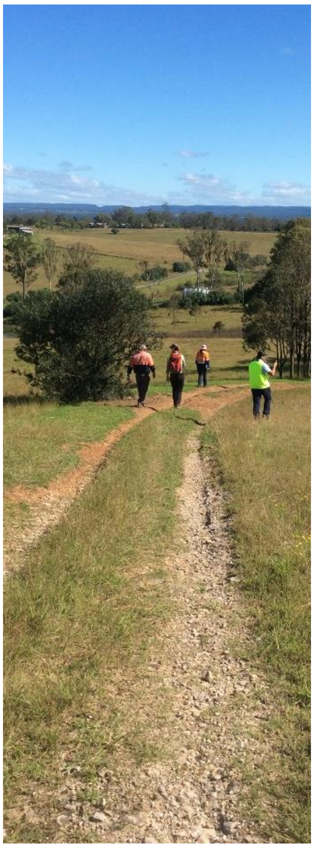
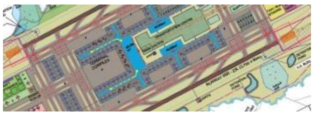
VOLUME 4

Appendix M1
Aboriginal cultural heritage





Western Sydney Airport

Aboriginal Cultural Heritage Assessment

Unrestricted access version

October 2015

Authors
Kelvin Officer
Oliver Macgregor
Tony Barham
Jill Huntley

Client: *GHD*
Planning and approval:
Dept Infrastructure and Regional Development

Navin Officer heritage consultants Pty Ltd
acn: 092 901 605

Number 4
Kingston Warehouse
71 Leichhardt St.
Kingston ACT 2604

ph 02 6282 9415
fx 02 6282 9416

Report Register

The following register documents the development and issue of this document.

Issue No.	Notes/Description	Issue Date
v. 1.6	Chapters 1 -5, Draft for GHD comment	3 June 2015
v. 2.1	Chapters 1 -5 Draft with GHD comments addressed Chapters 6-11 Draft for GHD comment	11 July 2015
v. 2.3	Full draft report for WSU review	16 July 2015
v. 3.8	Revised draft addressing first round WSU comments	7 August 2015
v. 3.10	Revision of section 1.1 and addressing changes in revised landuse planning	13 August 2015
v. 3.12	Revised draft addressing second round WSU comments and EIS chapter revisions (A.1)	28 August 2015
v. 3.13	Revision of figure formatting/orientation	31 August 2015
v. 3.18	Refinement following WSU mitigation workshop and feedback	14 September 2015
v. 3.19	Preparation of restricted and unrestricted access versions after review by Dept of the Environment	5 October 2015

Table of Contents

1. Introduction

1.1 Background

Planning investigations to identify a site for a second Sydney airport first commenced in 1946 with a number of comprehensive studies—including two previous environmental impact statements for a site at Badgerys Creek—having been completed over the last 30 years.

More recently, the *Joint Study on Aviation Capacity in the Sydney Region* (Department of Infrastructure and Transport, 2012) and *A Study of Wilton and RAAF Base Richmond for civil aviation operations* (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney. The airport is proposed to be developed on approximately 1,700 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Construction could commence as early as 2016, with airport operations commencing in the mid-2020s.

The proposed airport would provide both domestic and international services, with development staged in response to demand. The initial development of the proposed airport would include a single, 3,700 metre runway coupled with landside and airside facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of up to 10 million passengers per year. While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments including a potential express service. A final alignment will be determined in consultation with the New South Wales Government, with any enabling work required during Stage 1 subject to a separate approval and environmental assessment process.

In the longer term, approximately 40 years after operations commence and in accordance with relevant planning processes, the airport development could include parallel runways and additional passenger and transport facilities for around 82 million passenger movements per year. To maximise the potential of the site, the airport is proposed to operate on a 24 hour basis. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site.

On 23 December 2014, the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015. Approval for the construction and operation of the proposed airport will be controlled by the *Airports Act 1996* (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan which will serve as the authorisation for the development of the proposed airport.

The Australian Government Department of Infrastructure and Regional Development is undertaking detailed planning and investigations for the proposed airport, including the development of an Airport Plan. The draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, referred to as Stage 1, as well as a long-term vision of the airport's development. This enables preliminary consideration of the implications of longer term airport operations. Any stages of airport development beyond Stage 1 would be managed in accordance with the existing process in the Airports Act. This includes a requirement that for major developments (as defined in the Airports Act), a major development plan be approved by the Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

The Airport Plan will be required to include any conditions notified by the Environment Minister following this EIS. Any subsequent approvals for future stages of the development will form part of the airport lessee company's responsibilities in accordance with the relevant legislation.

1.2 The Airport Site

The land which forms the subject of this assessment is defined as all land owned by the Australian Government situated at Badgerys Creek. These lands are shown in Figure 1.1 and comprise approximately 1,700 hectares.

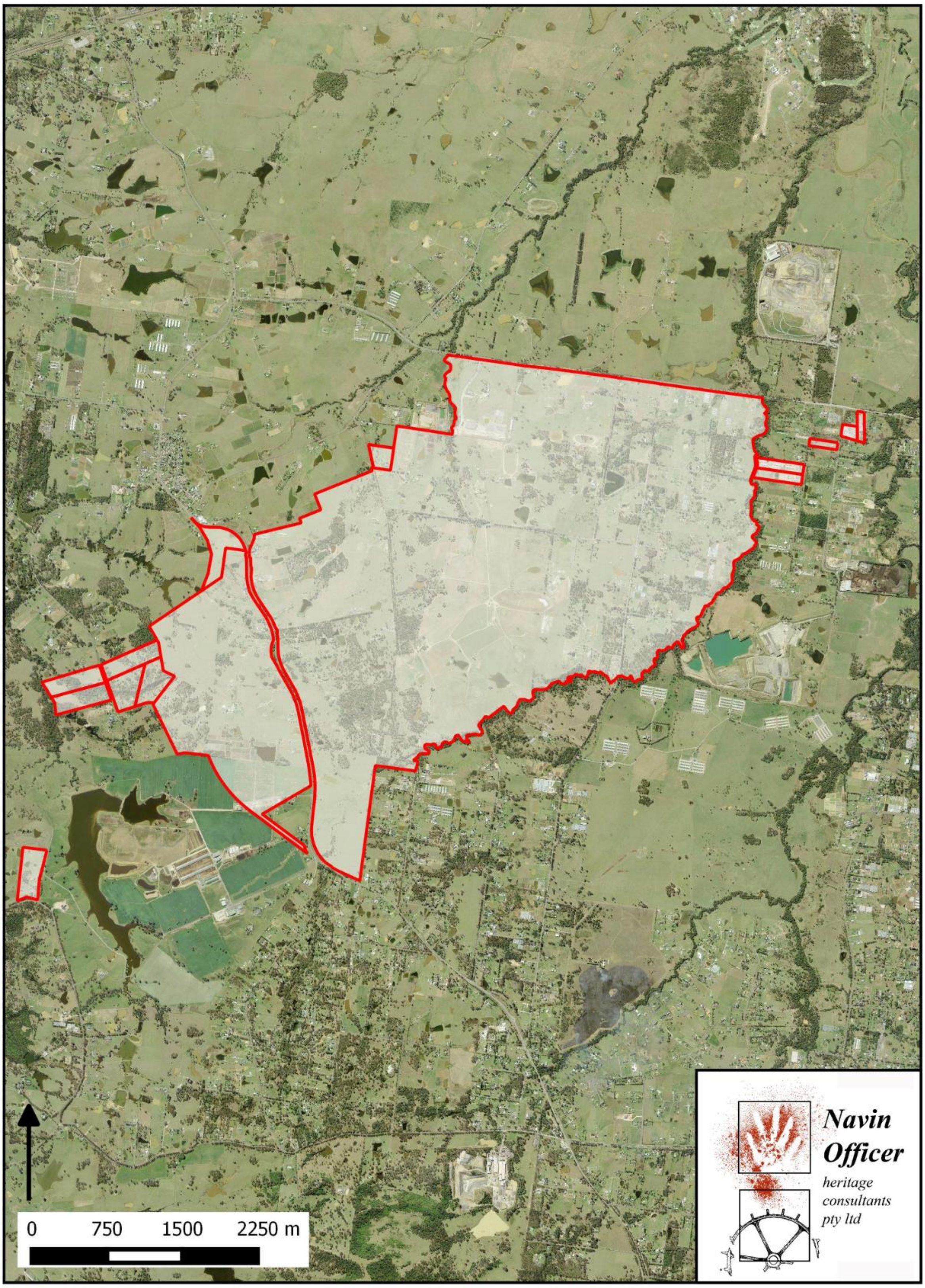


Figure 1.1 The location of all Australian Government owned lands at Badgerys Creek. These lands were the subject of the Aboriginal cultural heritage assessment.

1.3 Staged Development

This assessment evaluates the potential impacts of a proposed initial development referred to as Stage 1, and an indicative concept of longer term development.

1.4 Aims and objectives

The general aims of this assessment were:

- to document and assess the Aboriginal cultural heritage values of the airport site;
- to provide an assessment of the potential impacts of the proposed airport development; and
- to draft mitigation and management strategies to be adopted in the event that the airport proposal is implemented.

Specific objectives of the assessment included:

- to build upon, and effectively apply, the corpus of existing information previously generated about the airport site, and in particular from the 1997-1999 Second Sydney Airport proposal EIS process (NOHC 1997, PPK Environment and Infrastructure 1999), and the 2014 Environmental Field Survey (SMEC 2014, AMC 2014);
- to address, as appropriate, issues raised in response to the 1997-1999 Second Sydney Airport proposal EIS assessment by the independent auditor and the then Department of the Environment and Heritage;
- to conduct an assessment program which effectively addressed assessment aims within the determined limitations of the investigation scope;
- to conduct an assessment of Aboriginal cultural values based on an inclusive program of Aboriginal stakeholder consultation, and based primarily on the views communicated by those stakeholders; and
- to conduct an archaeological assessment of the airport site which acknowledges the limitations of an approach based on surface sites and focuses instead on an investigation of the subsurface archaeological evidence.

1.5 Report contributors

Aboriginal consultation for this investigation was conducted by Kelvin Officer, Nicola Hayes, Jo Dibden and Oliver Macgregor.

The fieldwork program was directed by Kelvin Officer and Nicola Hayes. Field personal included Jo Dibden, Lucy Blackam, Julia MacLachlan and Anna Kotarba.

Stone artefact analysis was conducted by Oliver Macgregor, with supplementary contributions by Jill Huntley.

Specialist geoarchaeological analysis was contributed by Anthony Barham.

This report was written by Kelvin Officer, Oliver Macgregor, Anthony Barham, Nicola Hayes and Jill Huntley.

Please refer to Sections 2.3.1 and A1.2 for a list of Aboriginal stakeholder entities and their field representatives who participated in, and contributed to, this investigation.

1.6 Information access

1.6.1 Copyright

Copyright to this report rests with the Western Sydney Unit except for the following:

- The Navin Officer Heritage Consultants logo and business name (copyright to this rests with Navin Officer Heritage Consultants Pty Ltd).
- Generic content and formatting which is not specific to this project or its results (copyright to this material rests with Navin Officer Heritage Consultants Pty Ltd) subject to the licence provisions of the contract.
- Descriptive text and data relating to Aboriginal objects which must, by law, be provided to the NSW Office of Environment and Heritage or other statutory authorities for its purposes and use.
- Information which, under Australian law, can be identified as belonging to Indigenous intellectual property.
- Content which was sourced from and remains part of the public domain.

1.6.2 Restricted information

This is an 'unrestricted access' version of this report and has been made available for use by a general audience. Consistent with sensitive information protocols, site specific map-grid references and large scale site mapping have been removed from this version. This follows directions by statutory authorites and Aboriginal stakeholder groups. Where information has been removed or modified, a note in italics has been inserted for the information of users.

No information provided by Aboriginal stakeholders in this report has been specifically identified as requiring access restrictions due to its cultural sensitivity.

1.6.3 Confidentiality

The content of this report is not considered to be confidential provided that it is only published as part of the public release of the Western Sydney Airport Draft EIS, and that any restricted information, as specified in Section 2.11.2 is excluded from public access versions of the report.

2. Methodology

2.1 Legislation and Guidelines

This assessment has been prepared:

- in accordance with the provisions and requirements of the *Environment Protection and Biodiversity Conservation Act 1999*;
- in consultation with the Australian Government Department of the Environment (DoE); and
- in accordance with the *Guidelines for the Content of a Draft Environmental Impact Statement – Western Sydney Airport* (DoE 2015c) (EIS guidelines) for Western Sydney Airport.

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The objectives of the Act include: the protection of the environment, especially those aspects of national significance; to promote the conservation of biodiversity and ecologically sustainable development; and to recognise the role of indigenous people and their knowledge in realising these aims.

The EPBC Act provides a legal framework for the protection and management of matters of national environmental significance (MNES). MNES include, among other things, World Heritage properties and National Heritage places.

The EPBC Act also applies to actions that have a significant impact on the environment where the actions affect, or are taken on, Commonwealth land, or are carried out by a Commonwealth agency.The EPBC Act adopts a broad definition of the environment that is inclusive of cultural heritage values. In particular, the 'environment' is defined to include the social, economic and cultural aspects of ecosystems, natural and physical resources, and the qualities and characteristics of locations, places and areas (s528).

Specific requirements for the Western Sydney Airport EIS

On 23 December 2014, a delegate for the Minister for the Environment determined that the construction and operation of a Western Sydney Airport at Badgerys Creek (EPBC 2014/7391) is a controlled action because the proposal has the potential to have a significant impact on matters of NES and other matters protected under Part 3 of the EPBC Act. The delegate also determined that the proposal is to be assessed by preparation of an Environmental Impact Statement (EIS). On 29 January 2015 the Department of the Environment released guidelines for the content of a Draft EIS for this project which require the following in relation to Aboriginal heritage:

The EIS must include:

- A description of the World Heritage/National Heritage values of the Greater Blue Mountains Area World Heritage property/National Heritage Place, as described in the Statement of Outstanding Universal Value and including reference to the World Heritage criteria the area is listed for as well as the integrity of the property.

- A description of the environment in all areas of potential impact, including all components of the environment as defined in Section 528 of the EPBC Act including heritage values and places.

- A description of all of the relevant impacts of the action.

- The EIS should identify and address cumulative impacts, where potential project impacts are in addition to existing impacts of other activities (including known potential future expansions or developments by the proponent and other proponents in the region and vicinity).

- If the conclusion is made that any relevant controlling provision or element of a relevant controlling provision will not be impacted by the proposed action, then justification must be provided for how this conclusion has been reached. This includes any heritage items/places likely to be on site and other relevant elements of the environment that may be impacted by the proposed action.

- A full heritage impact assessment and the findings of the further program of archaeological survey that was foreshadowed in the referral for this project.

- The identification and assessment of impacts to the environment should include removal and degradation of heritage items/places (historic, natural and indigenous).

- Provide information on proposed avoidance and mitigation measures to manage the relevant impact of the action on a matter protected by a controlling provision.

- The EIS must take into account relevant agreements and plans that cover impacts or known threats to a matter protected by a controlling provision, including those for the Greater Blue Mountains Area World Heritage property.

- Specific and detailed descriptions of the proposed avoidance and mitigation measures based on best available practices.

- Details of the likely residual impacts upon a matter protected by a controlling provision after the proposed avoidance and mitigation measures have been taken into account.

A report on the Environmental Survey of Commonwealth Land at Badgerys Creek: Aboriginal Heritage, prepared by Australian Museum Consulting and dated October 2014 (AMC 2014), was one of the referral documents for Western Sydney Airport under the EPBC Act. Recommendation one of that report stated that the EIS assessment "should address" the requirements of the NSW Office of Environment and Heritage (OEH) document: *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010b). Recommendation 2 stated that the EIS should comply with the requirements of the OEH document: Code of Practice for Archaeological investigation of Aboriginal Objects in New South Wales (DECCW 2010a).

It should be noted that many of the requirements specified in these two OEH documents relate to Part 6 of the *National Parks and Wildlife Act 1974*, most provisions of which do not apply to Commonwealth lands. Consequently, recommendations one and two of the Australian Museum Consulting report have been followed where appropriate during the conduct of this assessment.

The National Heritage List

The National Heritage List is a schedule of places which the Minister for the Environment considers to have ‘National Heritage Value’ based on prescribed ‘National Heritage Criteria’.

There are no places within the airport site that are included on the National Heritage List (date of search: 24 June 2015).

The Commonwealth Heritage List

The Commonwealth Heritage List is a schedule of places owned or controlled by the Commonwealth, which the Minister for the Environment considers to have ‘Commonwealth Heritage Value’.

The EPBC Act places a range of obligations on Commonwealth agencies with regard to places included on the Commonwealth Heritage List. These include:

- a responsibility to undertake an assessment process to identify which of the places they own or control have Commonwealth Heritage values;

- establish and maintain a heritage register, as part of the heritage strategy, which is a list of places that a Commonwealth agency owns or controls that sets the Commonwealth Heritage values (if any) of each place;

- development of a heritage strategy applicable to all listed places controlled by the agency;

- preparation of a management plan for each Commonwealth Heritage listed place;

- ensuring that no action is taken which has, will have, or is likely to have an adverse impact on the National heritage values of a National Heritage Place, or the Commonwealth heritage values of a Commonwealth Heritage Place, unless there is no feasible or prudent alternative and all reasonable measures to mitigate impact have been taken; and

- including a covenant in any sale or lease contract for land which includes a Commonwealth Heritage Place which stipulates the protection of the Commonwealth heritage values of that place, unless such an action is found by the agency to be unnecessary, unreasonable or impractical.

There are no places within the airport site that are included on the Commonwealth Heritage List (date of search: 24 June 2015), or the DIRD Heritage Register (date of search 25 August 2015).

The Australian Heritage Council

The Australian Heritage Council is an independent body of heritage experts established through the *Australian Heritage Council Act 2003*. It replaces the Australian Heritage Commission as the Australian Government's independent expert advisory body on heritage matters.

The Council's role is to assess the values of places nominated for the National Heritage List, Commonwealth Heritage List, and the list of overseas places of historic significance to Australians. The Council provides advice to the federal Minister for the Environment on conserving and protecting listed values. The Council may also nominate places with heritage values to these lists.

It is the Council's duty to promote the identification, assessment and conservation of heritage and to advise the Minister on a range of matters relating to heritage. It also engages in research and promotional activities.

Commonwealth heritage management principles

Schedule 7B of the *Environment Protection and Biodiversity Conservation Regulations 2000* (Regulation 10.03D) lists the Commonwealth Heritage Management Principles. These principles are:

1. The objective in managing Commonwealth Heritage places is to identify, protect, conserve, present and transmit, to all generations, their Commonwealth Heritage values.

2. The management of Commonwealth Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their Commonwealth Heritage values.

3. The management of Commonwealth Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places.

4. The management of Commonwealth Heritage places should ensure that their use and presentation is consistent with the conservation of their Commonwealth Heritage values.

5. The management of Commonwealth Heritage places should make timely and appropriate provision for community involvement, especially by people who:

    a) Have a particular interest in, or associations with, the place; and

b) May be affected by the management of the place.

6. Indigenous people are the primary source of information on the value of their heritage and that the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values.

7. The management of Commonwealth Heritage places should provide for regular monitoring, review and reporting on the conservation of Commonwealth Heritage values.

2.1.2 Heritage and consultation principles and protocols

The Burra Charter

The Australian ICOMOS Charter for the conservation of places of cultural significance (the Burra Charter, as adopted in November 1999) provides principles for the treatment of places of cultural significance. The Charter also provides specific guidance for physical and procedural actions that should occur in relation to significant places. This assessment has been prepared in accordance with those principles.

Table 2.1 lists definitions from the Burra Charter (pp21-22) of key terms used in this assessment.

