or development activities should proceed until the on-site components of these works have been completed.
- The Eastern Creek landform terrace will be conserved, with no development works impacting this area. Archaeological salvage will be undertaken in the Eskdale Creek landform terrace due to the impact the development will have on this deposit.
- Consultation with the Registered Aboriginal Parties should continue throughout the project. This will allow stakeholders to continue their involvement in management and interpretation of Aboriginal cultural heritage values of the project.
- The recommended mitigation measures are based on the analysis of the potential impacts as presented in Section 10.1 of this report. If development or construction activities are required beyond the identified impact footprint, the mitigation measures of this report would need to be reassessed, and any additional requirements implemented prior to construction/development beginning/resuming.
- Aboriginal Site Impact Recording Forms must be prepared and submitted to the AHIMS Registrar to outline the findings of the archaeological excavations within the study 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.
- A copy of this report should be submitted to DPIE.

11. References

- AHMS. 2015. Water-Related Infrastructure—Northwest Growth Centre—Aboriginal Archaeological Excavation Report. AHMS Report to Lend Lease and Sydney Water.
- AHMS. 2015. Bungaribee Business Hub, Bungaribee, Blacktown LGA Preliminary Aboriginal Heritage Assessment. Unpublished report to Western Sydney Parklands Trust.
- AHMS. 2016. Aboriginal Cultural Heritage Assessment Report 81 Riverstone Parade Riverstone NSW. Prepared for Riverstone Parade Pty Ltd.
- Archaeological Management & Consulting Group Pty Ltd (AMAC) (1997) European Heritage & Archaeology: Assessment & Survey. Surplus Land Adjoining Australia's Wonderland, Eastern Creek, NSW. For Gutteridge Haskins & Davey Pty Ltd.
- Artefact Heritage. 2016. Sydney Zoo Bungaribee Precinct Aboriginal Cultural Heritage Assessment Report. Unpublished report to Sydney Zoo.
- Attenbrow, V. 1993. Darling Mills State Forest 2 Radiocarbon Dates. Unpublished report for the Australian Institute of Aboriginal and Torres Strait Islander Studies, Canberra.
- Attenbrow, V. 2004. What's Changing: Population Size or Land Use. The Archaeology of Upper Mangrove Creek, Sydney Basin. Terra Australis (Vol. 21). Canberra: Pandanus Books.
- Attenbrow, V. 2010.. *Sydney's Aboriginal Past: investigating the archaeological and historical records* (2nd ed.). Sydney: University of New South Wales Press Ltd.
- Backhouse, J. 1843.. *A Narrative of a Visit to the Australian Colonies*. London: Hamilton, Adams and Co.
- Banks, J. 1998.. *The Endeavour Journal of Joseph Banks, 25 Aug 1768—12 Jul 1771*. (B.P. Sandford, Ed.) (Vol. 2). Sydney: Mitchell Library, State Library of New South Wales.
- Banksia Heritage. 2003. Westlink M7—Wallgrove Army Base and Migrant Hostel [WSO-E-11]: Archaeological Recording. For ERM Australia and Abigroup Leightons Joint Venture.
- Bannerman, S.M. and Hazelton, P.A., 1990. Soil Landscapes of Penrith 1: 100 000 Sheet. Soil Conservation Service of NSW.
- Blacktown City Council. 2018. Website: BCC MapsOnline. Accessed February 1, 2018. URL: <http://maps.blacktown.nsw.gov.au>.
- Bradley, W. 1969. *A Voyage to New South Wales: The Journal of Lieutenant William Bradley RN of HMS Sirius, 1786-1792*. Sydney: Trustees of the Public Library of New South Wales in association with Ure Smith.

Collins, D. 1798. An account of the English colony in New South Wales: with remarks on the dispositions, customs, manners, &c., of the native inhabitants of that country. To which are added, some particulars of New Zealand (1st ed., Vol. 1). London: T. Cadell Jun. and W. Davies.

Collins, D. 1804. An account of the English colony in New South Wales, from its first settlement in January 1788, to August 1801: with remarks on the dispositions, customs, manners, &c. of the native inhabitants of that country. To which are added, some particulars of New Zealand (2nd ed., Vol. 1). London: T. Cadell and W. Davies.

Cox, W. 1815. Journal, 7 July, 1814—6 January, 1815. SLNSW: Manuscript, C 708/1-2, Safe 1/264-265.