Table 2.1 Key terms used in this assessment as defined in the Burra Charter

Term	Definition
Conservation	means all the processes of looking after a *place* so as to retain its *cultural significance*. It includes *maintenance* and may according to circumstance include *preservation, restoration, reconstruction and adaptation.*
Maintenance	means the continuous protective care of the *fabric*, contents and setting of a *place*, and is to be distinguished from repair. Repair involves *restoration* or *reconstruction* and it should be treated accordingly.
Restoration	means returning the EXISTING *fabric* of a *place* by removing accretions or by reassembling existing components without the introduction of new material.
Adaptation	means modifying a *place* to suit proposed compatible uses.
Preservation	means maintaining the fabric of a place in its existing state and retarding deterioration
Reconstruction	means returning a *place* as nearly as possible to a known earlier state and is distinguished by the introduction of materials (new or old) into the fabric.

Australian Government Aboriginal consultation guidelines

Guidelines for consultation regarding indigenous heritage places and values are outlined in an Australian Heritage Commission publication entitled 'Ask First, A guide to respecting Indigenous heritage places and values (Australian Heritage Commission 2002). This publication provides an overview and guidance on the principles and conduct of Aboriginal stakeholder consultation within possible arenas of Australian government involvement. The principles and guidelines outlined in this document were drawn upon in the design and conduct of the program of Aboriginal stakeholder consultation adopted for this assessment.

The NSW Office of Environment Aboriginal consultation protocol

The NSW Office of Environment and Heritage (OEH) has produced a document titled: *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010b), (the 'NSW OEH Protocol'), that sets out the requirements for 'consulting with those Aboriginal people who can provide information about the significance of Aboriginal cultural heritage as part of the heritage assessment process' (ibid:1). The environmental survey of Commonwealth Land at Badgerys Creek, conducted by Australian Museum Consulting in 2014 recommended that the EIS assessment should address these OEH consultation requirements (AMC 2014: recommendation 1). The OEH protocol was accordingly used as a guide for the conduct of the program of Aboriginal stakeholder consultation. The protocol was applied based on the understanding that:

- it outlines current best-practice within NSW;
- it provides a clear procedural, timing and resourcing structure; and
- its application would meet procedural expectations now established within the NSW Indigenous stakeholder community.

The protocol specifies four stages of consultation:

Stage 1 - Notification of the project and identification and registration of stakeholders

Stage 2 - Presentation of information about the project and the proposed assessment methodology

Stage 3 - Gathering information about cultural significance, and

Stage 4 - Review of draft cultural heritage assessment report

2.1.3 Implementation of protocols for the Western Sydney Airport

Stage 1 Notification of the project proposal and identification and registration of stakeholders

A public notice advising of the project assessment and inviting registrations from interested Aboriginal parties was placed in the following local newspapers. A copy of the notice is provided in Appendix 1 - Section A1.1).

- Blacktown Advocate - Wednesday 18 February, 2015
- Liverpool Leader - Wednesday 18 February, 2015
- Fairfield City Champion - Wednesday 18 February, 2015
- Camden Advertiser - Wednesday 18 February, 2015
- Penrith Press - Friday 20 February, 2015
- Macarthur Chronicle Tuesday 24 February, 2015

Letters were sent to the following organisations seeking the identification of Aboriginal stakeholders for the purpose of inviting their participation in the consultation program (dated 13 February 2015):

- Gandangara Local Aboriginal Land Council
- Office of the Registrar *Aboriginal Land Rights Act (1983) NSW*
- Native Title Services Corporation Limited
- Liverpool City Council
- Greater Sydney Local Land Services
- Office of Environment and Heritage

A search was conducted of the National Native Title Tribunal registers on 13 February 2015 (refer to Section A1.3, Appendix 1). The search returned no relevant entries for the airport site.

Letters were sent to the following recipients, inviting registration from parties suggested by others as potential stakeholders, or considered likely by NOHC (dated 3 March 2015):

- Walbunja Aboriginal Corporation
- NSW Aboriginal Land Council

- Darug Tribal Aboriginal Corporation
- Gandangara Local Aboriginal Land Council
- Darug Aboriginal Land Care Incorporated
- Gundungurra Aboriginal Heritage Association Inc
- Tharawal Local Aboriginal Land Council

Letters were sent to the following recipients, inviting registration from parties suggested by the NSW OEH and not already directly contacted by NOHC (dated 6 March 2015):

- Darug Tribal Aboriginal Corporation (additional address)
- Warragil Consultancy Services
- Wurrmay Consultancy
- Goobah Developments Pty Ltd
- Gunyuu (emailed 9/3)
- Badu
- Wullung
- Yerramurra
- Nundagurri

The closing date for stakeholder registrations was 24 March 2015.

Thirty four registrations were received from the following entities prior to the commencement of the fieldwork program on 4 May 2015:

- Badu
- Bilinga CHTS
- Butucarbin Aboriginal Corporation
- Cubbitch Barta Native Title Claimants Aboriginal Corporation
- Darug Aboriginal Cultural Heritage Assessments
- Darug Aboriginal LandCare
- Darug Custodian Aboriginal Corporation
- Darug Land Observations
- Darug Tribal Aboriginal Corporation
- Deerubbin Local Aboriginal Land Council
- Dhinawan-Dhigaraa Culture and Heritage Pty Ltd
- EORA
- Gangangarra
- Goobah
- Gandangara Local Aboriginal Land Council
- Gundungurra Aboriginal Heritage Association Inc.
- Gunyuu
- Kamilaroi-Yankuntuatjara Working Group
- Kawul Cultural Services
- Mungunya (sic) CHTS
- Murrumbul

- Ngunawal
- Ngunawal Heritage Aboriginal Corporation
- Nundagurri
- Tharawal Local Aboriginal Land Council
- Tocomwall Pty Ltd
- Wandandian
- Walbunja
- Wingikarah CHTS
- Warragil Cultural Services
- Wullung
- Wurrumay
- Yerramurra

Consistent with the NSW OEH protocol, all late registrations received during the assessment program have been accepted and the subject entities invited to participate in all subsequent consultation actions, as appropriate. Seventeen registrations have to date (6 August 2015) been received following the completion of the fieldwork program:

- Bidawal
- Bulling Gang Elders
- Curwur Murre Elders
- Dharug
- Djiringanj
- Elouera
- Gadung Elders
- Golangaya Elders
- Gulla Gunar Elders
- Kuringgai
- Murrin
- Ngarigo
- Peter Falk Consultancy
- Tharawal
- Thauaira
- Walbunja Elders
- Walgalu

Stages 2 and 3 Presentation of information about the project, proposed assessment and gathering information about cultural significance

A combined background paper and draft methodology for the Aboriginal cultural heritage assessment was sent to all registered stakeholders on 26 March 2015 with an invitation to provide comment on both the methodology and any known Aboriginal cultural values relevant to the airport site (refer to Section A1.4.1, Appendix 1). Consistent with recommendation 2 of the 2014 report of the environmental survey of Comonwealth land at Badgerys Creek by Australian Museum Consulting (AMC 2014), the draft methodology was based on scoping and excavation techniques specified in the Code of Practice for Archaeological investigation of Aboriginal Objects in New South Wales

(DECCW 2010a), Submission of written comments was invited by 23 April 2015, and the commencement of a three week field program was proposed on the 27 April 2015.

A meeting with the invited attendance of all registered stakeholders was held at St Marys on 8 April 2015. (refer to Section A1.4.3, Appendix 1). An introduction to the airport proposal, an outline of previously conducted assessment work in the airport site, and the proposed draft methodology for the Aboriginal cultural heritage assessment were presented and discussed at this meeting. The agenda and minutes of this meeting are included in Section A1.4.3 of Appendix 1.

A majority of representatives present at the 8 April 2015 meeting expressed a desire to discuss a number of issues directly with a representative of the Department of Infrastructure and Regional Development. These issues included:

- the scope of the archaeological field program;
- representation of Aboriginal stakeholders in the field program;
- field program pay rates;
- the use of wet sieving;
- potential distribution of a list of all registered participants to all registered stakeholders;
- Native Title; and
- management of recovered cultural material.

A supplementary stakeholder meeting was subsequently held at the same venue on 23 April 2015, with the participation of the General Manager of Environment, Legal and Communication, Western Sydney Unit, Department of Infrastructure and Regional Development. The agenda of this meeting is presented in Section A1.4.4 of Appendix 1. Responses from the GHD EIS assessment team to most of the issues raised by stakeholders regarding the proposed methodology were presented and further discussed at the meeting. An exception was the conditions of employment for stakeholder representatives in the field program.

As a consequence of the timetabling of the supplementary meeting, the stakeholder response submission date was extended to 30 April 2015, and the commencement of the field program revised to 4 May 2015.

A finalised set of conditions of stakeholder field participation was delivered to each stakeholder as part of a formal Invitation for Employment on 30 April and 1 May 2015. Stakeholder participation in the field program was conditional upon formal acceptance of the conditions. All 33 stakeholders registered at that time opted to accept the conditions and were represented in the subsequent field program.

2.1.4 Summation of Aboriginal stakeholder issues and project team responses

The following tabulation (Table 2.2), provides a summation of the main issues presented by stakeholders at the two meetings and in written submissions. Each issue is paired with a response from the EIS assessment team, including input from NOHC, noting where revisions or other actions were instigated in response. A detailed tabulation of the issues raised is presented in Section A1.4.5, of Appendix 1.

Table 2.2 Summary of Aboriginal stakeholder issues regarding the assessment methodology and EIS team responses

Issues raised by Stakeholders	Response by the EIS team
The scope of previously conducted archaeological survey across the airport site has been limited. More surface archaeological survey, such as 100% coverage, should be undertaken as part of this assessment.	The archaeological survey conducted for the 1997 EIS achieved a survey coverage of just over 50% of the current airport site. Given the low number of surface artefacts encountered during the 2014 re-inspection of selected 1997 site recordings (AMC 2014), the repeat conduct of systematic surface survey was considered unlikely to provide any analytical conclusions significantly different to the 1997 survey. However, a program of field survey and reconnaissance was conducted with stakeholders over one week in order to obtain an overview of the airport site, and to evaluate optimal subsurface testing locations As the objective of the current assessment was to focus on the assessment of the potential subsurface archaeological resource across the airport site, archaeological field work concentrated on test excavation.
A large number of stakeholders expressed the view that the proposed scope of the archaeological test excavation program was too limited. It was proposed that there be substantial increases in the number of test locations, test pits and allocated field time	The scope of the test excavation program was drafted within a framework which sought to balance minimum analytical requirements and the resources and timeline available for the investigation. In response to stakeholder concerns, the field team was increased in number from five, to 11 stakeholder representatives per day. This allowed a significant increase in scope by increasing the number of test pits that could be completed per day, and potentially the number of test locations which could be investigated in the allocated time. An undertaking was made to review the progress of the field program at the end of each week relative to the testing aims and targets. Consideration was given in each review about the need to extend the field program based on an appreciation of the accumulating field results.
Many stakeholders considered that there had not been enough time allocated for the assessment.	The scope of the test excavation program was drafted within a framework which sought to build upon the work already conducted during the 1997 EIS, and to balance minimum analytical requirements with the resources and timeline available to the investigation. It is useful to note that the current assessment has the advantage of access to an already developed corpus of survey data and analysis. This meant that the conduct of a time intensive surface survey of the airport was neither considered necessary nor consistent with the priority for an assessment of subsurface archaeological potential.
Some stakeholders considered that there had not been enough information provided about the airport project.	At the time of the assessment, the design, configuration and capacity of the proposed airport was still subject to development and change. Unfortunately this meant that only general information and objectives about the project could be communicated to stakeholders.

Issues raised by Stakeholders	Response by the EIS team
Some stakeholders considered that there had not been enough support for the assessment methodology prior to the testing program. In particular, there was not enough justification for and documentation of the representativeness of the possible test locations.	The selection of test locations was based on a priority to include a representative range of the large and small scale landform types and topographic variables present within the airport site. Reference was also made to current predictive site location models so that well substantiated and low potential variables were not re-tested. For this reason, a large database of representative data, such as the proportion of each landform type/variable within the airport site, was not presented in support of the test location selections. Given the land-use history of the airport site, a greater priority was the minimisation of exposure to areas of substantive ground surface disturbance. This was one of the priorities fulfilled during the first week of field reconnaissance and orientation in which the potential test locations were shortlisted.
Some stakeholders considered that the large number of stakeholder registrations indicated that many did not have a strong association with the airport site. There were suggestions that the number of registered stakeholders who were to participate in the field program should be limited, such as to include only those representing Darug heritage, or those who had participated in person at the meetings.	The primary role is acknowledged of those cultural values expressed and derived from individuals and their lore which are related to local country, tribal identify and tradition. However, a principle in both the Commonwealth and State guidelines of stakeholder consultation is that of inclusiveness. This is required so that the potential submission of relevant information from unexpected or unanticipated sources is not excluded from the process. Similarly, descendants from a subject area may now be resident in variously distant locations, or may identify primarily with other tribal groups. These physical and social dynamics make the potential exclusion of stakeholders based on perceived identity or allegiance, unhelpful and counterproductive. Based on the emphasis on inclusive representation by the adopted protocols, it was decided to provide equal opportunity to all registered stakeholders to nominate field representatives to participate in the field program.
Many stakeholders considered that the proposed roster system for dividing field participation across all registered stakeholders was too restrictive. It was suggested that all stakeholders be represented on every day of programmed fieldwork.	Given the number of registered stakeholders at the time (33), and the assessment team's commitment to an inclusive process of consultation and field participation, the suggested daily inclusion of all stakeholders in fieldwork would have resulted in an inefficient use of resources and a counterproductive set of logistical requirements.
Most stakeholders considered that the draft methodology proposal for a roster of five stakeholder representatives per day was too small.	In response to these concerns, the size of the field team was increased from five to 11 stakeholder representatives per day. This significantly increased the potential for discussion amongst stakeholders during the first week of field inspections, as well as expanding the scope of the investigation by increasing the number of test pits that could be completed per day.
Most stakeholders considered that the proposal to conduct dry sieving was not appropriate for the Cumberland Plain and should be replaced with a wet sieving methodology.	A wet sieving methodology was adopted for the test excavation program.

Issues raised by Stakeholders	Response by the EIS team
A number of stakeholders concluded that their views had not been adequately taken into consideration.	All views expressed by stakeholders were given careful consideration. In many cases suggested actions, principles or policy could not be realised or developed because they were incompatible with project objectives, the adopted consultation protocol or the resourcing constraints of the project.
The cumulative impact of large developments on the Cumberland Plain have not been affectively mitigated or managed in the past. The cumulative impact of the airport project will be a critical component of the assessment and needs to be taken into consideration by the assessment.	It was acknowledged by the team that cumulative impacts on cultural values are an important component of the net impact of any development proposal and would be addressed in the assessment.
The possible conditions of fieldwork employment were extensively debated. A number of disparate positions regarding potential conditions of employment and pay rates were presented by various stakeholders however no consensus opinion emerged.	The assessment team gave careful consideration to all stakeholder suggestions and issues raised on this matter. An offer of employment was made based on the following: • Equal representation of all registered stakeholders • Field participation to be spread across the full field program according to a roster drafted by NOHC • One representative per registered stakeholder per rostered day • A single hourly rate and allowance package applicable to all field participants • All field participants to be proficient in 'Sites Officer' field skills (unfortunately it was not possible to offer a junior or unskilled/trainee position) • Consideration of employment conditions offered at other similar, recent Aboriginal cultural heritage assessment programs involving Commonwealth agencies.
One stakeholder group suggested that a review of previously conducted geotechnical testing data should be conducted as a precursor to selecting optimal test excavation locations. The provision of all previously conducted data to interested stakeholders was suggested.	It was agreed that data from geotechnical testing conducted within the airport site, conducted previously (where available), and for the current EIS assessment, will be reviewed and applied where applicable in the Aboriginal cultural heritage assessment.

2.1.5 Field participation

All Aboriginal stakeholders who were registered at the time, opted to participate in the fieldwork program. A roster was established which allowed for the participation of all stakeholder representatives by defining three sub-groups. Each group participated for five field days which were spread over the three week field program, mostly across paired days. Eleven stakeholders were represented on each field day. A list of all field representatives is provided in Section A1.2, Appendix 1.

The field program was divided into two components:

Week One A primary objective of the first week was to provide an opportunity for stakeholders to identify and discuss cultural and intangible values

	associated with the airport site. In this week, stakeholder representatives were given an opportunity to become familiar with the site's characteristics and to inspect the diversity of landforms present. This was achieved through both reconnaissance inspections, and the systematic on-site evaluation of each of the proposed archaeological test locations.
Weeks Two and Three	In the following two weeks, representatives were employed in the systematic conduct of archaeological test excavations across a shortlisted number of test locations, selected and evaluated in the first week.

2.1.6 Stage 4 Comments on the Draft EIS

All registered Aboriginal stakeholders will be provided with, or advised where to locate a copy of, the draft EIS report and specialist Aboriginal cultural heritage report, and invitated to provide a written response on its findings and proposed mitigation and management strategies. This comment period will coincide with the statutory period for public display of the Draft EIS and submission of comments. All responses will be documented, reviewed and addressed in finalising the EIS.

2.2 Consultation with other stakeholders

2.2.1 Liverpool City Council

A meeting with the Heritage Officer for Liverpool City Council, was held on the 28 May 2015 with Kelvin Officer (NOHC) and Erin Williams (RPS) from the EIS assessment team. A general outline of the project and assessment approach was provided, followed by a discussion of potential issues and priorities.

2.2.2 NSW Office of Environment and Heritage

A meeting with a senior archaeologist with the Heritage Branch, Office of Environment and Heritage (OEH) was held on 29 May 2015, with Kelvin Officer (NOHC) and Erin Williams (RPS) from the EIS assessment team. A general outline of the project and assessment approach was provided, followed by a discussion of potential issues and priorities. A representative from the Office with responsibility for Aboriginal heritage was unable to attend the meeting. Given that the OEH would not have a statutory role in the assessment of the EIS, it was explained by the attending OEH officer that limited resources and competing priorities had not enabled additional attendance.

2.3 Review of previous work and heritage registers

2.3.1 Sources

A range of archaeological and historical data was reviewed for the airport site and its surrounds. This review was used to:

- determine the nature and status of known Aboriginal sites within and around the airport site;
- facilitate site prediction on the basis of known regional and local site patterns; and
- place the area within an archaeological and heritage management context.

The review of documentary sources included heritage registers and schedules, local histories, and archaeological reports. A primary information source was the Aboriginal Heritage Information Management System (AHIMS) maintained by the NSW OEH together with its associated files and catalogue of archaeological reports.

Searches were undertaken of the following heritage registers and schedules:

- Aboriginal Heritage Information Management System (AHIMS) (NSW OEH) (accessed 9 January 2015 and 18 June 2015);
- World Heritage List;

- The National Heritage List (Australian Heritage Council);
- The Commonwealth Heritage List (Australian Heritage Council); and
- The Register of the National Estate (Australian Heritage Council).
- The Heritage Register of the Department of Infrastructure and Regional Development

Searches of these registers and listings revealed that Aboriginal sites and places are only included within the AHIMS register.

2.3.2 Excluded and revised recordings

A review of original site recording field data generated by the 1997 EIS archaeological survey was conducted for all recordings within the airport site. These records comprised the original field site card forms, annotated topographic mapping and print photography. All of the map grid coordinates from this program were generated from visual interpretation of 1:25,000 topographic mapping, without the aid of reliable GPS technology. When complemented with contemporary mapping applications and aerial photography, it was possible to refine and correct a number of the site locations. As a consequence, one recording, a modified tree (B8, AHIMS site no. 45-5-2634) was found to be situated outside of the airport site on the southern side of Badgerys Creek. Due to an original 1997 mapping error, the tree tentatively ascribed to this recording by AMC in 2014 is not the tree recorded in the 1997 survey (AMC 2014:53). All revised map coordinates have been incorporated into the site inventory for this investigation (Appendix 2).