Crew, D. 1989. Archaeological Survey of Proposed International Grand Prix Circuit, Eastern Creek, Near Blacktown, NSW. Prepared for NSW Department of Sport Recreation and Racing.

Curio Projects. n.d. 'Wallgrove Army Camp.' Blacktown City Council. Viewed 14 January 2019. Available at [https://www.blacktown.nsw.gov.au/About-Council/Our-city/Blacktown-Memories/Our-history-and-heritage/Heritage-Interpretative-Study-Wallgrove-Road/WallgroveArmy-Camp].

Doelman, T., Webb, J., Williams, A. and F. Barry. 2015. 'Paleochannels and Patches: A Geoarchaeological Assessment of Silcrete Sources in the Cumberland Plain, Eastern Australia', *Geoarchaeology: An International Journal* 30:495–510.

Dominic Steele Consulting Archaeology Pty Ltd. 2002. Aboriginal Archaeological Survey and Assessment Report: Proposed Wonderland Business Park Development Wallgrove Road, Eastern Creek. Prepared for Australand.

Dominic Steele Consulting Archaeology. 2003. Aboriginal Archaeological Test excavation Report: Proposed Wonderland Business Park Development. Unpublished report prepared for Australand.

Ecoplaning. 2019. Biodiversity Development Assessment Report. Report prepared for Western Sydney Parklands Trust.

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.

Environmental Earth Sciences. 2018. Proposed Lighthorse Interchange Business Park-Contamination Assessment. Report prepared for Western Sydney Parklands Trust.

Extent Heritage Pty Ltd. 2018. Bungarabee Tourism Hub Aboriginal Cultural Heritage Assessment Report. Unpublished report to Western Sydney Parklands Trust.

Extent Heritage Pty Ltd. 2019. Light Horse Interchange Business Hub, Eastern Creek NSW (SSD 9667) Preliminary Non-Aboriginal Heritage Assessment.

Goodrum, J. 1987. 'Locations of Aboriginal groups in the Sydney area' in Mulvaney, D J & White, J Peter, *Australians to 1788*. Broadway: Fairfax, Syme & Weldon Associates.

Helen Brayshaw Heritage Consultants. 1996. M4 Upgrade Archaeological survey for Abroginal sites for proposal to upgrade the M4 motorway from Church Street Parramatta to Coleman Street Mays Hill and Prospect to Emu Plains. Prepared for SWR Constructors Pty Ltd.

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

Hiscock, P. and V. Attenbrow. 2005. Australia's Eastern Regional Sequence Revisited: Technology and Change at Capertee 3. BAR International Series 1397. Oxford: Hadrien Books.

Horton, D. 2000. *Aboriginal Australia* (Rev. ed.). Canberra: AIATSIS.

Hunter, J. 1793) *An Historical Journal of the Transactions at Port Jackson and Norfolk Island*. London: John Stockdale.

Jiménez-Moreno, G., García-Alix, A., Hernández-Corbalán, M., Anderson, R., & Delgado-Huertas, A. 2013. Vegetation, fire, climate and human disturbance history in the southwestern Mediterranean area during the late Holocene. *Quaternary Research*, 79(2), 110-122.

Jo McDonald Cultural Heritage Management Pty Ltd. 1997. Interim heritage management report: ADI site St Marys. Test excavation report (2 volumes). Unpublished report to Lend Lease—ADI Joint Venture.

Jo McDonald Cultural Heritage Management Pty Ltd. 2005a. Archaeological Salvage Excavation of Eight Archaeological Landscapes in the Seconds Ponds Creek Valley, Rouse Hill Development Area. NSW. Unpublished Report to Rouse Hill Infrastructure Pty Ltd and Landcom.

Jo McDonald Cultural Heritage Management Pty Ltd. 2005b. Salvage Excavation of Six Sites along Caddies, Second Ponds, Smalls and Cattai Creeks in the Rouse Hill Development Area, NSW. Australian Archaeological Consultancy Monograph Series 1. Sydney: Australian Association of Consulting Archaeologists Inc.

Jo McDonald Cultural Heritage Management Pty Ltd. 2006. Archaeological Salvage Excavation of the Colebee Release Area, Schofields, NSW, Volume 1. Unpublished report to Medallist Golf Holdings Pty Ltd.