A review of the AHIMS register data revealed one recording which had been plotted within the airport site, based on an erroneous map grid reference. This site is 'EG6' (AHIMS site no. 45-5-2562) and was recorded in 1999 along a proposed easement of the eastern gas pipeline. This site is situated 5 km to the east of the airport site.

2.4 Field inspection and surface survey

A three week fieldwork program was conducted which comprised an initial week devoted to Aboriginal consultation and a review of possible test excavation locations, and two weeks in which archaeological test excavations were conducted. The field program extended from 4 to 22 May 2015. This program reflected the objectives of the assessment, which were the identification of Aboriginal cultural values and the testing of the subsurface archaeological resource.

The field program comprised the following:

Week One	Stakeholder orientation and reconnaissance
	Identification and discussion of cultural and intangible values
	Review of potential test locations and development of a prioritised list
Weeks Two and Three	Conduct of archaeological test excavation program

The systematic conduct of surface archaeological survey across the airport site was not attempted. However, a number of sites were identified and recorded during the process of accessing and inspecting potential test excavation locations.

2.5 Test excavation

As outlined in the results of the consultation program (refer Table 2.2), the draft methodology for the test excavation program was modified by the inclusion of wet sieving and increasing the number of stakeholder representatives per field team. All adopted field program methodologies were consistent with the *Code of Practice for Archaeological investigation of Aboriginal Objects in New South Wales* (DECCW 2010a) where appropriate.

The aim of the test excavation program was to characterise the nature and occurrence of the subsurface archaeological resource by conducting archaeological test excavations within a representative selection of landform types present within the airport site.

The methodology, developed in consultation with Aboriginal stakeholders, anticipated the conduct of test excavations in at least ten representative test locations, with around ten hand dug archaeological test pits executed at each location, each with dimensions of 1 x 0.5 m. The pits were to be arranged at regular intervals along straight line transects to sample micro-topographic variation.

The initial desktop pre-selection of test excavation locations involved the following steps, considerations and priorities:

- Classification and mapping of archaeologically relevant landform units present across the airport site (refer to Chapter 3);
- Consideration and avoidance of areas displaying substantial ground disturbance;
- Identification of areas of early nineteenth century non-Aboriginal occupation, with a view to testing for the presence of ‘contact’ archaeological material;
- Consideration of existing and well-established Aboriginal site location criteria with the aim of avoiding the need to replicate test results from low potential areas, such as high gradient or poorly drained micro-topographic contexts;
- Selection of at least one of each of the large-scale landform units identified at the airport site;
- Selection of at least one test location from each of the main catchments;
- Selection of test locations from throughout the horizontal and vertical topographic range of the airport site;
- Preference given to locations with 4WD, or better, access; and
- Exclusion of properties where permission to access had been withheld.

Based on the above desktop selection criteria, 38 potential archaeological test locations were pre-selected. Following on-site review and field inspection of each location, with the participation of Aboriginal stakeholders, the locations were prioritised and a shortlist developed.

In four instances, potential locations were paired and combined to form two single test locations (test locations 8 &10, and 26 & 27). The location and summary descriptions of the pre-selected locations are presented in Table 2.3 and Figure 2.1.

Archaeological test excavations were conducted at 13 of the 38 preselected potential locations. With the pairing of four of these, there was a total of eleven test locations.

All excavation was conducted by hand, using spades, hand trowels, and where necessary picks. All sieving was conducted by hand using pressurised water sourced from a water truck. All artefactual material, including European materials (but excluding plastic and imported gravels) was recovered and subject to itemised description in the laboratory.

Sieve (square aperture) meshes used were:

- 12.5 millimetres (0.5 inch), as necessary, and always as a (nested) top mesh, and/or
- 3.13 millimetres (5/32 inch).

All pits were backfilled with sieved spoil and/or imported clean fill, using a bobcat.

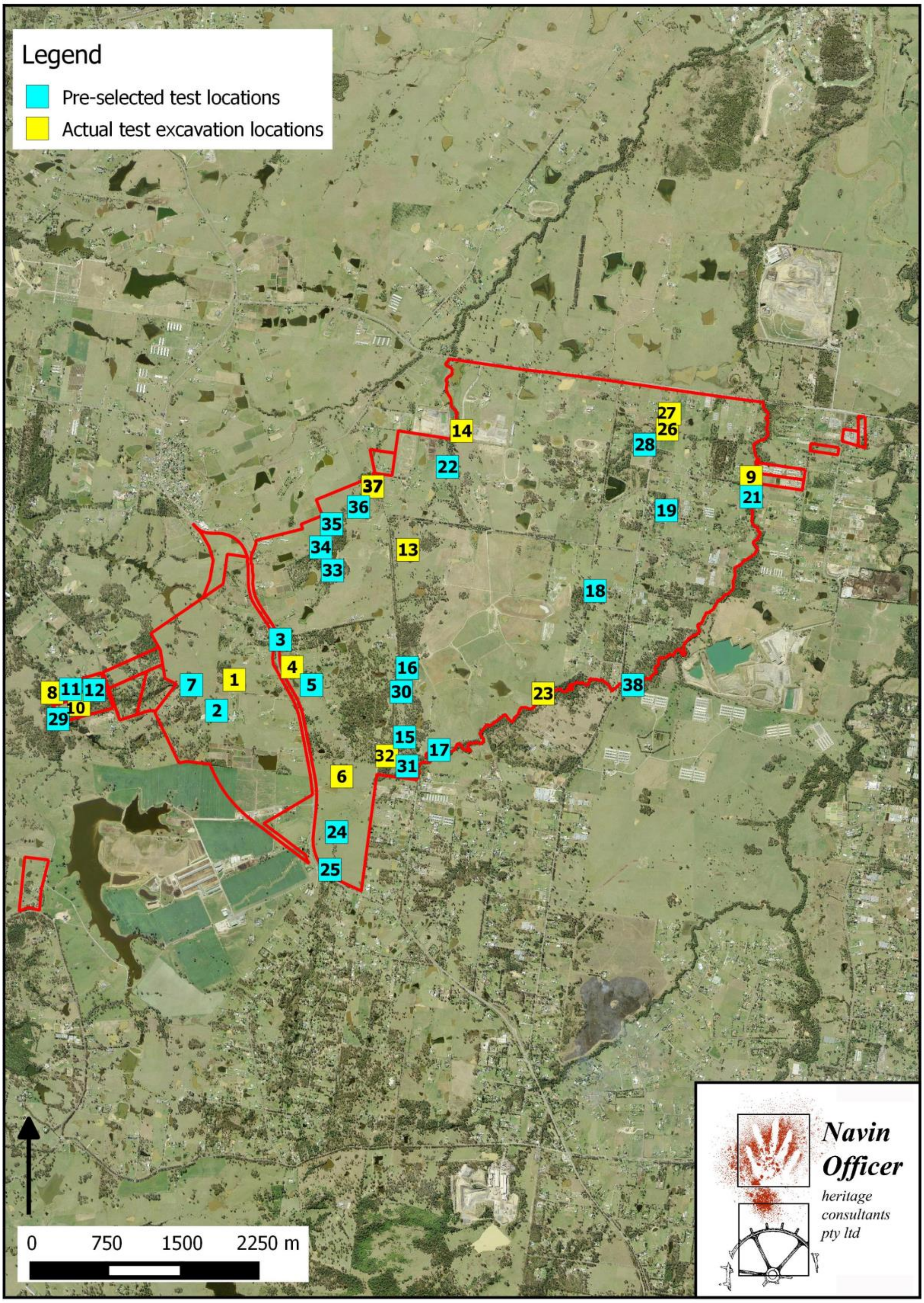


Figure 2.1 General location of pre-selected and actual test excavation locations across the Airport Site.

Table 2.3 List of potential test locations identified from desktop analysis, and review comments following field inspection. **Bolded numbers** indicate locations where archaeological test pits were conducted.

Test location no.	Landform types	Location	Property Numbers	Map page numbers (refer to Appendix 5)	Comments
1	Major watershed ridgeline crest and upper slopes	Major watershed ridgeline, just north of Vicarys Winery	404786 & 404794	12	Good access, pasture improved
2	Major watershed ridgeline crest and upper slopes	Major watershed ridgeline, Vicarys Winery	404757	12	Good access, but close to/includes building disturbance zone
3	Secondary watershed ridgeline crest and upper slopes	Prominent ridgeline formed from basaltic dyke (highest elevations in airport site)	404607	6 & 12	Avoidance of historic church site and burial sites exclude most of location, poor access, quartz flakes present, surface sandstone outcrops
4	Secondary watershed ridgeline crest and upper slopes	Prominent ridgeline formed from basaltic dyke (highest elevations in airport site)	404766	12	Good access, relatively undisturbed
5	Secondary watershed ridgeline crest and upper slopes	Prominent ridgeline formed from basaltic dyke (highest elevations in airport site)	404768	12	Steep access, highly disturbed by quarrying
6	Mid slopes, basal slopes, valley floor, minor spurline crest, alluvial flats	Adjacent to third and fourth order streamline on east side of The Northern Road	404772	12	Good access, pasture improved, exclude western side of creek
7	Tributary watershed ridgeline and secondary spurline	Spurs and ridgelines descending to fifth order streamline, Duncans Creek	404753 & 404810	11	Constrained access, powerline disturbance, native grasses and thus reduced disturbance in places, artefacts on western side of track
8	Basal slopes, valley floor, alluvial flats	Adjacent to fifth order streamline, Duncans Creek, at western end of airport site	404808	10	Good access, native grasses and thus reduced disturbance, could be combined with location 10
9	Basal slopes, valley floor, alluvial flats, possible levee deposit	Basal slopes, flats and banks of fifth order streamline, Badgerys Creek, at eastern end of Gardiner Road near eastern end of airport site	404681	9	Good access, avoid impact to historic buildings, some cultivation impact, artefacts evident on surface and in adjacent road reserve

Test location no.	Landform types	Location	Property Numbers	Map page numbers (refer to Appendix 5)	Comments
10	Mid slopes, basal slopes, minor spurline crest	Minor spurline adjacent to fifth order streamline, Duncans Creek, at western end of airport s	404801	10 & 11	Good access, native grasses and thus reduced disturbance, could be combined with 8
11	Basal slopes, valley floor, minor spurline crest, creek banks	Adjacent to second order streamline, close to confluence with Duncans Creek	404808	10	Good access, native grasses and thus reduced disturbance, TL 8/10 is a better option
12	Basal slopes, valley floor, minor spurline crest, creek banks	Adjacent to second order streamline, close to confluence with Duncans Creek	404808	11	Obscured by scrub
13	Secondary spurline crest, \minor spurline crest	Centrally located upper catchment context on E side of Anton Lane	404601	7	Good access, native grasses and thus reduced disturbance, avoid disturbance areas associated with airstrip
14	Mid slopes, basal slopes valley floor, minor spurline crest	Adjacent to east bank of fourth order streamline, Oaky Creek	404587	1	Good access, native grasses and thus reduced disturbance, locally elevated micro-topography
15	Mid slopes, basal slopes, minor spurline crest	Rise between minor second and third order streamlines close to Badgerys Creek	404796 & 404600	13	Constrained access, some disturbance, surface artefacts (AHIMS site no. 45-5-2699, B46)
16	Secondary watershed ridgeline crest	East of Anton Road, high catchment context	404600	13	Difficult access, very boggy, recently ploughed, very disturbed
17	Valley floor, alluvial flats	Banks and flats adjacent to fifth order streamline, Badgerys Creek	404796	13	Constrained access, requires creek crossing, immediately downslope of former 'Stanfield' farmstead
18	Secondary spurline crest, upper slopes	Small saddle on spurline west of Badgerys Creek Road	404640 & 404639	8	Highly disturbed (intensive agriculture), European rubbish, TL27 a better alternative
19	Tributary watershed ridgeline crest, upper slopes	North of Pitt Street	404688	9	Constrained access, stock animals
20	Valley floor, alluvial flats, possible levee deposit (low rise adjacent to creek)	West bank and flats adjacent to fifth order streamline, Badgerys Creek, at east end of Leggo Street	404732	9	Flooded and under water

Test location no.	Landform types	Location	Property Numbers	Map page numbers (refer to Appendix 5)	Comments
21	Valley floor, alluvial flats, possible levee deposit (low rise adjacent to creek)	West bank and flats adjacent to fifth order streamline, Badgerys Creek, at east end of Leggo street	404670	9	Constrained (waterlogged) access, highly disturbed adjacent to creek, flats disturbed by levelling and cropping
22	Valley floor, basal slopes, minor spurline crest, creek banks	Banks and slopes adjacent to third and fourth order streamlines, Oaky Creek and tributary	404594	1 & 7	Consent for property access unavailable
23	Mid slopes, upper slopes, minor spurline crest, basal slopes	Elevated minor spurline/bench adjacent to Tributary watershed ridge, and fifth order streamline, Badgerys Creek	404600 & 404610	14	Access weather dependent, adjacent to grinding groove site (B120), adjacent to former 'Spredenburg' farmstead
24	Valley floor, minor spurline/low rise, alluvial flats	Rise adjacent to fourth order streamline, Badgerys Creek, close to Northern Road crossing	404772	17	Ground water-logged, constrained access, all pasture improved, some disturbance
25	Valley floor, minor spurline/low rise, alluvial flats	Rise adjacent to fourth order streamline, Badgerys Creek, close to Northern Road crossing	404772	17	Access difficult, access to east side of creek constrained, pasture improved, flats are waterlogged
26	Valley floor, alluvial flats	Banks of fourth order stream line (unnamed in NE portion of airport site)	404571 &404569	3	Good access, avoid half of area subject to fill and dumped debris, downslope of 'Pennell's', farmstead in area of site B88 (AHIMS site no. 45-5-2665), could be combined with TL27
27	Basal slopes and upper slopes, secondary spurline crest	Spurline adjacent to Elizabeth Drive	404572	3	Good access, avoid adjacent Scout Hall block which is highly disturbed, adjacent to former 'Pennell's' farmstead, could be combined with TL26
28	Valley floor, basal slopes, minor spurline	Adjacent to fourth order stream line (unnamed in NE portion of airport site)	404565	2 & 3	No access to northern side of Creek, access constrained by scrub, surface artefacts on S side of creek (AHIMS site no.45-5-2763, B87)
29	Basal slopes, knoll	Knoll adjacent to fifth order streamline, Duncans Creek	404801	10	Poor access, test area obscured by scrub, shallow soil

Test location no.	Landform types	Location	Property Numbers	Map page numbers (refer to Appendix 5)	Comments
30	Midslopes, minor spurline crest	Adjacent to second order streamline in mid valley context, south of Antons Lane	404600	13	Difficult access, very boggy, recently ploughed, very disturbed
31	Valley floor, alluvial flats, possible levee deposit	Alluvial flats between former and current bed of fifth order streamline, Badgerys Creek	404796 & 404771	13	Constrained access across creek, low disturbance levels
32	Mid slopes, basal slopes, valley floor, minor spurline crest, alluvial terrace	Minor spurline adjacent to fifth order streamline, Badgerys Creek	404796	13	Good access, some cross drains, good micro-topographic variation, close to sites B45 and B46 (AHIMS site nos. 45-5-2663 & 2699)
33	Basal slopes, secondary spurline	Spur situated between two second order streamlines draining into tributary of Cosgroves Creek	404604	6	Constrained access, boggy creek crossing, under power line easement, surface artefacts adjacent to creek
34	Basal slopes, secondary spurline	Spur situated between two second order streamlines draining into tributary of Cosgroves Creek	404604	6	Constrained access, boggy creek crossing, some erosion and track disturbance, surface artefacts
35	Mid slopes, basal slopes	Western fall of valley of third order streamline tributary of Cosgroves Creek	404603	6	Steep and problematic access
36	Basal slopes, valley floor, minor spurline crest	Eastern fall of valley of third order streamline tributary of Cosgroves Creek	404603	6	Constrained access, limited micro-topographic variation, upstream of dam 100 m upstream of former 'Haines' farmstead
37	Valley floor, basal slopes, minor spurline crest, creek banks, elevated rise/terrace	Banks and slopes adjacent to third order streamline (tributary of Cosgroves Creek)	404603 & 404602	6	Good access, good micro-topographic variation, stock animals, surface artefact on embankment, from 0 – 100 m downstream of former 'Haines' farmstead
38	Valley floor, alluvial flats	Alluvial flats and banks of fifth order streamline, Badgerys Creek	404655	15	Constrained access, boggy ground, stock animals, either side of early European creek crossing 'to Mr Bell's' (1859)

2.6 Recording parameters

2.6.1 A paradigm shift from surface to subsurface evidence

This assessment incorporates site data generated by the 1997 EIS investigation. Some of the current conclusions and assessments drawn from this data differ from those made in 1997. This is due to an emerging and better understanding of the nature of the subsurface archaeological resource.

It is now established that Aboriginal stone artefacts in subsurface contexts are distributed across the full spectrum of landscape variation. The areal incidence of this distribution is discontinuous and uneven, but broad and relative categories of artefact incidence can be reliably predicted according to landform types and variables. A corollary understanding is that the location and boundaries of recorded surface sites relate more directly to patterns of erosion and land-use, factors which determine ground surface exposures, than to patterns in Aboriginal occupation. A consequence of this is that measures generated solely from surface site recordings, such as site frequency, density (areal incidence), and even the identification of discrete potential archaeological deposits, can have reduced relevance unless coupled with analysis of the unexposed archaeological resource.

Current predictive modelling now allows the extrapolation of subsurface artefact incidence data to untested landforms of the same type. The nature of the predicted archaeological resource can now be mapped in terms of broad area landforms and topographic variables.

The integration of surface and subsurface information which characterises current best practice can be understood as a shift in paradigm - from one which is site-based and focused on surface evidence, to one focused on the subsurface resource that may be revealed by both surface sites and test excavation.

This development has introduced a parallel shift in analysis from sites to landscapes. When predictive modelling is generated by, or substantiated from, locally applicable and excavation-derived datasets, it provides a basis for making significance assessments applicable to landform suites and landscapes. The assessment conducted for this investigation adopts a landscape approach based on the predictive value of the test excavation program. This is complemented by the results of the previous 1997-1999 EIS assessment methodology which employed a site based approach.

A more detailed discussion of the shift in approach from surface to subsurface evidence is provided in Appendix 7.

2.6.2 Terminology used

Potential archaeological deposit (pad)

This classification is typically applied to a relatively small and discrete location, defined spatially either by geomorphological, disturbance, or administrative criteria. Within such an area, there is a predicted likelihood that subsurface archaeological material is present, and that this material would warrant archaeological investigation in order to determine its scientific, cultural, or statutory value and status. The latter qualification is necessary to avoid the inclusion of predicted low or very low subsurface artefact incidences which is an expected trait across a majority of assessed landscapes.

Archaeologically sensitive landscape (asl)

Large and broad-area assessments often necessitate the identification of the archaeological resource at a broader level such as landform type or a combination of topographic variables. To define these as potential archaeological deposits would be inaccurate. This is because of the expected discontinuous distribution of archaeological material across the defined zone and the very low incidence within some included small-scale landforms. The terminology ‘archaeologically sensitive’ landscape is used to indicate an area in which sites and/or pads are known or predicted to occur at a scale or frequency which necessitates management action in the future.

Both the categories: archaeological deposit, and archaeologically sensitive landform, can be used on their own where there is evidence of archaeological material, or with the prefix ‘potential’, where there is a lesser degree of supporting evidence. For a specific deposit, direct evidence of archaeological material would be needed to remove a 'potential' prefix, such as from a visible soil profile section or test pit.

The basis for the identification of archaeologically sensitive landforms in this assessment is the conduct and results of the test excavation program. Only locales with direct evidence of archaeological material are classified as sites.

Aboriginal site

An Aboriginal site is a place or location which relates to past or contemporary Aboriginal occupation. Aboriginal sites can be divided into those that are identified from archaeological evidence (archaeological sites), and those related to intangible cultural values, such as revealed by oral tradition and lore, or from the historical record. A site may include both archaeological and intangible heritage values.

Stone artefact occurrences

A spatially discrete distribution of stone artefacts in an open context, (that is not situated within a rock shelter or cave), is the most commonly recorded site type in Australia. In the past, these recordings were subdivided into 'isolated finds', when based on the discovery of single artefact, and 'open camp site' or 'artefact scatter' when comprised of more than one artefact.

As a consequence of the growing body of evidence that surface artefact occurrences are an unreliable indicator of both subsurface deposits, and bounded subsets relevant to past activity, the typology for recording artefact occurrences has become less interpretive and now refers to artefact occurrences.

This investigation adopts the following typology:

Surface artefact occurrence	One or more stone artefacts which occur within a specified surface area, and which are distinguished from other recordings by defined criteria, such as the boundary of ground surface exposures, landform type, or an arbitrary separation distance
Subsurface artefact occurrence	One or more stone artefacts which occur within a specified deposit, and which have been revealed as a result of natural or human excavation. The boundaries of a recording may be strictly tied to known artefacts (such as test pits or erosion scarps) or consist of an interpretation base on topographic or disturbance variables. Subsurface artefact occurrences can also be described as archaeological deposits

Given the varied incidence of ground surface exposure and deposit disturbance within the airport site, a specification of 60 metres has been adopted for recordings identified from surface survey evidence. The 60 metre parameter was also employed in the 1997 EIS survey recordings (NOHC 1997).

Where a site has been identified from subsurface evidence, (and in the context of the current investigation this is solely based on the evidence from test pits), then pits have been grouped into sites based on relevant landform boundaries.

Background scatter

Background scatter is a term used generally by archaeologists to refer to artefacts which cannot be usefully related to a place or focus of past activity (except for the net accumulation of single artefact losses).

There is no single concept for background discard or 'scatter', and therefore no agreed definition. Commonly agreed is that background discard occurs in the absence of 'focused' activity involving the production or discard of stone artefacts in a particular location. An example of unfocused activity is occasional isolated discard of artefacts during travel along a route or pathway. Examples of 'focused activity' are camping, knapping and heat-treating stone, cooking in a hearth, and processing food with stone tools.

Scarred Trees

The scarred tree classification refers to a tree with a scar or scars of assessed Aboriginal origin. Most such scars are the result of the removal of bark or wood. The identification of a scar as Aboriginal in origin is dependent on a set of inter-related interpretive criteria, and is often associated with varying degrees of recorder confidence or surety. For this reason classifications are often prefixed as possible, probable or most likely. The credibility of alternative causal explanations such as natural traumas and other types of human scarring must be tested for each scar.

Scarred trees are now included in the more inclusive site type classification of *modified tree* or *culturally modified tree*. Scarred trees make up a large proportion of this category. Each tree is normally considered to be a separate site.

A range of diagnostic criteria has been developed to assist in the identification of Aboriginal scarred trees. The following criteria are based on archaeological work conducted by Simmons (1977) and Beesley (1989), and the field manual for Aboriginal scarred trees developed by Long (2005):

1. The scar does not normally run to ground level: (scars resulting from fire, fungal attack or lightning nearly always reach ground level). However, ground termination does not necessarily discount an Aboriginal origin (some ethno-historical examples of canoe scars reach the ground);

1(a). If a scar extends to the ground, the sides of the original scar must be relatively parallel: (natural scars tend to be triangular in shape;

2. The scar is either approximately parallel sided or concave, and symmetrical: (few natural scars are likely to have these properties except fire scars which may be symmetrical but are wider at the base than their apex. Surveyors marks are typically triangular, and often adzed);

3. The scar should be reasonably regular in outline and regrowth: scars of natural origin tend to have irregular outlines and may have uneven regrowth;

4. The ends of the scar should be 'shaped', either squared off, or pointed (often as a result of regrowth): (a 'keyhole' profile with a 'tail' is suggestive of branch loss);

5. A scar which contains adze or axe marks on the original scar surface is likely to be the result of human scarring. Their morphology and distribution may lend support to an interpretation of an Aboriginal origin: (marks produced after the scarring event may need to be discounted);

6. The scar must date to the time of Aboriginal bark exploitation within its region: The traditional Aboriginal exploitation of bark probably ceased in most regions between 100 and 150 years ago. However, in some locations associated with Aboriginal settlement, the Aboriginal removal of bark may have continued to the present day, or restarted as part of new cultural movements; and

7. The tree must be endemic to the region: (and thus exclude historic plantings).

Field identification of Aboriginal scars, is based on surface evidence only and will not necessarily provide a definitive classification. In many cases the possibility of a natural origin cannot be ruled out, despite the presence of several diagnostic criteria or the balance of interpretation leaning toward an Aboriginal origin. For this reason interpretations of an Aboriginal origin are qualified by the recorder’s degree of certainty. The following categories were used:

- Aboriginal scar - This is a scar where an Aboriginal origin is considered the most likely. The scar conforms to all of the criteria and a natural origin is considered unlikely and improbable;

- Probable Aboriginal scar - This is a scar that conforms to all of the criteria and where an Aboriginal origin is considered to be the most likely. Despite this, a natural origin cannot be ruled out; and

- Possible Aboriginal scar - This is a scar which conforms to all or most of the criteria and where an Aboriginal origin cannot be reliably considered as more likely than alternative natural causes. The characteristics of this scar will also be consistent with a natural cause.

2.6.3 Site numbering

The site numbering adopted for this assessment follows the protocol adopted in the 1997 EIS investigation.

All recordings were given a consecutive 'B' number following on from the last site recording (B112) within the 1997 EIS Badgerys Creek assessment area.

In the 1997 investigation, the 'B' prefix was intended to differentiate Badgerys Creek from Holsworthy recordings. The 'B' prefix has been retained for the current assessment in order to group all the Badgerys Creek area sites together, and to flag their related assessment history.

3. Landscape context

3.1 Regional overview

3.1.1 The Sydney Basin

The airport site is located on the central western margin of the Cumberland Plain (Figure 3.1). The Cumberland Plain is a centrally positioned landscape unit of the much larger Sydney Basin. The Sydney Basin is a large sedimentary structure, six kilometres thick, made up of fine-grain lithologies originally laid down in a foreland basin through late Permian and Triassic time (Herbert 1997). The Basin covers an area of 64,000 km^2, (the onshore component being 36,000 km^2) and extends over 1500 km from Port Stephens to Batemans Bay. The Basin is situated between the New England and Lachlan Foldbelts.

The surface topographies of the basin display an elongated saucer shape. The gently undulating lowlands of the Cumberland Plain are situated approximately at its centre. The basin rises steeply in the west and more gently in the north and south where the landscapes are dominated by sandstone and characterised by steeply incised plateaus (Young and Young 1988). The rock types around the margins of the basin are dominated by sandstones, such as the Hawkesbury Sandstone around Sydney, and are older than the overlying and softer shales across the centre which form the Cumberland Plain. Basaltic dykes and volcanic plugs occur throughout (Haworth 2003; Hazelton and Tille 1990). Triassic Wianamatta Group shales overlay the Hawkesbury Sandstone and outcrop throughout the plateaus, on the Cumberland Plain, and Moss Vale tablelands (Haworth 2003; Hazelton and Tille 1990; Sullivan and Hughes 1983).

The climate of the Sydney region is warm and temperate; orographic effects result in more precipitation and less temperature variation along the coast.

3.1.2 The Cumberland Plain

The airport site is located on the western side of the northern portion of the Cumberland Plain (Figure 3.1). The northern Cumberland Plain is that section of the Plain where the creek lines drain north and west to the Hawkesbury River (McDonald and Rich 1993). The Cumberland Plain is in a centrally positioned portion of the inner Sydney Basin which consists of rolling and low gradient topographies which have developed on the shale dominated bedrocks of the Wianamatta Group of middle Triassic age.

The Wianamatta Group makes up the uppermost portion of the Triassic depositional sequence and was laid down as epimarine, intertidal, back-swamp and alluvial sediments during a period of marine regression (the exposure of former seabed), and progradation (the seaward and progressive deposition of shoreline deposits) (Jones and Clarke 1991; Smith 1979).

The Wianamatta Group consists of, in order of deposition up-sequence:

a) the Ashfield Shales Formation, grading from shales to fine sandstones and siltstone laminates, (Smith 1979), laid down in shallow marine and lacustrine conditions. Outcrop is very limited on the Cumberland Plain;

b) the Minchinbury Sandstone Formation, a quartz lithic sandstone normally up to 6 m thick which exhibits low angle, cross-bedding indicative of a prograding bar barrier or beach system; and

c) the Bringelly Shales, predominantly consisting of claystone and siltstones with thin laminate layers and locally discontinuous, thin and often sinuous sandier units (former channel deposits).

The Cumberland Plain comprises three broad physiographic units:

- the River Plain, comprising the alluvial flats associated with the Nepean-Hawkesbury River, and the Eastern, South and Ropes Creeks (approximately 11 per cent of the plain);

- the Dissected Plateau, where stream incision into the underlying sandstone has occurred, particularly around the margins of the Plain (approximately 33 per cent of the plain); and
- the Shale Slopes, formed on the Ashfield and Bringelly Shales (approximately 56 per cent of the plain) (Dept of Environment and Planning 1984).

The airport site falls within the Shale Slopes unit. The area of the airport site, approximately 17 km^2, comprises around 1.2 per cent of this unit.

Some characteristics of the Shale Slopes unit include:

- gently undulating, rounded hills and valleys with a low degree of vertical differentiation – this has a consequence that the more elevated country, the network of ridges and spurlines (also known as interfluves), do not pose a major obstacle for, and have less strategic value in, cross-country movement and control;
- mature landforms;
- deep texture contrast soils which are clayey and stiff;
- surface hydrology characterised by a dendritic pattern of drainage lines;
- native vegetation structures dominated by grassy woodland and open forests; and
- broad area flooding and associated aggradation of sediments across valley floor contexts.

3.1.3 Current and palaeo-climate

The climate in southeast Australia during the Holocene period (the last 10,000 years) was relatively stable, with environmental changes of a smaller amplitude and shorter duration than those experienced in the late Pleistocene (Attenbrow, 2004:204). Slightly wetter conditions than those of today persisted between ~7000 BP (Before Present) and ~5000 BP, and the overall trend from ~3800 BP to ~1500 BP was to cooler, drier conditions.

The last1000-1500 years saw small increases in temperature and rainfall equivalent to those currently experienced. After 3000 BP, the El Niňo-Southern Oscillation (ENSO) began to operate as it does now, resulting in more marked seasonality and variation in precipitation patterns. Evidence for the end of cooler and drier conditions in the mid Holocene shows regional variance, but the transition back to warmer and wetter conditions on the southeast coast began at about 2000 BP (Attenbrow 2002:206-7). The scale of impact from mid-Holocene cooler and drier conditions produced changes in the extent of vegetation communities, rather than a total change of vegetation (Attenbrow 2002:37; Haworth 2003; Nanson and Young 1983; Young and Young 1988).

The contemporary climate of the Penrith area is humid and subtropical with hot summers and mild winters. The average summer temperature range is 17.9 ºC to 29.8 ºC and in the winter 6.2 ºC to 18.6 ºC. The average January maximum temperature is 29 ºC and the average July minimum is 5 ºC (based on 50 years of data (1956-2006).

Since the mid twentieth century, average annual rainfall in South Creek catchment has been less than 800 millimetres and varied only slightly from the area where it arises south of Bringelly to the confluence with the Hawkesbury River in the north (Bringelly 760 mm, St Marys 759 mm, Windsor 757 mm) (DEC 2005a). A higher proportion of the annual total rainfall occurs in the warmer months of the year and summer rainfall is less variable than winter rainfall. Average rainfall only exceeds evaporation in June, with the difference between rainfall and evaporation being greatest in December (Rae 2007).

Across the airport site, the mean monthly rainfall ranges from 126 millimetres (February) to 23 mm (July) (dataset: 1999 – 2013). Seasonal mean maximum temperatures range from 28.8 ºC in summer to 18.1 ºC in winter, and mean minimum temperatures from 16.5 ºC in summer to 4.7 ºC in winter. The dominant wind direction is southwesterly in all seasons. Wind direction is more constant in autumn and winter than in spring and summer. Mean wind speeds are relatively constant throughout the year ranging from 5 to 7 knots (BOM 2015).

The following seasonal divisions for the Sydney region have been recorded by D'harawal knowledge holders (http://www.bom.gov.au/iwk/dharawal/index.shtml).

- January/February/March (*Burran*) - Hot and dry
- April/May/June (*Marrai'gang*) - Wet, becoming cooler
- June/July (*Burrugin*) - Cold, frosty, short days
- August (*Wiritjiribin*) - Cold and windy
- September/October (*Ngoonungi*) - Cool, getting warmer
- November/December (*Parra'dowee*) - Warm and wet

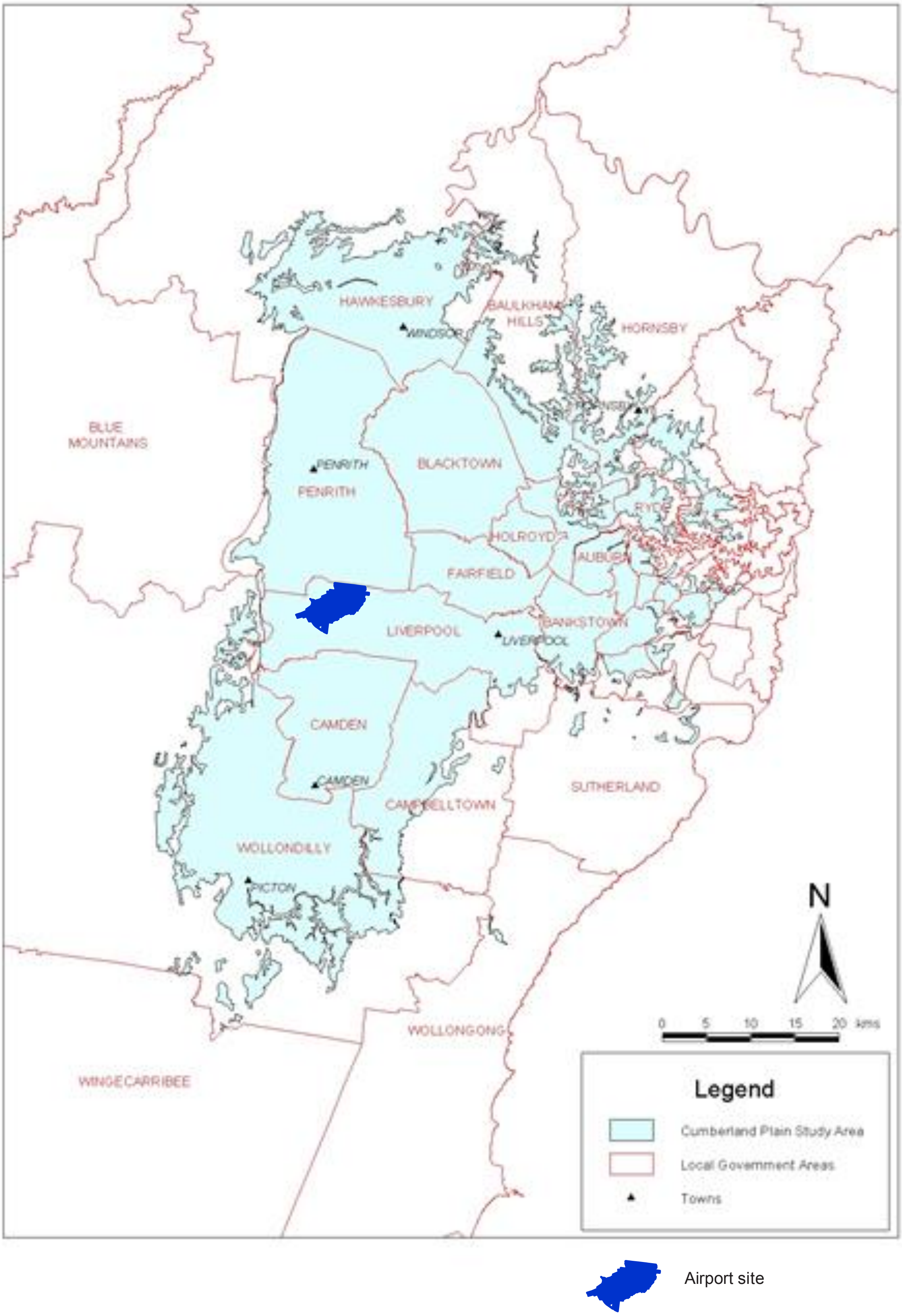


Figure 3.1 The Cumberland Plain (after Office of Environment and Heritage web site: http://www.environment.nsw.gov.au/threatenedspecies/MapOfTheCumberlandPlain.htm)

3.2 The airport site

3.2.1 Topography

The landscape of the airport site is typical of the Shale Slopes component of the Cumberland Plain, with low relief, undulating and low gradient topography, and a medium drainage line density. Ground elevation varies of from 118 to 43 m AHD. The Bringelly Shale outcrops throughout the area. Surface exposures of Minchinbury Sandstone also occur in isolated locales. A post-Triassic basaltic dyke outcrops along a north-west south-east alignment in the western half of the airport site. The resistant nature of this rock has formed higher slope gradients and a small area of moderately graded undulating terrain. The steeper slopes contain screes of volcanic gravels.

Small areas of naturally occurring surface silcrete gravels occur across some portions of the airport site. These may constitute a surface lag (ancient remnant gravels from a now fully eroded deposit), or relate to as yet poorly mapped subsurface remnants of ancient weathering (refer to Appendix 6).

3.2.2 Soil Landscapes

The mapped soil-landscapes within the airport site are: Blacktown, Luddenham and South Creek (Bannerman and Hazelton 1990).

Blacktown soil-landscape

The Blacktown soil-landscape dominates the Cumberland lowlands and has developed on the predominantly shale bedrocks of the Wianamatta Group. It is characterised by local relief of between 10 and 30 metres and gradients of mostly less than 5 per cent, but up to 10 per cent. Crests and ridges are typically broad and rounded, with convex upper slopes grading into concave lower and basal slopes. Outcrops of shale occur in association with eroded areas but were not a feature of the pre-European landscape. Soils are shallow to moderately deep (<100 centimetres) hardsetting mottled texture contrast soils including red, brown podzolics on crests, and yellow podzolic types on lower slopes and flats (podzolic soils are characterized by moderate leaching which produces an accumulation of clay). These soils can be generalised as comprising friable top loams which overlie hard-setting clay loams and compact mottled clays (Bannerman and Hazelton 1990:28-31).

Luddenham soil-landscape

The Luddenham soil-landscape occurs only in the western end and possibly also the northern margin of the airport site. It has developed on predominantly shale bedrocks of the Wianamatta Group, often in association with Minchinbury sandstone. It is characterised by low rolling to steep hills with local relief in the 50 to 120 metre range and low to moderately inclined slopes, mostly between 10 and 15 per cent. Ridges and hill crests are convex and narrower than for the Blacktown category. Moderately inclined side slopes grade into narrow concave drainage lines. Soils include shallow dark podzolic soils to massive earthy clays on crests, moderately deep (70 – 150 centimetres) red podzolics on upper slopes, and moderately deep yellow podzolics and prairie soils on lower slopes and flats. These soils can be generalised as comprising friable top loams which overlie hard-setting clay loams and basal clays (Bannerman and Hazelton 1990:63-66).