Jones, D. C. and Clark, N. R. 1991. *Geology of the Penrith 1:100 000 Sheet 9030*. Sydney: New South Wales Department of Minerals and Energy.

Karskens, G. 2009. *The Colony: A History of Early Sydney*. Crows Nest, NSW: Allen & Unwin.

Kohen, J. 1993. *The Darug and Their Neighbours: The Traditional Owners of the Sydney Region*. Sydney: Darug Link in association with Blacktown & District Historical Society.

Kohen, J. L. 1986. Prehistoric Settlement in the Western Cumberland Plain: Resources, Environment, Technology. Sydney: PhD Thesis, School of Earth Sciences, Macquarie University.

Kohen, J.L., E.D. Stockton and M.A.J. Williams. 1984. Shaws Creek KII Rockshelter: A prehistoric occupation site in the Blue Mountains piedmont, eastern New South Wales. *Archaeology in Oceania* 19(2):57-73.

Lampert, R. 1966. An excavation at Durras North, New South Wales. *Archaeology and Physical Anthropology in Oceania*, 1(2), 83–118.

Lampert, R. 1971. *Burrill Lake and Currarong: coastal sites in southern New South Wales* (Vol. 1). Canberra: Dept. of Prehistory, Research School of Pacific Studies, Australian National University.

Lowe, K., Shulmeister, J., Feinberg, J.M., Manne, T., Wallis, L.A., Walsh, K. 2017. Using soil magnetic properties to determine the onset of Pleistocene human settlement at Gledswood Shelter 1, Northern Australia. *Geoarchaeology*, 31(3): 211-228.

McBryde, I. 1966. Radiocarbon dates for northern New South Wales. *Antiquity*, 40(160), 285–292.

McBryde, I. 1974. Aboriginal prehistory in New England: an archaeological survey of northeastern New South Wales. Sydney: Sydney University Press.

McCarthy, F. 1948. The Lapstone Creek excavation: two culture periods revealed in eastern New South Wales. *Records of the Australian Museum*, 22(1), 1–34.

McCarthy, F. D. 1978. New light on the Lapstone Creek excavation. *Australian Archaeology*, 49–62.

McDonald, J. 1995. Thermo-luminescence dates from Site RS 1 (45-5-982) at Regentville, Mulgoa Creek, western Sydney. Unpublished report for Pacific Power.

McDonald, J., E. Rich and H. Barton. 1994. The Rouse Hill Infrastructure Project (Stage 1) on the Cumberland Plain, western Sydney. In M. Sullivan, S. Brockwell and A. Webb (eds), *Archaeology in the North: Proceedings of the 1993 Australian Association Conference*, pp.259-293. Darwin: Northern Australia Research Unit, The Australian National University. .

Macquarie, L. 1917. Governor Macquarie to Earl Bathurst, 24th March 1819. In *Historical Records of Australia. Governors' despatches to and from England. January, 1819—December, 1822*. (Vol. 10, pp. 84–100). Sydney: The Library Committee of the Commonwealth Parliament.

Megaw, J. V. S. 1965. Excavations in the Royal National Park, New South Wales: a first series of radiocarbon dates from the Sydney District. *Oceania*, 35(3), 202–207.

Megaw, J. V. S. 1968. A dated culture sequence for the south Sydney region of New South Wales. *Current Anthropology*, 9(4), 325–330.

Mills, R. 1996. Archaeological Survey of the Proposed Western Sydney Orbital Road from West Baulkham Hills to Cecil Park. Part A: Non-Indigenous Heritage. For the RTA, c/o-Sinclair Knight Merz.

Mitchell, P.B. 2010. Geomorphology and Soils in Relation to Archaeological Investigations on the Cranebrook Terrace, Penrith Lakes, NSW. Unpublished report to Comber Consultants.

Moore, D. R. 1970. Results of an Archaeological Survey of the Hunter River Valley, New South Wales, Australia. Part I. The Bondaian Industry of the upper Hunter and Goulburn river valleys. *Records of the Australian Museum*, 28(2), 25–64.

Moore, D. R. 1981. Results of an archaeological survey of the Hunter River Valley, New South Wales, Australia. Part II. Problems of the lower Hunter and contacts with the Hawkesbury Valley. *Records of the Australian Museum*, 33(9), 388–442.

Mulvaney, J. and J. Kamminga. 1999. Prehistory of Australia. St Leonards: Allen and Unwin.