South Creek soil-landscape

The South Creek soil-landscape occurs throughout the present active floodplains and valley floor flats of the Cumberland Plain drainage network. This landform has formed from Quaternary alluvium derived from the Wianamatta Group shales and where situated upstream, the Hawkesbury sandstone. The topography is mostly flat or gently sloping alluvial plain with occasional terraces and levees providing low relief. Slopes are less than 5 per cent and local relief is under 10 m. Soils are often very deep with layered sediments over bedrock or relict soils. Soil types include structured plastic clays or structured loams adjacent to drainage lines, red and yellow podzolics on terraces, and structured or leached clays, and yellow solodic soils (Bannerman and Hazelton 1990:68-71).

3.2.3 Drainage network

Most of the airport site falls within the upper catchment of South Creek, a north draining tributary of the Hawkesbury River with a course length of 64 km and a catchment area of around 620 km^2 (Rae 2007). The far western portion of the site forms part of the immediate catchment of the Nepean River, via the north and west draining minor tributary of Duncans Creek. The watershed ridgeline between the South Creek and Nepean River catchments in the airport site is situated along the northern half of The Northern Road and then southwards and west of this road along the ridge containing Vicarys Winery (Figure 3.3). This watershed is significant in terms of the hydrology of the Cumberland Plain but for most of its length, provides an unimposing topographic feature as a broad and low gradient ridgeline.

The airport site is dominated by upper catchment terrain, with most of its drainage lines originating from headwaters situated within the site and reaching stream orders of three and four. The stream order analysis conducted for the Aboriginal heritage analysis identified two fifth order streamlines: Badgerys Creek along the southern and eastern boundary, and Duncans Creek just outside of the western site boundary. The headwaters of Badgerys Creek are situated three kilometres upstream of the airport site, and its confluence with South Creek occurs four kilometres downstream. The southern and eastern fall of the Badgerys Creek catchment occupies the southern margin of the site, and two tributaries of Cosgroves Creek, including Oaky Creek, drain to the north. These tributaries reach orders of three and four.

Only the fifth order section of Badgerys Creek (approximately downstream of Mersey Road) is classed as perennial on the NSW Land and Property Information 1:25,000 topographic map series.

3.2.4 Vegetation

The vegetation across most of the Cumberland Plain prior to European land-use comprised an open eucalypt woodland in which the trees were widely spaced and the ground cover dominated by grasses (Perry 1963). The woodland would have been dominated by Grey Box (*Eucalyptus moluccana) and Forest Red Gum (E. tereticornus).* Native grasses included *Themeda australis* and *Aristida* spp, with *Lomandra* spp. occurring as a common herb. Along the riparian corridors forest communities would have included Rough-barked Apple (*Angophora floribunda*) and *Casuarina cunninghamiana* together with *Acacia* spp (Benson and Howell 1990).

Most of the original native vegetation has been cleared from the airport site and is now dominated by agricultural grasslands or cultivated fields with scattered Eucalypt and exotic trees and pockets of open Eucalypt woodland or shrubland. The remaining native vegetation includes pockets of native grassland and mostly regenerating woodland or forest. Older growth Eucalypts, dating from the early twentieth century may remain as isolated occurrences.

3.2.5 Land-use

Since the early 1800s, non-Aboriginal land-use of the airport site has been primarily agricultural and consisted of varied phases of stock grazing, cropping, orcharding, dairying and market gardening. A pattern of increasingly smaller subdivision commenced in the mid nineteenth century and culminated in the delineation of numerous rural residential lots associated with post war immigration. A broader spectrum of activities characterised the middle and later twentieth century including market gardening, hobby farming, animal husbandry such as poultry farming, horse and dog breeding and training, and some light industrial functions. Acquisition of the land by the Australian Government began in the 1980s and the nature of residency changed from freehold to tenancy. This was associated with a slow process of depopulation and loss of long-term residents which has accelerated in recent times. A reduction in intensive agricultural activity since the late twentieth century has facilitated forest and woodland regrowth.

All of these activities can be expected to have had a substantial impact on the Aboriginal archaeological resource, especially where resident in the top soil and the plough zone. Vegetation clearance and repeated ploughing and cropping will have removed nearly all trees with the potential for Aboriginal scarring. Artefact occurrences will have been impacted by soil loss, lateral and vertical soil movement across the land surface, and to a depth of the relevant plough zone.

3.3 Landform classification

The following landform categories have been applied in the mapping and analysis of topographic variables across the airport site (refer to Figure 3.3 and Appendix 5). Table 3.1 summarises the proportion of various landform divisions within the airport site.

An objective of this typology was to simplify landscape variation into a concise set of types which were relevant to current archaeological modelling and applicable within an initial-phase test excavation program. Some of the categories, such as fluvial corridors, and first and second order spurline crests, occur only in conjunction with other units, such as valley floor, and basal slopes, whereas an underlying subset of large scale categories can be defined independent of other categories, and don't overlap each other, such as valley floor, basal, mid and upper slopes.

Large-scale, independent landform categories

Valley floor	Level and low gradient ground forming the floor of a valley and comprised predominantly of alluvial landforms such as drainage channels, banks, flats, levees and terraces.
Basal slopes	Low gradient slopes with a characteristic concave cross-section, which occur between the alluvial valley floor and steeper mid valley slopes. This is an intermediate zone and may include buried valley floor alluvium, or remnant high terrace deposits. This zone is characterised by discontinuous locally elevated landforms, separated by drainage lines, and including low bedrock based spurs, and colluvial and fan deposits.
Mid slopes	The side-slopes of valleys and ridges which are situated in a middle valley context and may constitute the steepest grades along a base to crest profile. This zone may include variously graded first and second order spurlines.
Upper slopes	The upper side-slopes of ridges and spurs characterised by a convex cross section, and which include, or extend up to the 'break-of-slope' transition to the lower gradients or flat ground of the spur or ridge crest.
>2nd order crests	The crests of ridges which define the upper watershed of locally prominent watersheds. The attributed order of spurs and ridgelines is partly qualitative, and based on relative prominence and relative position within the dendritic network of interfluves.

Smaller scale categories which may occur in combination

Crests

Crest	The upper ground surfaces of a ridge or spurline, situated between the break-of-slope on either side. The level and low gradient upper portion of a ridge or spur as revealed in a transverse cross section.
Fifth order ridge crest	The highest order of ridgeline within the airport site and delineates the upper portion of the watershed between the immediate tributaries of the Nepean River and South Creek.
Fourth order ridge crest	This order of ridgeline separates the upper portion of the internal catchments of South Creek tributaries, such as between Cosgroves and Badgerys Creeks).
Third order ridge crest	This order of ridgeline separates the upper portion of the internal tributary catchments of Badgerys Creek tributaries, such as Oaky Creek.

Secondary spurline crest	This order of spurline typically separates second order streamline catchments
First order spurline crest	This order of spurline comprises all minor spurlines and typically delineate first order stream gullies and valleys. These spurs often constitute the lowest and free-ended unit of the dendritic ridge and spurline network.

Drainage line order

The order of the airport site drainage lines was determined using the Strahler classification system (Strahler 1952). This system allocates a progressive 'order' number according to the order of adjoining and upstream tributaries (refer to Figure 3.2). The classification of first and second order streamlines was based on a manual and visual interpretation of one metre contour topographic mapping. All stream classifications are illustrated in mapping presented in Appendix 5.

The stream order analysis conducted for this cultural heritage assessment was generated independently of the depiction of streamlines on the NSW Land and Property Information 1:25,000 topographic map series (and its associated dataset, Hydroline). This was necessary because the Hydroline data does not classify or depict all streamlines. As a consequence, some stream order classifications differ from those presented by Hydroline. The Hydroline dataset has been applied in other separate analyses for this EIS, where and as required, according to relevant methodological standards. The stream orders presented in this heritage analysis have been generated with the objective of identifying Aboriginal site location determinants. Any differences in stream classification across separate disciplines are a consequence of different formal methodologies rather than errors in fact.

According to the stream order analysis conducted for this analysis, Badgerys and Duncans Creeks are fifth order streams, and are the highest order streamlines within or adjacent to the airport site.

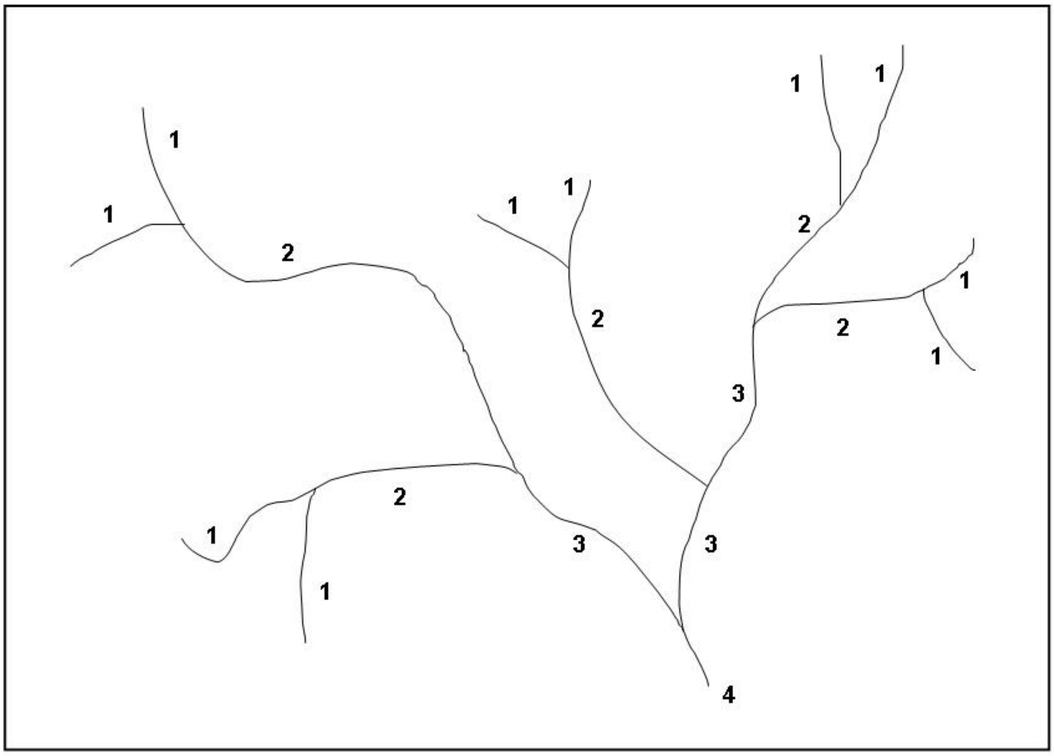


Figure 3.2 Diagram showing the allocation of drainage line order according to the Strahler classification system (Strahler 1952, 1954).

Riparian corridors (100 m)

Riparian corridors were delineated around all second or larger streamlines, and defined as a 100 metre radius around the drainage line. The distance of 100 metres is derived from the current predictive Aboriginal site location model which observes that most site recordings occur within 100 metres of streamlines. It is important to note that this corridor definition is based on archaeological parameters and the predictive model for Aboriginal archaeologiclal site. It does not correspond with other riparian definitions which may be applied by other floral, faunal or hydrological studies for the Western Sydney Airport EIS.

Gradient

flat	Surfaces of between zero and two per cent, typically found on the valley floor, some sections of basal and upper slopes, and some crest areas on spurs and ridges
low	Slopes of between two and five per cent, typically found on basal, mid and upper slopes and occurs over some crest areas on spurs and ridges
low to moderate	Slopes of between five and 10 per cent, typically found on mid and upper slopes
moderate	Slopes of between 10 and 20 per cent, typically found in limited locations across the airport site in upper slope contexts on ridgelines.

Table 3.1 Net calculations for the incidence of landform categories within the airport site

Landform category or feature	Area (ha)	net linear distance (km)
Riparian corridor (100 m either side of drainage line)		
2nd order streamline corridor	394.3	21.3
3rd order streamline corridor	173.5	9.3
4th order streamline corridor	66.4	3.8
5th order streamline corridor	76.8	6.9
Ridge and spur crests		
1st order	187.1	34.5
2nd order crest	83.7	13.1
3rd order crest	55.2	9.1
4th order crest	51.0	6.7
5th order crest	15.3	3.0
Large scale independent categories		
Total area of 3rd, 4th and 5th order crests	122.5	18.8
Valley floor	184.0	-
Basal slopes	214.2	-
Mid and Upper slopes	1324.4	-
Total area[1]	***1845.1***	-

Note 1. The area total includes Australian Government owned lands which are non-contiguous with the airport site

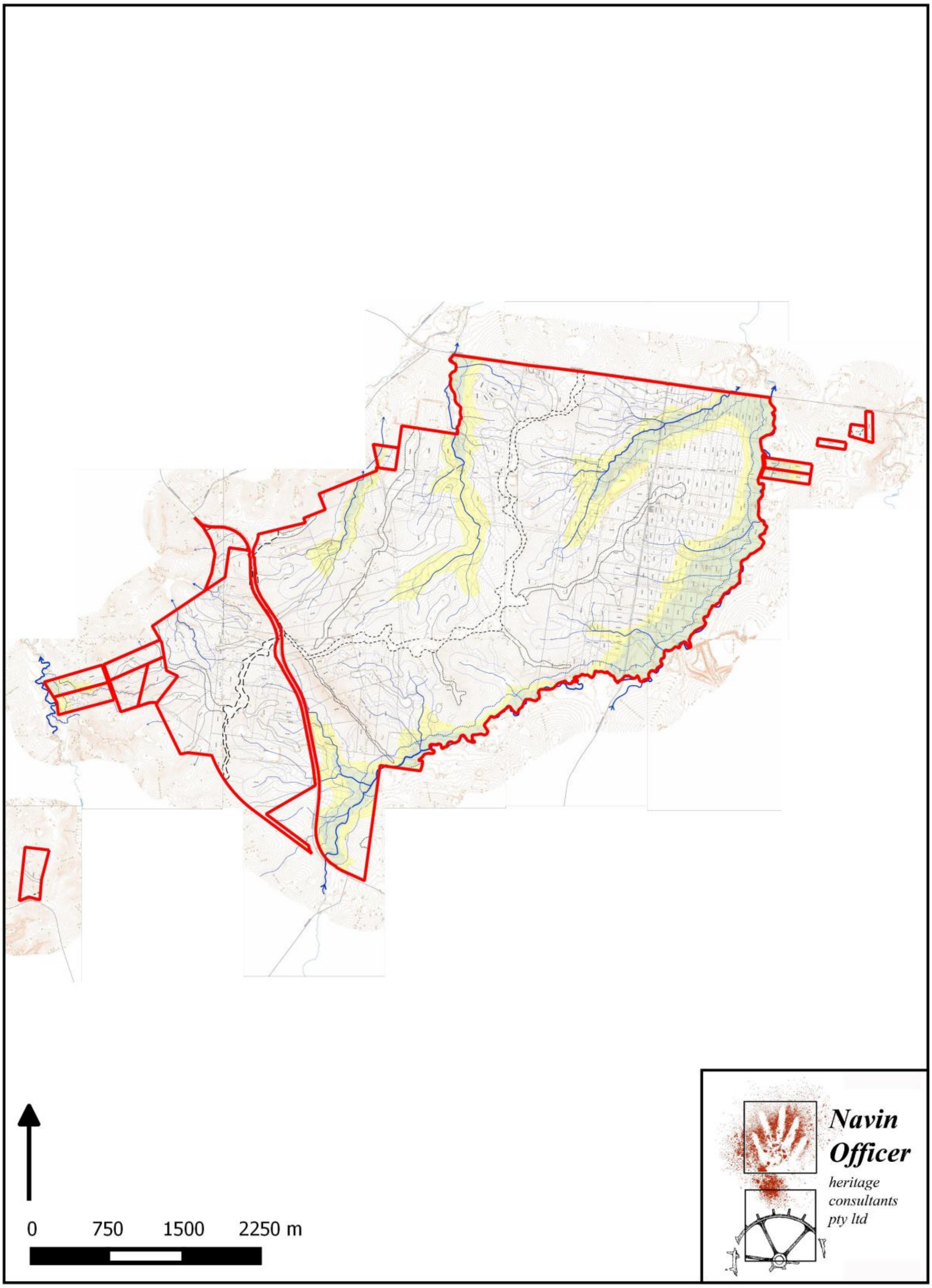


Figure 3.3 Mapped landform units and drainage corridors across the airport site (boundary shown in red, (refer to next page for key and Appendix 5 for large scale mapping).

Key to landform mapping

Drainage lines

First order — *not delineated*

Second order

Third order

Fourth order

Fifth order

Crests

(5) Major watershed (Nepean R – South Creek)

(4) Secondary watershed (Cosgroves Creek – Badgerys Creek)

(3) Tributary watershed (eg Oaky Creek)

(2) Secondary spurline

(1) Minor spurline or locally elevated ground

Valley Context

Valley Floor Flats/infill sediments

Basal valley slopes

Upper and mid valley slopes

Riparian zone

100 metre radius around:

Second order drainage line

Third order drainage line

Fourth order drainage line

Fifth order drainage line

Figure 3.3 cont. Key to landform mapping presented in Figure 3.3. Note that the Figure 3.3 map is greatly reduced and this key is shown at a larger scale for clarity. Please refer to Appendix 5 for greater detail.

3.4 Review of geotechnical borehole data

A review of previous geotechnical testing data from the airport site was conducted in 2015. This study had the following objectives:

- to assess the potential of available geotechnical data to assist with archaeological evaluation of the terrain, soils and sediments forming regolith across the airport site;
- to specifically address whether geotechnical data may assist in establishing whether palaeosols or buried soils may exist within the airport site; and
- examine whether geotechnical data may assist in establishing the potential for archaeological assemblages to occur at depth, associated with palaeosols or potentially stratified beneath deposits of alluvium or colluvium.

The full report of this review is provided in Appendix 6.

The review suggested there would be considerable value in integrating a model of the near-surface geometry of unconsolidated deposits over bedrock (a regolith model based on geotechnical data) with requirements set for any post-EIS archaeological salvage program. The geotechnical data are sufficiently detailed to permit direct comparison with archaeological field results from subsurface testing (e.g. as depths of topsoil; recorded depths to subsoil; evidence or not of saprolite or bedrock rockhead near surface). In areas where shallow archaeological excavations have been completed (often to 0.3-0.5 metres to “clay”), geotechnical data can provide broad cross-checks of the stratigraphy likely to lie below the depths investigated. However, as spatial variation in near surface regolith depths is high, such cross-checking will only provide broad areal information.

Notwithstanding this future application, the historic geotechnical data was found to have neither sufficient spatial coverage, nor consistency of investigative method, to profitably drive a full geoarchaeological model applicable to the conduct of the Draft EIS archaeological test excavation program. In particular, field verification of historic data would be needed ahead of investigating deeper regolith for archaeological purposes.

Most data indicated quite shallow depths to bedrock. As the majority of data points are on interfluves and plateau areas, this does not help resolve whether, for example, small narrow areas of significant archaeological deposit might exist at the edge of small tributary valley floors, or under small colluvial fans. A general limitation of the data reviewed is therefore adequacy of spatial coverage across all landform elements.

A small number of individual locations were seen where stratified unconsolidated deposits, some showing grading, or fining upwards trends could be inferred from the logs. Most sequences of this type relate to observations of “gravel” some of which were specifically described as “silcrete” or quartzose or quartz. Such deposits are clearly described as stratifying above saprolite and are often within 2-3 m of the present land surface. The records thus pinpoint locations where useful additional supplementary archaeological investigations might take place. The data does not, however, allow the mapping of units or areas. More data points and much more detailed analysis of elevation, topography and deposit relationships would be needed to assign “archaeological significance” unequivocally. While there is clear evidence of weathering, possible stratification and locations worth testing, evidence of age is weak. Such units need not relate to the period of human occupation of Australia – broadly the last 50,000 +/-5000 years BP. Gravels, where logged near the surface have potential, but could be millions of years old and represent minor unmapped upstream remnants (or age-equivalents) of the “Rickabys Creek Gravels”.

No palaeosols were seen in logged data which suggested unequivocally recent (late Pleistocene or Holocene) ages. No records were observed that identified wood, or peat, tufa or other types of clearly recent sediments with unequivocal dating potential, despite waterlogging and high tables within 5 m of the surface in many logs.

The data examined did not provide a basis for thinking that its application in the Draft EIS test excavation program would provide substantial improvement. This is because of significant skew in patterns chosen for borehole transects, notably a preference for interfluve and plateau locations.

It was concluded that a more efficient approach would be to marry the historic geotechnical data, with the array of new borehole and test pit data recently acquired for the Draft EIS, and for future and post-EIS investigations. The combined data could generate a geospatial “net” and mode:

a) with much improved coverage of the geometry of shallow regolith cover over bedrock (superficial deposits); and

b) a specific relationship to scheme “cut and fill” geometry.

The historic data do not provide sufficient coverage to drive deep archaeological investigations, especially in “high risk” landforms such as upper (1^{st} order) tributary floors and slope margins.

The larger post-EIS data set model could be used to verify and cross-check outcomes from archaeological assessment testing conducted for the current investigation. In particular, areas of “uncertainty” can be refined where combined archaeological testing and geotechnical sources of data show either:

a) high archaeological potential at depth; or

b) areas and zones of “high uncertainty and risk” predicted from geotechnical data - which justify deeper archaeological investigations at specific “known” points in the landscape.

Building and applying this geometry model using a geoarchaeological methodology could form one part of the archaeological salvage strategy to be conducted in the event of development approval. The methodology would require the application of geoarchaeological criteria for interpreting geotechnical data. A common Digital Terrain Model (DTM) and geo-referencing system would be required to integrate data.

4. Cultural context

4.1 Ethno-history

References to the Aborigines of the Sydney region are found in the journals, diaries and general writings of the early colonists, explorers and settlers. The ‘natives' were one of the main subjects of interest to those who arrived in the First Fleet and ‘all the journals contain frequent references to them' (Fitzhardinge 1961:102).

Accounts written by early visitors to Australia which document the more obvious details of Aboriginal life include Bradley (1786), Collins (1798), Hunter (1793), Phillip (1789), Tench (1789, 1793, 1961) and White (1790). Although these early commentators were not trained in anthropology or linguistics, they provided some useful information regarding the Aborigines around the Sydney region.

Tench (1789:79) describes the equipment of the Aborigines as ‘Exclusive of their weapons of offence, and a few stone hatchets very rudely fashioned, their ingenuity is confined to manufacturing small nets, ...and to fish-hooks made of bone, neither of which are skilfully executed’. Tench also notes the use of bark canoes for fishing (Tench 1789:81-82).

Comments were made on the types of Aboriginal shelters observed. These were described as consisting ‘only of pieces of bark laid together in the form of an oven, open at one end, and very low, though long enough for a man to lie at full length in … they depend less on them for shelter, than on the caverns with which the rocks abound' (Tench 1789:80). Collins observed that the huts were ‘often large enough to hold six to eight people' (Collins 1798:555). These shelters were often grouped together.

Early observers reported a distinction between the food and lifestyles of the coastal and hinterland Darug. Watkin Tench noted from a conversation with two Darug people on the Hawkesbury-Nepean in 1791 that hinterland people: "depend but little on fish, as the river yields only mullets, and that their principal support is derived from small animals which they kill, and some roots (a species of wild yam chiefly) which they dig out of the earth." He also noted that coastal Aborigines appeared to have no knowledge of the region west of what is now known as Parramatta (Tench 1961:230).

Within a short period of time after white settlement, the Sydney Aboriginal population was greatly reduced as a result of two epidemics (most probably) smallpox. The first occurred only a short time after settlement in 1789 and the second in 1829-1831 (Butlin 1983). The first outbreak of the disease is believed to have killed 50 per cent of the Aboriginal population (Collins 1798:53, Ross 1988:49, Tench 1961:146, Turbet 1989:10). Loss of life on such a scale caused a major social reorganisation of Aborigines around the area (Ross 1988:49) with 'remnants of bands combining to form new groups' (Kohen 1986:30). Therefore the anthropological observations and other observations by chroniclers of the time do not depict the pre-settlement situation accurately.

An article written by ‘a Medical Gentleman of Bunbury Curran’, a district east of Ingleburn, and published in 1820, describes ‘the mortal efficacy of the late influenza that raged throughout the Colony for many weeks with increased violence, and particularly among the scattered tribes of natives.’ After describing ‘a great mortality’ amongst the Aborigines regardless of health or age, during the winter, it notes that ‘they had for the most part quitted the thinly wooded and more open tracts of the interior and betaken themselves to the sea coast and bushy and broken country, where there were quantities of honey, and where they would undoubtedly remain until they return in the summer’ (Sydney Gazette 1820: Dec 16)

There are other accounts dating from the early 1800s that provide more detailed references to Aboriginal life in the Sydney region. However the information must be interpreted and used with caution due to the immense changes that occurred in the Aboriginal population and society during the early years of settlement (McDonald 1994:34).

Detailed anthropological work focussing on a systematic documenting of Aboriginal society was not undertaken until the late 19th century, beginning with R.H. Mathews' work (Mathews 1895, 1898, 1901a, 1901b, 1901c, 1904, 1908, Mathews and Everitt 1900). His anthropological work was, however, undertaken with a greatly changed population of people after more than a hundred years of contact. It does not therefore represent the situation at the time of contact or reflect pre-contact society. He documented some myths and also vocabulary of Aboriginal groups around the Sydney region.

For a more detailed review and outline of information on Sydney's Aboriginal past, the reader is referred to Val Attenbrow's recently revised book of the same title (Attenbrow 2010).

4.2 Tribal and cultural affiliations

A number of authors have variously interpreted the available evidence and drafted maps of the pre-contact and contact territories of Aboriginal people in the Sydney region (Capell 1970, Eades 1976, Kohen 1986, 1988, Mathews 1901a, 1901b, Ross 1988, Tindale 1974). The location and nature of boundaries between Aboriginal groups in the Sydney region that existed in 1788 are now difficult to reconstruct because of the lack of reliable data available from that time. The primary data is limited by the scope and interests of the early observers (members of the First Fleet and settlers) who did not unfortunately document how Aboriginal people distinguished their differing social and territorial groupings. In addition, early European and anthropological descriptions may not relate to pre-European social structures. The population of Aboriginal people around Sydney was depleted by disease and impacted European land incursions and many survivors could have relocated and/or joined other groups.

Although most discussion about the distribution of tribal groupings necessarily involves the interpretation of recorded language, it is useful to outline the probable social organisation of the populations encompassed by these 'tribal' groupings.

Aboriginal society was comprised of a hierarchy of groups with fluid boundaries between them, the smallest being the `family' and the broadest being a culture area (Peterson 1976). The family comprised of a man with one or more wives, their children and often a parent of one of the adults. A second level of organisation involved the band, which was a group of several nuclear families. Bands, in turn, followed a regional network which comprised groups of several bands.

The next level of social organisation was the tribe. At each successive level from family through to tribe, there were less common or shared beliefs amongst the individuals making up that particular group. At the level of a tribe, the members shared common initiation ceremonies and spoke closely related languages (Peterson 1976). Anthropologists previously used the term `tribe' to denote concrete political, cultural, economic, geographical and linguistic units, however today they recognise geographic variability in the way that Aboriginal people perceive themselves and their relationship to one another (Peterson 1976).

The identification of tribal boundaries by the early anthropologists, later ethnographers and subsequent linguists have often involved contrasting conclusions, both regarding geographic extent, and whether a distinction relates to a clan, dialect or language (Capell 1970, Eades 1976, Kohen 1986, Mathews 1901a and b, Ross 1988, Tindale 1974). Since the 1970s, archaeologists and anthropologists working in the Sydney region have adopted the nomenclature for linguistic groups compiled by Capell (1970), and amended by Eades (1976), (Attenbrow 2010). These schemes all place the airport site within the area of the Darug. Debate continues whether the use of Darug was exclusively inland or extended in dialect form to the coast on the Sydney Peninsula (Attenbrow 2010:33, Kohen 1993, Ross 1988,).

Historical and linguistic sources present a range of spellings for the Darug. These comprise:

Dhar'-ook	(Mathews and Everitt 1900:265)
Dharook	(Mathews and Everitt 1900:265)
Dhar'rook	(Mathews 1901a:140, 1902:49)
Dharruk	(Mathews 1901d:128,151,155; 1903:259, 271; Capell 1970:21)
Dharook	(Capell 1970:20)
Dharuk	(Capell 1970:Map 1)

This report adopts the modern spelling 'Darug' which is preferred by many members of contemporary Darug community (Attenbrow 2010:32).

At the turn of the twentieth century, anthropologist R .H. Mathews placed the Dharruk to the north of the Thurrawal [(or Tharawal), south of the Georges River], and extending northwards along the coast to the Hawkesbury River and inland to Windsor, Penrith and Campbelltown (Mathews 1901a:155). He also noted that the Dhar'-ook dialect closely resembled Gundungurra, the language to the south west, and was spoken at Campbelltown, Liverpool, Camden, Penrith and possibly as far east as Sydney where it merged with the Thurrawal (Mathews and Everitt 1900).

Some names of social subdivisions within the Darug language groupings (probably bands) have survived to the present day (Murray and White 1988:20, Darug Weavers website). Most of these relate to the Sydney peninsula and riverine hinterland however some from the western and central Cumberland Plain include:

Mulgoa ('Mulgowey')	along the Nepean between Mulgoa and Castlereagh
Boorooboorongal	along the Nepean from Castlereagh to beyond Richmond.
Wawarawarry	Eastern Creek/Blacktown
Gommerigal (tongarra)	on both sides of South Creek
Cannemegal (Warmuli)	Prospect
Cattai	Windsor
Muringong	Cowpastures/Camden
Burraberongai	Richmond

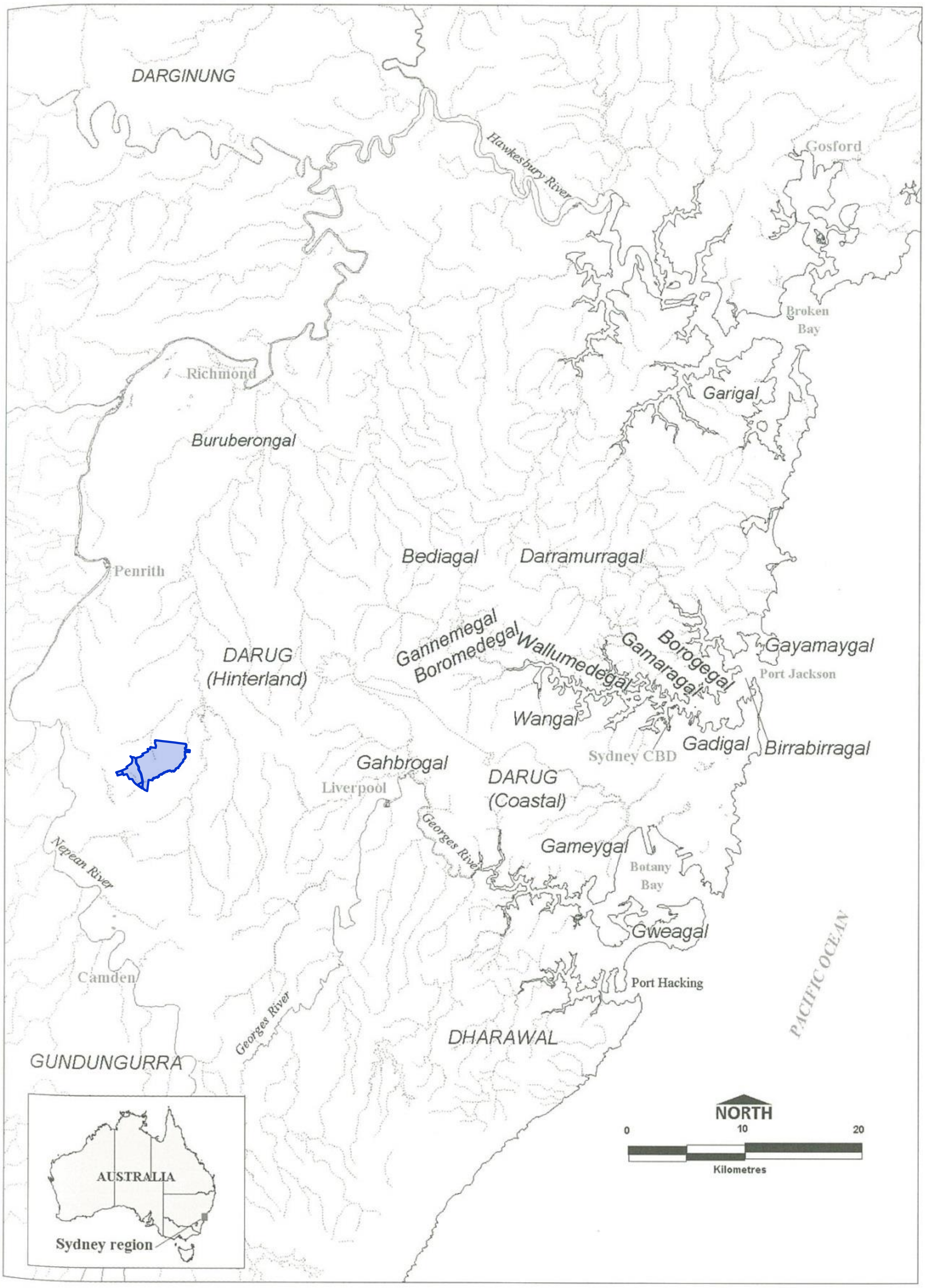


Figure 4.1 The airport site (blue) relative to a recent compilation by Attenbrow of language, clan and other named groups in the Sydney region based on early historical sources (base figure: Attenbrow 2010: Figure 3.3).

4.3 Overview of early post-European Aboriginal history

The Darug peoples bore the first impact of Sydney's European settlement due to their lands being situated on the Sydney peninsula, and the adjoining hinterlands of the Cumberland Plain. The Peninsula and its embayments became the residential and commercial focus of the settlement, while the fertile lowlands and woodland of the hinterland were developed for agricultural production and the granting of freehold lands. The Cumberland Plain was an integral component of Darug territory and cultural identity, from which they were incrementally excluded and dispossessed by European land-use and occupation.

In the five decades following the establishment of the Sydney Cove colony, the impact of European incursion saw a steep decline in the Darug population, loss of economic autonomy, and a break-down in traditional social organisation and practice. Despite this, the Darug and their descendants maintained their local presence and adapted as necessary to survive as a minority in a drastically changed cultural and social landscape.

A critical factor in the breakdown of Darug society was their exclusion from traditional grounds for hunting and procuring food. An example is the Darug's use of the fertile banks of the Hawkesbury River to cultivate wild yams. Their collection method included replanting a portion of the tuber, to ensure they did not deplete the resource for the following season. The fertility of the river banks was however quickly recognised by the European colonisers and their transformation of these lands to cropping was in direct competition with the Dharug (Goodall 1996:27). By 1795, the majority of the yam beds had been replaced by European crops (Kohen 1993:63). Such conflicts over land and resources occurred throughout the 1790s (Keating 1996:13).

In 1804, Governor King promised a delegation of Aborigines that there would be no further grants of land on the lower Hawkesbury near Portland Head, thus leaving some of the riverbank for yam production (Wiley 1979:175). This promise was however dishonoured after King departed in 1807 (Goodall 1996:28).

The Cumberland Plain Aborigines were originally evident to Europeans only through their incidental observations of camp remains and notched trees, during their infrequent expeditions into the Sydney interior. Subsequent personal encounters were often reported to be peaceable and belied the later violent encounters prompted by increasing territorial incursion (refer to accounts by Captain Tench in 1790 (Collins 1798) and Governor Macquarie in 1802 and 1815 (Macquarie 1956).

A rare record of Aboriginal observations of the Europeans and their alien culture survives in a rock art site from the Cowpasture area which includes three large drawings of bulls which probably represent the original polled cattle which escaped to the area from the first fleet (Lyon and Urry 1979).

Although no reliable appraisal of the number of Aborigines living in the Sydney region was made by early observers, it has been estimated that the population density was between 2-4 individuals per square kilometre (Maddock 1972). Following European settlement, the Aboriginal population went into steep decline, and in less than a century, many aspects of traditional Aboriginal life and society could no longer be practised or were prevented by European practice or policy. In 1821, Reverend William Walker listed nine 'tribes' in the Sydney region, of which only three could be described as 'numerous' - Broken Bay, Cowpasture and Five Islands (Illawarra). The others such as the people of the Liverpool area had been reduced to fewer than twenty persons (Wiley 1979).

The incremental westward encroachment of European settlement across the Cumberland Plain sparked conflict and retaliation from some sections of the Darug. The fatal spearing of Governor Phillip's gamekeeper, John McIntyre by Pemulwuy in 1790 was the catalyst for the 'first (but unsuccessful) punitive expedition' against Aboriginal people on the Cumberland Plain (Attenbrow 2003:14). Pemulwuy (c.1750- 1802), was a Darug warrior, thought to be from the Botany Bay area, north of the Georges River, from the Bediagal or 'woods tribe'. With the support of other members of his community, he waged armed warfare against the European intruders (Kohen 2005:318-9, Comber 2014).

From 1792, Pemulwuy led raids on settlers at Prospect, Toongabbie, Georges River, Parramatta, Brickfield Hill and the Hawkesbury River. In December the following year, David Collins reported an attack by Aborigines who 'were of the Hunter's or Woodman's tribe, people who seldom came among us, and who consequently were little known'. He also reported that 'Pe-mul-wy, a wood native, and many strangers, came in' to an initiation ceremony held at *yoo-lahng* (Farm Cove) on 25 January, 1795. Collins thought him 'a most active enemy to the settlers, plundering them of their property, and endangering their personal safety'. Raids were made for food, particularly corn, or as 'payback' for atrocities: Collins suggested that most of the attacks were the result of the settlers' 'own misconduct', including the kidnapping of Aboriginal children (Kohen 2005, Comber 2014).

Conflict was ‘waged in earnest between 1797 and 1805 during which time the farms in the Parramatta-Toongabbie area and the Hawkesbury and Georges River districts were raided’ in retaliation against ‘random killings and massacres by white colonists’ and dispossession from traditional lands. Retaliatory attacks were made on colonists who ventured out of the settlements, away from their farms, or into the bush (Attenbrow 2003:14 and 15).

At the same time the government, explorers and some settlers maintained friendly relations with individual Aboriginal men, who they relied on as guides and interpreters, as well as their communities who were given freedom to come and go from settlements (Collins 1798: Vol 1 Ch 24, 26, Comber 2014).

Governor Hunter was not ignorant of the cause of much of the conflict between settlers and Aboriginal people. He placed blame for some incidents squarely with the settlers, also acknowledging that the forces of law and order rarely took this into account.

Subsequent Governors such as King were less sympathetic to the double-standards that were being imposed (Brook and Kohen 1991:16). On 1 May, 1801, Governor King issued a government and general order that Aborigines near Parramatta, Georges River and Prospect could be shot on sight, and in November a proclamation outlawed Pemulwuy and offered a reward for his death or capture (Kohen 2005). Pemulwuy evaded capture until 1802 when he was shot and killed by Henry Hacking during an armed patrol (Kass et al 1996: 49; Kohen 2005; Comber 2014).

In 1809, two Darug men, Bundle and Tedbury (a son of Pemulwuy), were recorded menacing and stealing from travellers as well as driving sheep off properties around the Cook and Georges Rivers area (Liston 1988:6-7; Keating 1996:13). Tedbury had become attached to John Macarthur who allowed him to reside on his Elizabeth Farm property. In 1810, Tedbury was shot and killed by Edward Luttrell at Parramatta (Kohen 2005).