Nanson, G.C., R.W. Young and E.D. Stockton. 1987. Chronology and palaeoenvironment of the Cranebrook Terrace, near Sydney, containing artefacts more than 40,000 years old. *Archaeology in Oceania* 22:72-78.

Navin Officer Heritage Consultants. 2000. Proposed Redevelopment of Eastern Creek Waste Management Facility EIS. Prepared for National Environmental Consulting Services (NECS).

Navin Officer Heritage Consultants. 2001. Proposed Redevelopment of Eastern Creek Waste Management Facility Archaeological subsurface testing program. Prepared for National Environmental Consulting Services (NECS) on behalf of Waste Service NSW.

NSW National Parks and Wildlife Service. 2002. Native Vegetation in the Cumberland Plain: Blacktown LGA 1:25 000. NSW National Parks and Wildlife Service, Australia.

Office of Environment and Heritage. 2011. Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW. Sydney South: OEH.

Office of Environment and Heritage. 2012. *Guide to completing the AHIMS Site Recording Form*. Sydney: OEH.

Office of Environment and Heritage. 2016. eSPADE: NSW soil and land information. Retrieved 13 January 2016, from <http://www.environment.nsw.gov.au/eSpadeWebApp/>

Peterson Bushfire. 2019. Light Horse Interchange Business Hub, Eastern Creek (SSD 9667). Report prepared for Western Sydney Parklands Trust.

Phillip, A. 1914. Governor Phillip to Lord Sydney, 15th May 1788. In *Historical Records of Australia. Governors' despatches to and from England*. (Vol. 1). Sydney: William Applegate Guillick, Government Printer.

Polach, H., Stipp, J., Golson, J., & Lovering, J. 1967. ANU radiocarbon date list I. *Radiocarbon*, 9, 5–27.

Rich, E. 1989. Horsley Road Deviation, Eastern Creek Archaeological Inspection for Aboriginal sites. Prepared for Premiers Department of NSW.

Shand, A. 2012. 'Long Road Home'. Adam Shand. 20 February 2012. Viewed 10 January 2019. Available at [<https://adamsh.wordpress.com/2012/02/20/long-road-home/>].

Smith, L. 1986. 'Artefact analysis of a 3450 year old open site at Quakers Hill on the Cumberland Plain, New South Wales' *Australian Archaeology* 23:11-24.

Staib, R. 2002. Archaeological assessment in the Rouse Hill urban release area. *Australian Archaeology*, 54: 22-28.

Stockton, E.D. 1973. Shaw's Creek Rockshelter human displacement of artefacts and its significance. *Mankind* 9:112-117.

Stockton, E., & Holland, W. 1974. Cultural sites and their environment in the Blue Mountains. *Archaeology and Physical Anthropology in Oceania*, 9(1), 36–65.

Tench, W. 1961. Sydney's First Four Years: Being a Reprint of 'A Narrative of the Expedition to Botany Bay' and 'A Complete Account of the Settlement at Port Jackson', Angus & Robertson, Sydney.

Thackway, R. and Crasswell, I.D. 1995. *An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4.0*. Australian Nature Conservation Agency, Canberra.

Theden-Ringl, F., Gadd, P. 2017. The application of X-ray fluorescence core scanning in multi-element analyses of a stratified archaeological cave deposit at Wee Jasper, Australia. *Journal of Archaeological Science: Reports* 14: 241-251.

Tindale, N.B. 1974. Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits and Proper Names. Australian National University Press, Canberra

White, E., & McDonald, J. 2010. Lithic artefact distribution in the Rouse Hill Development Area, Cumberland Plain, New South Wales. *Australian Archaeology*, 70, 29-38.

White, J. 1790. Journal of a Voyage to New South Wales with Sixty-five Plates of Non-descript Animals, Birds, Lizards, Serpents, Curious Cones of Trees and Other Natural Productions. London: J. Debrett.

Williams, A. N., Mitchell, P., Wright, R. V., & Toms, P. 2012. A Terminal Pleistocene Open Site on the Hawkesbury River, Pitt Town, NSW. *Australian Archaeology*, 74, 85-97.

Williams, A.N., Ulm, S., Cook, A.R., Langley, M., Collard, M. 2013. Human refugia in Australia during the Last Glacial Maximum and Terminal Pleistocene: A geo-spatial analysis of the 25-12ka Australian archaeological record. *Journal of Archaeological Science*, 40: 4612-4625.

Williams, A.N., Atkinson, F., Lau, M., Toms, P. 2014. A Glacial cryptic refuge in southeast Australia: Human occupation and mobility from 36,000 years ago in the Sydney Basin, New South Wales. *Journal of Quaternary Science*, 29(8): 735-748.

Abbreviations

ACHAR	Aboriginal Cultural Heritage Assessment Report
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AHMS	Archaeological and Heritage Management Solutions
BP	Before present (AD 1950)
CHL	Commonwealth Heritage List
CRM	Cultural Resource Management
DCP	Development Control Plan
DECCW	Department of Environment, Climate Change and Water (now DPIE)
DP	Deposited Plan
DPIE	Department of Planning, Industry and Environment (formerly OEH)
ERS	Eastern Regional Sequence
ka	Abbreviation for thousands of years ago (e.g. 1 ka equals 1,000 years ago)
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
NHL	National Heritage List
NPW Act	National Parks and Wildlife Act 1974
OEH	Office of Environment and Heritage (formerly DECCW, now DPIE)
PAD	Potential Archaeological Deposit
RAP	Registered Aboriginal party
REP	Regional Environmental Plan
SEPP	State Environment Planning Policy
WHL	World Heritage List

Glossary

Aboriginal cultural heritage assessment report (ACHAR)	A document developed to assess the archaeological and cultural values of an area, generally required as part of an environmental assessment (EA).
<i>Aboriginal Heritage Requirements for Proponents 2010</i> <i>Cultural Consultation for</i>	Guidelines developed by DECCW to guide formal Aboriginal community consultation undertaken as part of an Aboriginal cultural heritage assessment report (ACHAR).
Aboriginal Heritage Impact Permit (AHIP)	The statutory instrument that the Director General of the Department of Planning, Industry and Environment (DPIE) issues under section 90 of the <i>National Parks and Wildlife Act 1974 (NSW)</i> to allow the investigation (when not in accordance with certain guidelines), impact and/or destruction of Aboriginal objects. AHIPs are not required where project approval under the state-significant provisions of Part 4 (Division 4.1) of the <i>Environmental Planning and Assessment Act 1979 (NSW)</i> .
Aboriginal object	A statutory term defined under the <i>National Parks and Wildlife Act 1974 (NSW)</i> 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'.
<i>Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales</i>	Guidelines developed by DECCW (2010) to inform the structure, practice and content of any archaeological investigations undertaken as part of an Aboriginal cultural heritage assessment report (ACHAR).
Department of Environment, Climate Change and Water (DECCW)	Now known as the Department of Planning, Industry and Environment (DPIE), Department of Premier and Cabinet.
<i>Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales</i>	Guidelines developed by DECCW, outlining the first stage of a two-stage process in determining whether Aboriginal objects and/or areas of archaeological interest are present within a study area. The findings of a due diligence assessment may lead to the development of an Aboriginal cultural heritage assessment report.
<i>Environmental Planning and Assessment Act 1979 (NSW)</i>	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.
<i>Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW</i>	Guidelines developed by OEH to inform the structure and content of an Aboriginal cultural heritage assessment report (ACHAR).
Isolated find	An isolated find is usually considered a single artefact or stone tool, but can relate to any product of prehistoric Aboriginal societies. The term 'object' is used in the Aboriginal cultural heritage assessment report (ACHAR), to reflect the definitions of Aboriginal stone tools or other products in the <i>National Parks and Wildlife Act 1974 (NSW)</i> .

<i>National Parks and Wildlife Act 1974 (NSW)</i>	The primary piece of legislation for the protection of Aboriginal cultural heritage in New South Wales. Part 6 of this Act outlines the protection afforded to and offences relating to disturbance of Aboriginal objects. The Act is administered by DPIE
Department of Planning, Industry and Environment (DPIE)	The DPIE is responsible for managing the Aboriginal Heritage (and other) provisions of the <i>National Parks and Wildlife Act 1974</i> .
Potential archaeological deposit (PAD)	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 <i>National Parks and Wildlife Act 1974 (NSW)</i> , PADs are generally considered to retain Aboriginal objects and are therefore protected and managed in accordance with that Act.
Proponent	A corporate entity, government agency or an individual in the private sector which proposes to undertake a development project.