There were more severe conflicts between 1814 and1816 when the area was gripped by a severe drought (Perry 1963:30). Aboriginal raids on crops angered European farmers, who retaliated. Governor Macquarie advised caution and stated that the loss of part of ones' crop was a small price to pay for peace (Liston 1988:9). Tensions however escalated and Aborigines and Europeans were killed in the ensuing struggles. Several incidences occurred on Nepean River properties in the Bringelly district where both Europeans and Aborigines were killed (Organ 1990:56).

Despite expressions of sympathy with their plight, in 1816 Governor Macquarie ordered the mobilisation of military detachments to ‘drive away these hostile Tribes from the British Settlements’. As ‘a counter balance for the restrictions’, natives were offered land on which to establish themselves as settlers, as well as the necessary tools and stores for six months. As attacks on settlers were reported at the Nepean, Grose Valley, Hawkesbury and South Creek, restrictions were also imposed on Aboriginal people between Sydney and Parramatta. General Orders were that those found in the vicinity were to be detained (*Sydney Gazette* 11 May 1816:1; HRA I/9:139-145, 365; Brook & Kohen 1991:21, 23, 32). At the same time, Land Grants previously given to Aboriginal people were rescinded.

There were three punitive expeditions as a result of Macquarie’s direction, two of which had Aboriginal guides (variously claimed to be Tharawal or Darug) which were not surprisingly, unsuccessful. In 1816, a regiment headed by Wallis perpetrated a massacre of fourteen Aboriginal men, women and children at Appin (Keating 1996:18, Liston 1988:12-13, Organ 1990:75ff).

Two years before in 1814, Lachlan Macquarie had proposed the 'Native Institute' a school for Aboriginal children in Parramatta with the object of 'conveying Education and Habits of Industry'. The school was central to an assimilation policy instituted by Macquarie and was established under the guidance of an ex South Sea Island missionary named William Shelly. Plans involved a two year trial period for a live-in school, catering for six boys and six girls, with the appropriation and clearing of land for a settlement, and the provision of food to pupils while they remained at the settlement.

In 1814, Macquarie also announced a meeting or conference with Aboriginal tribes to be held in December at the Parramatta Market Place. The intended purpose of the meeting was multiple:

- to introduce and explain the purpose and function of the Native Institute, and in future years to provide an opportunity for parents to visit attendees;
- to establish an annual meeting with the attendance of representatives of 'District Tribes', based on places of usual 'resort'. Tribes would elect a Chief, who the Governor would 'distinguish with an 'honorary badge'', and who would be responsible for resolving problems within the tribe, and accountable to the Governor for their conduct; and
- to consider requests for the allocation of land from Aboriginal people who wished to become settlers (Brooks and Kohen 1991:65-6; Comber 2015).

About sixty-Aboriginal people attended the first meeting. The Sydney Gazette report speculated that others had not come because they doubted the Governor's motives, or feared that their children may be forcibly taken away (Sydney Gazette 31 Dec 1814:2).

The Native Institute officially opened in Parramatta the following year with three children who were already being tutored by Shelley and four other children who were chosen as a result of the Market Place meeting. Their ages ranged from four to eight and they were identified as being from Richmond, Prospect, Caddie (Cattai Creek), Portland Head and South Creek. Later enrolments would be from the Hawkesbury, Cowpastures, Botany Bay, Newcastle and Kissing Point. Enrolments remained relatively low with the numbers increasing to 23 in 1820 (Brook and Kohen 1991; Comber 2015).

In 1819, Macquarie made the first land grant to Aboriginal people, granting 30 acres to Colebee and Nurragingy on Richmond Road at the intersection of what is now Rooty Hill Road. These grants formed the nucleus of an Aboriginal settlement which by the 1820s, had become known as 'Black Town'. In 1821, Michael Yurringgy, a 'native constable' of Richmond, and his son Robert married two girls from the school, Polly and Betty Fulton, and were each granted lands in the same area.

After the death of Colebee, ownership of his grant was transferred to his younger sister Maria Lock in 1843. Maria died in 1878 with a significant Black Town land holding of 60 acres. This was equally shared amongst her nine surviving children. By the 1920s, the Lock lands were deemed by the government to be an Aboriginal Reserve (subsequently known as Plumpton) and title was revoked by the Aborigines Protection Board (Parry 2005).

In 1823, Governor Brisbane moved the Native Institute to land adjoining the new Black Town settlement. In the following year, Brisbane dismissed the committee and placed the school under the control of the Church Missionary Society. At the end of the year, however, the Institute was closed as part of an amalgamation of native and orphan schools (Office of Environment and Heritage website, Blacktown Native Institution).

The Aboriginal conference became an annual event and was coupled with a 'feast' for those attending. Macquarie and a number of subsequent governors used the 'Native Meeting' to manage tensions between Aborigines and settlers, promote the Native Institute, and distribute clothes and blankets. With the exception of 1815, the conference was held each year until 1835 (Turbet 1989:120). Almost 300 Aboriginal people attended in 1818, and in 1821 a record number of around 340 attended a farewell to Lachlan Macquarie (Willey 1979). Despite attendance of 287 in 1832, the government's interest in its continuation declined, its function having been reduced to a distribution of blankets without the liaison conducted by earlier Governors (Brook and Kohen 1991:102). The conference was discontinued in 1835 (Turbet 1989:12).

By 1821, all of the airport site had been the subject of European land grants, with a majority of the area falling within a 6710 acre grant made to John Blaxland in 1813 (Robinson 1953, O'Sullivan 1977). This pattern of land alienation was repeated across most of the Darug lands. The establishment of European ownership imposed a cumulative sequence of constraints on traditional Aboriginal land-use. The effect, over the course of a relatively short period of time, was to severely limit access to traditional food and habitation sites and to disrupt the normal seasonal round of movement which formed part of social and territorial life. As a consequence, the Sydney Aborigines displaced by European settlement became increasingly dependent on European food sources, estates to live on, and employment.

The traditional food economy of the Sydney Aboriginal groups appears to have been substantially displaced by the 1840s, with many Aborigines being employed by whites on farms or selling their traditional food items for European goods (Hassell 1902; Jervis 1935, 1949). In a report to a Select Committee on the Aborigines in 1845, a local Campbelltown J. P. reported that:

> 'For the last five to ten years they [the Aborigines] have been gradually decreasing, from the number of about fifteen to twenty, until none can be said to belong to this police district, as a tribe. Their death may be attributed to natural causes' (Select Committee on the Aborigines 1845:33).

Despite the social impact of decreasing population and loss of traditional lands, some aspects of traditional life appear to have continued in Sydney. Macarthur describes a corroboree which took place on his property (Liston 1988:14) and Mathews documented ceremonies in the late 1800s. There is another mention of a ceremony taking place at Denbigh near Camden in the 1830s (Kohen 1985) and a corroboree involving over 400 individuals at the same place in the mid 1820s (Hassell 1903:3). It is likely that new family groups or mixed communities formed, taking up residence in remnant pockets of bushland on the outskirts of settlements and homesteads. Forced movement of people resulted in the loss of many aspects of Aboriginal culture and the emergence of new groups incorporating people from diverse areas. Reorganisation ensured the preservation of some of the core cultural practices and knowledge in Aboriginal communities (Hinkson 2001).

Contemporary Aboriginals of the Sydney region continue some traditional ceremonies, such as those conducted in the Bents Basin area (Keating 1996:1).

In parallel with the European take-up of the Cumberland Plain by the 1830s, Darug residency became disparate and limited to the estates of enlightened or tolerant land holders. This would often involve an employment relationship, with Darug working as farm labourers and domestic servants. Individuals and families began living within settlements and adopted aspects of European culture. There are a number of references from the Cumberland Plain which characterise this engagement.

Some Darug clans are known to have lived at an encampment on the 'Mamre Farm' estate, on South Creek at Orchard Hills, nine kilometres north of the airport site. This property was established in 1798 by the Reverend Samuel Marsden who was interested in creating a model farm where experimental crops and animal husbandry could be trialled. The estate eventually grew to over 1300 acres and was assigned a large contingent of convicts. An Aboriginal encampment was situated a few hundred yards from the homestead on the opposite side of the creek (Keating 1996:19, Thekingscandlesticks website). Marsden was an evangelist and motivated by a desire to civilise and convert the Aborigines. Some reports indicate that the Darug had always maintained a camp on or around the Mamre Estate, and that Marsden's first approach was to encourage them to work in exchange for food and clothing (WSCA website). However, his belief that the adoption of European material civilisation was a necessary first step towards conversion proved a source of disillusionment. He wrote that 'The natives have no reflection — they have no attachments, and they have no wants.' By the time Governor Macquarie founded the Native Institute in 1815, Marsden had apparently abandoned all hopes of success (Yarwood 2015).

In 1835, the Quaker missionary James Backhouse visited Mamre Farm and noted that '...the South Creek Natives live on Charles Marsden's property 'Mamre', often staying at the junction of South Creek and Eastern Creek. In comparison with some other tribes, the South Creek Natives may be considered as half-domesticated, and they often assist in the agricultural operations of the settlers.' He was also impressed by the fact that the wife of their Aboriginal guide - supplied by Marsden -

could read, having been 'educated in a school, formerly kept for the Natives, at Parramatta' (A History of Aboriginal Sydney website).

Backhouse added that ‘A few of the Natives...were, at one time, located upon a piece of the worst land in this part of the country, at a place, called Black Town. Here some of them raised grain, in spite of the sterility of the soil, at a time when they were unable to dispose of it.’ (Martin 1988:80).

Samuel Marsden died in 1838 and the Estate was taken up by his son Charles who continued the residential relationship with the local Darug (Keating 1996:19).

Emily MacLaurin who lived at Mamre, described a meeting place on South Creek at Mamre at a point where '...the Creek takes in a small stream from the west, the right bank of which reaches into the creek in a narrow finger'. It is thought that despite the influence of the Rev. Samuel Marsden, Darug ceremonies continued to be held at this spot for some time (WSCA website).

Mulgoa was also a recorded place of historical Darug settlement.

Allan Cunningham, explorer and botanist, wrote the following about the Mulgoa people, many of these men work upon the settlers’ farms at odd jobs throughout the year, and also at harvest of late ... A gentleman of Mulgoa...had, in 1826, 30 acres of wheat reaped by a party of them in 14 days as well as by Whites. They were always out before the Whites in the morning, and were fed and paid a regular price for their labour, the gentleman giving it as his opinion that the chief cause of dislike to work on the part of the Cumberland Blacks is their being cheated by the small convict settlers’ (Martin 1988:76-7).

The Macarthur's were known to have Aboriginal people living on their property at Camden. Macarthur's daughter is quoted as writing to a friend praising them and begging her friend to accept them (Liston 1988:14). In fact, in 1818, land was marked out on the Macarthur estate for Aborigines who wanted to live there under his protection (Liston 1988:14).

Cunningham notes at this time that

> ‘Toward the Hawkesbury and Cowpasture, the aborigines are not nearly so debased as around Sydney, and most of them will live in huts if they are built for them. Many of these too will work at harvest, and attend to other matters about the farm, having been brought up from infancy among the farming whites..." (Cunningham 1827:25).

According to Jack Hobbs, owner of the old Badgerys Homestead ‘Exeter Farm’ in the 1970s, the property was used by Aborigines for some time about the middle of the nineteenth century. The homestead, together with James Badgery’s land grant of 840 acres was situated on the northern side of Elizabeth Drive. There was also an Aboriginal campsite further south along South Creek (about three kilometres) on the Ciba Geigy property [245 Western Rd], (oral account recorded by Laila Haglund AHIMS site card 45-5-215 27 Jan 1978).

4.4 Previously identified cultural values

Consultation with Aboriginal stakeholders conducted since 1985 as part of environmental impact assessments for airport proposals at Badgerys Creek have documented a range of cultural values for the area.

4.4.1 1985 Draft EIS

The draft EIS prepared in 1985 for the proposed airport at Badgerys Creek included a section (9.4) titled 'Concerns of Aboriginal People’ (Kinhill 1985:209). The anthropological consultant for this project was referred to the Gandangara Local Aboriginal Land Council by the Western Metropolitan Regional Land Council as being the appropriate body with whom to liaise. She also canvassed other Aboriginal residents from around the area for their views on the project.

It was concluded that:

'Generally, there was considerable opposition to the concept of airport development in the area and fears were expressed about the changes to Aboriginal lifestyles which this would cause' (Kinhill 1985:211).

The ‘changes to lifestyles' referred to were noise and air pollution, and the loss of the relative peace and quiet of the area. There was also much cynicism expressed regarding employment opportunities for Aboriginal people.

The area was regarded as having characteristics which would have made it of significance in the traditional life of Aboriginal people of the pre-colonial past and, as such it should be retained in as natural state as possible (Kinhill 1985:211).

In response to the 1984-5 investigation of a preferred airport site, the members of the Gandangara Local Aboriginal Land Council passed the following motion at a meeting in 26/11/1984:

- That the Gandangara Local Aboriginal Land Council strongly oppose the development of an airport at either Badgerys Creek or Wilton and that land council officers be instructed to lobby to prevent airport development in both these areas (Kinhill 1985:211).

In addition, a range of actions were recommended by the Land Council in the event that an airport at Badgerys Creek was constructed. These can be summarised by the following points:

- Contractors to be advised of the protected status of Aboriginal sites and all site discoveries be reported to the National Parks & Wildlife Service;

- All site mitigation work to be checked by the NPWS and the Land Council prior to commencement, and that this review process be acknowledged in construction contracts;

- If the Land Council is dissatisfied with actions which damage sites, the Land Council may invoke the Commonwealth *Aboriginal and Torres Strait (Interim) Heritage Protection Act 1984*;

- Appropriately trained Aboriginal Sites Officers to be employed in monitoring construction works;

- The Gandangara and Tharawal Local Aboriginal Land Councils to select an appropriate Dharawal language name for the airport;

- An appropriate commemorative tribute to the Aboriginal people of the area to be included in the airport design; and

- An Aboriginal curator of any display items associated with this tribute to be appointed.

4.4.2 1997 – 1999 EIS assessment

The following stakeholder organisations were consulted as part of the 1997 EIS assessment and subsequent supplementary assessments:

- Gandangara Local Aboriginal Land Council;
- Darug Tribal Aboriginal Corporation;
- Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation (KEJ TEAC); and
- Campbelltown City Council Aboriginal Advisory Committee.

In addition, the assessment also referenced two native title applications submitted by the KEJ TEAC. Table 4.1 lists details of these submissions, both of which are no longer active.

There have been no further Native Title claims or applications since these were rejected.

Table 4.1 Details of Native Title Submissions relevant to the airport site (National Title Tribunal website accessed July 2015).

Name	NNTT file no	Date filed	Application status
Illawarra (KEJ Tribal Elders)	NC1997/003	13/01/1997	Rejected
Gundu-ngura	NC1996/021	26/06/1996	Rejected

Members of the Gandangara Land Council's Culture and Heritage Section believed that any airport development in the southwest of Sydney would be the 'thin edge of the wedge' of development in the region and they argued against the development. It was commented upon that Pemmulwuy, a legendary Aboriginal activist of last century, probably visited the area in question [Badgerys Creek] in a recruitment drive and that his ‘presence' can certainly be felt there.

Mr Gunther and Mr Thomas of the Land Council stressed that land is spiritual and has a value to Aboriginal people which is not reflected in the archaeology. The overall view communicated by a majority of Land Council members was in opposition to siting an airport at Badgerys Creek.

The Land Council wished to be involved in all further consultation relating to Aboriginal issues associated with airport development. In the event of airport approval, Council members wished to be involved in all archaeological salvage works and to monitor construction works. Consideration was also sought to facilitate employment opportunities for local kooris.

The Darug Tribal Aboriginal Corporation indicated that some of their members lived in the general Badgerys Creek region. Several family groups, such as the Botts from Mulgoa, were noted as being descendants of Darug ancestors such as Merri Merri (known as ‘Chief’ of the Mulgoa people), and for having a residential association with the general region, including Narellan, Hoxton Park and Liverpool. Colin Gale noted that he had shot and ferreted rabbits in the area up to the 1960s until it became too built up or fenced off (Letter from Colin Gale (DTAC) to Kerry Navin 17 Feb 1997).

Members of the Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation had previously submitted a Native Title claim over a large portion of the southern Sydney Basin which included all crown lands or lands held by the crown within the Badgerys Creek study area. The claim was on behalf of the ‘Gundu-Ngura’ people (NC96/21).

The claim submission stated that the ‘Gundu-nguru people have always occupied this land’ and that it contains ‘much rock and cave art and Lore, and sacred sites and places...’ (NC96/21). Proposed and existing developments, such as the proposed airport, were referred to as ‘inappropriate activities’ (NC97/3). A legally defined right of access and control of site management was requested. In discussions held with relevant members of the Elders Corporation, the basis for the submission of the Native Title claim was described in terms of descent from ancestors of known local tribal affiliation.

All Aboriginal stakeholders consulted for the 1997 EIS and subsequent assessments, expressed a strong view that sites and deposits associated with the archaeological record of Aboriginal occupation at Badgerys Creek were of high cultural value to Aboriginal people. In addition, the intangible cultural values of the landscape and its surviving biota were valued for their association with traditional culture and lore, and the sense of place and social identity derived from them. No sites or places of special cultural significance, unrelated to archaeological evidence, were identified during the assessment.

All stakeholder groups variously communicated a general opposition to the construction of a second airport in south-western Sydney.

5. Archaeological Context

This chapter provides an overview of the current understanding of the Aboriginal archaeology of the Sydney region, the Cumberland Plain, and in more detail, the Badgerys Creek area.

The information presented is based primarily on reviews conducted in 1997 for the EIS for the proposal for a second Sydney airport at Badgerys Creek or Holsworthy Military Area (NOHC 1997) and in 2014 by Australian Museum Consulting (AMC 2014) as part of an environmental survey of Commonwealth land at Badgerys Creek.

5.1 Sydney regional context

The Sydney region has been the subject of increasingly detailed archaeological survey and assessment since the passing of legislation protecting Aboriginal sites in 1974. The focus of this assessment has shifted in the last two decades to Western Sydney, and in particular to the new urban and industrial developments across the Cumberland Plain. This research has resulted in thousands of site recordings and a wide range of site types and features. The most prevalent recordings comprise surface occurrences of stone artefacts (ranging from single to hundreds of artefacts), shell middens, rock shelters containing occupation evidence (including deposits and rock art), grinding groove sites, and open context engraving sites. Rare site types include culturally modified trees, quarry and procurement sites, burials, stone arrangements, and traditional story or other ceremonial places.

Archaeological studies in the Sydney region have generated hundreds of reports and monographs and a number of academic theses. Studies generally fall into four categories - projects which have been carried out within a research-oriented academic framework, larger scale planning and management studies, archaeological surveys carried out by interested amateurs, and impact assessment studies which have been carried out by professionals within a commercial contracting framework. The latter mostly deal with specific localities subject to development proposals and constitute a large proportion of the archaeological research conducted to date.

Aboriginal occupation of the Sydney region dates back to the Late Pleistocene during the last glacial period, when sea levels were lower and the climate was colder and drier. To date, the earliest claimed evidence comes from two separate open context archaeological deposits. Nanson et al (1987) have argued that artefacts found in gravels of the Cranebrook Terrace (16 km to the NW of the airport site) are indicative of Aboriginal occupation over 40,000 years ago. There is, however, some doubt about the contextual integrity of these artefacts and this date is treated with caution by many reviewers (Nanson et al. 1987; Stockton 2009; Stockton & Holland 1974; Attenbrow 2010). More recently, excavations in a Pleistocene aged sand body on the Parramatta River (sites RTA-G1 and GG3), 25 km to the east of the airport site, have revealed an assemblage of silicified tuff artefacts dated to around 30,700 BP (Before Present) (JMCHM 2005b and 2005c, 2006).

The interpretation of artefacts within open context and fine grained sedimentary deposits, must always be treated with caution due to the potential for artefacts to move up and down the profile, and thus to be encountered in contexts which do not relate to their true age (e.g. Baker (1995:7)). For this reason, the Parramatta sand sheet sites are not yet considered to be definitive evidence for the early occupation of the Sydney region (Attenbrow 2004:335; 2010:20; Nanson et al. 1987; Williams et al. 2012:85).

The dating of artefacts recovered from deposits within enclosed rock shelter contexts is less likely to be affected by post depositional movement. For this reason, a basal occupation date from the Shaws Creek K2 rock shelter of 14,700 BP is the earliest and most widely accepted date for the Sydney region. This site is located near the western bank of the Nepean River, and 24 kilometres northwest of the airport site (Stockton and Holland 1974; Kohen et al. 1984; Stockton 2009a: 57-60).

Late Pleistocene occupation sites have also been identified elsewhere from the margins of the Sydney basin, and from rock shelter sites in adjoining areas. These include occupation between 15,000 and 11,000 BP from a levee deposit near Pitt Town adjacent to the Hawkesbury River

(Williams *et al.* 2012), a date of around 11,000 BP at Loggers Shelter in Mangrove Creek (Attenbrow 1981, 2004), a date of 12,200 BP from an open site hearth, Wombeyan 1, situated in a palaeosol on a colluvial fan at Wombeyan (NOHC 2003b), and occupation from 20,000 BP at Burrill Lake on the South Coast (Lampert 1971). A deflated Aboriginal hearth site located on a sand dune at Randwick provided, at the time, the earliest secure date (7820±50 BP Beta 87211) for an open site in the Sydney Basin (Austral/Godden Mackay 1997).

There are now thousands of sites in the Sydney region from which evidence of Aboriginal occupation has been dated using radiocarbon age determinations. This body of evidence reveals a steady increase in site use from around 6000 years ago, with almost 80 per cent of determinations occurring within the last 5000 years. The number of dated sites peaks in the second millennium. Twenty eight per cent of the Sydney region dates fall between 1000 and 2000 years BP (McDonald 1994).

The stone technologies used by Aborigines within the Sydney Basin have not remained static and a relatively consistent sequence of broad scale changes through time has allowed the development of model of technical change. This is known as the Eastern Regional Sequence and can be applied with various degrees of success and allowances for regional differences to sites throughout the eastern seaboard of Australia. Within the Sydney Basin the Sequence can be characterised using the following terminology and phases (based on McDonald 1994 and 2005):

The Pre-Bondian 30,000 - 8000 years PB.

In this phase, there was an apparent preference for utilising silicified tuff, often at great distances from the stone sources. This material was augmented with quartz and unheated silcrete (coarse-grained raw materials). Cores and tools varied widely in size. There were no backed artefacts, elouera or ground edge stone tools. Unifacial flaking was the predominant technique and bipolar flaking was rare. Artefacts from this period consisted mostly of large heavy artefacts including unifacial pebble tools, scrapers, core tools, denticulate saws, and hammerstones.

The Early Bondaian 8000 – 4000 years BP

Within this phase, characteristics of the pre Bondaian continued but tools on smaller blades were introduced and became predominant. There was a decline in silicified tuff as a preferred stone and more use was made of local raw materials (such as silcrete and chert), especially at sites occupied for the first time. Blades that were backed (one edge blunted by fine trimming) and ground edge implements were notable introductions. Bipolar flaking occurred widely although relatively rarely at individual sites. Unifacial and bifacial flaking were the dominant technique.

The Middle Bondaian 4000 – 1000 years BP

In this phase, utilised stone materials varied between and within sites over time. Edge ground artefacts were present in higher proportions as were quartz artefacts. The percentage of Bondi points (a type of backed blade) increased and remained greater than the percentage of bipolar artefacts. This was the main phase of backed artefact production. Asymmetric flaking with platform faceting was adopted. Cores and tools tended to be smaller, the use of bipolar flaking increased, ground stone artefacts appeared infrequently (at less than half of the dated sites) and elouera were rare.

The Late Bondaian 1000 years BP to European contact

In this phase, utilised stone material types continued to diversify, and in some localities the use of quartz either became predominant or markedly increased in proportion. Backed artefacts possibly declined, and became rare or absent particularly in coastal sites. Bipolar flaking became a little more common. Ground stone has been found in low frequencies at the small number of dated sites from this period, but was identified as a major tool type by Europeans at the time of contact. Elouera became a little more frequent. Bone and shell implements including fishhooks appeared in this phase, particularly in some coastal sites.

McDonald notes that the introduction of ground implements around 4000 BP and shell fishhooks in the last 1,000 years were major technological innovations (McDonald 1994:69). The significance and possible reasons for the technological changes in the Eastern Regional Sequence have been the subject of considerable research and debate since their identification. Contemporary theories postulate various changes in social behaviour, group interactions, and population dynamics either as contributing causes or as consequences of these technology changes (e.g. Attenbrow 1987; Beaton 1985; Lourandos 1985; Walters 1988; McDonald 1994; Attenbrow 2010). McDonald, for example, interprets the introduction of the Bondaian in the Sydney Basin as a manifestation of social change brought about by population pressure promoted by sea level rise (1994:347).

5.2 The Cumberland Plain

Hundreds of Aboriginal sites, predominantly open artefact scatters (also referred to as open camp sites), have been recorded within the Cumberland Plain. The campsites vary greatly in size from small sparse scatters to large concentrations of artefacts, with the larger denser sites tending to occur in close proximity to stone source localities and permanent water sources. Stone materials used in artefact manufacture at the sites reflect this proximity. Sites adjacent to the Hawkesbury/Nepean River contain higher proportions of chert and other fine-grained rocks found in the river gravels, while sites further east and south contain higher proportions of silcrete. Other rare site types include scarred trees (68 recordings), raw material extraction/procurement sites, stratified deposits, and grinding groove sites (3 recordings) where there are exposures of Minchinbury sandstone interbedded within the Wianamatta shales and clays.

The picture of Aboriginal utilisation and occupation of the Cumberland Plain is constantly being revised and refined as archaeological methods improve and more archaeological data becomes available for the area. The archaeological data for the Plain is derived from a number of sources including impact assessment studies, archaeological planning and management studies and academic archaeological investigations.

Larger scale projects undertaken on the Cumberland Plain include:

- Doctoral research on the western Cumberland Plain (Kohen 1986);
- A major compilation and analysis of data for the northern Cumberland Plain (Smith 1989a);
- Investigations at Rouse Hill (eg McDonald and Rich 1993; JMCHM 2005a);
- Surveys at Badgerys Creek for the 1997 EIS assessment of the Second Sydney Airport (NOHC 1997); and
- Work at the Australian Defence Industry site at St Marys (JMCHM Pty Ltd 1997).

Several predictive models have been formulated to explain Aboriginal site location on the Cumberland Plain. Haglund (1980) developed a predictive model of site location based on early survey work in the Blacktown area. She predicted that sites would most likely be located near water courses such as creeks and soaks, and on high ground near water.

Kohen (1986:292) postulated that the availability of water was the most important factor influencing the distribution of sites across the landscape. Other criteria which appear to play a role in site location are proximity to a diversity of economic resources such as food and lithic materials and to a lesser extent, elevation.

In 1989, Smith was commissioned by the NPWS to conduct a baseline study of Cumberland Plain sites to assist in the long term management of Aboriginal sites on the Cumberland Plain (Smith 1989a). Prior to her study, 307 sites had been recorded on the Cumberland Plain. These comprised 297 open context artefact occurrences, four scarred trees, one carved tree, four grinding grooves and an Aboriginal mission site (the Blacktown Institute). Smith (1989a:2) added 79 open sites and 29 isolated finds from field surveys related to her study.

Smith's analysis supported the predictions made by Haglund and Kohen that sites would most commonly be found near water sources. She concluded that site location and site densities were influenced by the availability of water and raw materials, but not by other tested variables such as topography, natural vegetation. Smith identified that site densities in the southern Cumberland Plain appeared to be lower overall to site densities on the northern Plain studies (1989a & 1989b:10).

The following is a summary of Smith's conclusions:

- Sites would occur in all areas of the Cumberland Plain, except where destroyed by European land-use, erosion processes and flooding;
- Sites would be located in all topographic units;
- Site densities may be expected to be 10 per cent higher in the northern section of the Plain because of the greater concentrations of stone resources in that area;
- Fifty percent of all sites would be found within 50 metres of a water source;
- Sites would tend to be more frequent around permanent water sources (apart from areas overlying the Londonderry Clay or Ricaby Creek Formation, and the Werrington Downs area); and
- Sites could be expected in relatively high frequencies on or near stone resources.

Smith's (1989b) following study of the Liverpool release areas tended to confirm this site location model in that almost 75 percent of sites were found in association with a permanent water source and over 60 percent of sites were within 50 metres of water. In this study, Smith concluded that sites in the Liverpool area were more likely to occur on creek flats than on any other topographical feature, and that the probability of sites occurring on creek flats increased near creek confluences.

The studies by both Kohen and Smith provided a strong foundation from which increasingly detailed and informed processes of archaeological model building and testing were conducted. The findings of the Kohen and Smith studies are now known to be limited by their reliance on surface-only evidence, and imbalances in survey coverage (eg. McDonald 1992a, Rich and McDonald 1995:14).

Kohen's later studies at Penrith confirmed the importance of fifth order creeks and rivers. He recorded over 50 sites in the Penrith area which included open artefact scatters, axe grinding grooves and rock shelters (Kohen 1997). He noted that sites occurring throughout the Penrith area "are particularly likely to occur adjacent to the rivers and creeks (Kohen 1997:7). The distribution of raw materials associated with the manufacture of stone tools suggests that chert and basalt were carried or traded east from the river gravels and that silcrete was traded or carried from sources near South Creek and Eastern Creek, west towards the Nepean flood plain".

Prior to 1993, relatively few open context sites had been excavated on the Cumberland Plain. There is now a substantial and increasing corpus of information from excavated contexts, revealing a substantial time depth and previously hidden richness in artefact density and diversity. Excavations at Plumpton Ridge, a major source of silcrete as a raw material, revealed evidence of extraction activity at least 2200 years ago (McDonald 1986). The stratified Power Street bridge site on Eastern Creek at Doonside yielded a date of 5,957±74 BP (NZA-3112) (McDonald 1993:21).

The more recently encountered Pleistocene aged date of 30,700 years BP for tuff artefacts within a Parramatta River sand sheet presents an argument for very early occupation of the Plain (JMCHM 2005b and 2005c, 2006).

Excavations on the Cumberland Plain have demonstrated that surface sites are generally an inaccurate representation of subsurface deposits (McDonald & Rich 1993, Rich & McDonald 1995).

The results of test excavations at Rouse Hill (McDonald & Rich 1993) have confirmed that sites occur widely across the landscape including areas such as hilltops and slopes, and near creeks. Larger sites with higher artefact densities are more likely to be located near permanent water. Excavations of a site at West Hoxton, southeast of Badgerys Creek, provided evidence of artefacts present up to 80 metres from a creek line, extending onto adjacent lower slopes (Rich & McDonald 1995).

In one of the largest test excavation programs in metropolitan Sydney to date, nineteen sites and fifteen potential archaeological deposits were systematically investigated in the context of the Rouse Hill Infrastructure Project (McDonald 1993, McDonald and Rich 1993, JMCHM 2005a). Over 7000 artefacts were retrieved from infrastructure project excavations and 87 percent of identified potential deposits were subsequently designated sites. Many of the sites and small surface scatters proved to be extensive, complex and relatively intact archaeological sites. The two potential deposits which were not found to be sites were located on hillslopes with thin topsoil development (McDonald & Rich 1993:93).

McDonald noted that:

> 'the range, complexity and high degree of intactness of the archaeological record were not expected either from the original surface recordings made nor from previous test excavations on the Cumberland Plain, which (in retrospect) were all of an extremely limited nature' (McDonald 1993:2).

Charcoal from two knapping floors located in sites OWR7 and RH/CD7 in the Rouse Hill development area have provided Early Bondaian dates of 4,060±90 BP (Beta 66450) and 4,690±80 BP (Beta 66453) respectively (McDonald & Rich 1993:101, 102).

The southwest section of the Rouse Hill Development Area was situated on shale geology and included the upper reaches of Caddies Creek and its tributary, Smalls Creek. This area provides a comparable topographic context to the airport site which is also on shale geology and contains the upper reaches of Badgerys Creek and Oaky Creek. The following findings from the Rouse Hill investigations are potentially applicable to similar upper catchment areas on the Cumberland Plain:

- most areas which were the subject of subsurface investigations contained sub-surface material;
- site patterning could be related to gross environmental factors, however the relationship between sites and the environment is complex - sites on permanent water are more complex than sites on ephemeral drainage lines. Major confluences are prime site locations;
- depositional environments e.g. alluvial terraces, contain the best potential for intact cultural material, although some hillslope zones may also have good potential;
- intact archaeological material may remain below the plough zone (i.e. top 25 centimetres of soil);
- minor gullies tend to have low density sites; and
- fewer sites were located on ridgetops possibly due to more disturbance in these areas.

The concluding analysis of the Rouse Hill investigations demonstrated the dynamic nature of stone tool technologies on the Cumberland Plain (JMCHM 2005a). McDonald reviewed previous project work within a theoretical framework to identify intra and inter-regional variation. Change in stone tool technology was identified over time and in relation to landscape (McDonald 2005a). Her report provided a framework to tentatively date sites through technological analyses and to identify cultural changes.

The Rouse Hill investigations further substantiated the finding that surface archaeological evidence on the Cumberland Plain may not accurately represent the subsurface resource. Of the excavations conducted, subsurface deposits were present even when there was no surface indication of a site. According to McDonald (2005a:5), "despite artefacts being rare or completely absent on the surface at each of the sites investigated, all six sites were found to contain intact archaeological deposit. Almost 500 square metres were excavated during this study and almost 35,000 artefacts retrieved."

McDonald (2005a) considered that Aboriginal occupation was focussed on the major river systems and characterised by mobility between a small number of sites. As a result of various studies and the application of stream order analysis, McDonald framed the following predictive statements regarding the density and complexity of archaeological sites relative to their associated fluvial contexts:

- Fourth and Fifth order streamlines (typically permanent creeks and small rivers) will be associated with archaeological evidence that is more complex and possibly stratified, reflecting more permanent and repeated occupation.

- Third order streamlines will be associated with evidence of more frequent occupation such as knapping floors. Higher artefact densities will be found in the lower reaches of tributary creeks.

- Second order streamlines will be associated with sparse archaeological evidence which is most likely to indicate occasional use and/or occupation.

- First order streamlines (with only intermittent water flow, typically in headwater contexts) will be associated with sparse archaeological evidence, which may be indistinguishable from, or may define, a background level of artefact incidence.

Comber undertook excavation at two sites at Penrith Lakes known as Camenzulis (2010b) and PL9 (2010a). At PL9, she retrieved more than 1,500 artefacts, including backed blades and an edge ground axe. Her work confirms McDonald's (2005) and Kohen's predictive model that sites are more likely to occur adjacent to the rivers and high order creeks.

The Penrith Lakes excavations further indicated that extensive subsurface archaeological deposits may remain in depositional environments despite disturbance from subsequent agricultural land use. Surveys (2006) prior to the excavations revealed a small number of artefacts amongst evidence of grazing, ploughing, cropping and a dam construction, and yet over 2,500 artefacts were recovered during excavation (Comber 2014).

5.3 The local district of the airport site

There have been a considerable number of archaeological investigations undertaken in the vicinity of the Commonwealth-owned land at Badgerys Creek. Australian Museum Consulting conducted a review of this work in 2014. A revision of their summary table is presented in Appendix 7. The location of previous surveys is presented in Figure 5.1. The review encompassed investigations, registered with the OEH AHIMS and from the localities of Badgerys Creek, Luddenham, Bringelly, Leppington, Erskine Park, Kemps Creek, West Hoxton and Orchard Hills.

5.4 Previously recorded Aboriginal sites in the local district around Badgerys Creek

A search of the NSW Aboriginal Heritage Information Management System (AHIMS), revealed 396 Aboriginal heritage recordings within an 18 x 16 km rectangular search area (accessed 18 June 2015). The search area was defined by a distance of 5 km from the northern, eastern and southern most points of the airport site, and a 4 km distance from the western boundary. The western margin was reduced in order to minimise the inclusion of topographies on Hawkesbury Sandstone.

A summary of the AHIMS search results, organised according to exclusive (primary feature) categories, is presented in Table 5.2. The search results are consistent with the broad trends for the whole of the Cumberland Plain. Open context artefact occurrences predominate and comprise 89 per cent of the search area record. The next highest category (6%) is potential archaeological deposits (where surface artefacts were not recorded). This low incidence is a consequence of former recording practice which emphasised surface find recordings and was limited to identifying high potential deposits. The remaining recording types comprise rare site types, such as modified trees (formerly known as scarred or carved trees) (n = 12, 3%), grinding grooves (n = 2, 0.5%) and single recordings of a burial, shell midden, stone arrangement, and resource gathering site.

Of particular importance to the district's Aboriginal cultural values is a late nineteenth century recording of a group of eight carved trees by R. J. Etheridge (AHIMS site no. 45-5-0234 [formerly 45-5-1234]) (Figure 5.2). These culturally modified trees almost certainly formed part of the traditional burial place of one or more prominent Aboriginal persons. Their location was recorded as the 'Greendale Estate, Vermont, near Narellan, Camden district' (Etheridge 1918:49, Australian Museum records, accession nos: E.3608 – 3615, Bell 1982). The carved sections of the trees were presented to the Australian Museum in 1892 by a Mr A. Vickery, possibly a local resident at the time.

There are two possible locations of the Greendale Estate (Figure 5.2). One is a land grant of 1200 acres to D'Arcy Wentworth which extended from the southwest of Luddenham, between The Northern Road and the Nepean River. This grant is identified as 'Greendale' on a pre-1840s parish map but by the late nineteenth century is known as 'Elmshall Park'. A more likely location is an 1813 grant of 500 acres to Mary Birch, which is situated 2.5 km to the southwest of the airport site. This property is identified as 'Greendale' on late nineteenth century maps and borders a grant of 55 acres to Samuel Fowler which is the central point for the locality name Greendale. This record of nomenclature is closest in time to the recording of the trees. The Birch landholding was sold to Wentworth in 1819. By 1902, most of the Greendale area was owned by a John Colburn (Liverpool City Council 2013).

A less likely possibility is that the trees were located on the Vermont Estate. This was a large original land grant to W.C. Wentworth which extended east and south of the confluence of Bringelly Creek with the Nepean River (9 km southeast of the airport site) (Figure 5.2).

Only one of the grinding groove recordings from the AHIMS search relates to the shale based topography of the Cumberland Plain. This is site 45-5-0215, which is situated on the South Creek flood plain, within two kilometres of the airport site.

It is most probable that this site consists of an outcrop of Minchinbury sandstone, a rock type which is poorly mapped and exposed infrequently across the Plain, typically in narrow lenses and isolated outcrops. This is in contrast to the massively bedded Hawkesbury sandstone which dominates the landscape surrounding the Plain and across which grinding grooves are frequently recorded.

The South Creek site is one of only three previously recorded grinding groove sites recorded on Minchinbury sandstone within the shale topographies of the Cumberland Plain (search area = 1539 km^2). The other two are located in the northeastern margin of the Plain, north and east of Blacktown.

Table 5.2 Summary of AHIMS search results

Site type/ feature	Number of recordings	Percentage of recordings
Open context artefact occurrence	353	89.2
Potential archaeological deposit (with no recorded surface artefacts)	25	6.4
Modified tree	12	3.1
Grinding grooves	2	0.5
Burial	1	0.2
Shell (midden)	1	0.2
Stone arrangement	1	0.2
Resource Gathering	1	0.2
Total	**396**	**100**

AHIMS accessed 18 June 2015

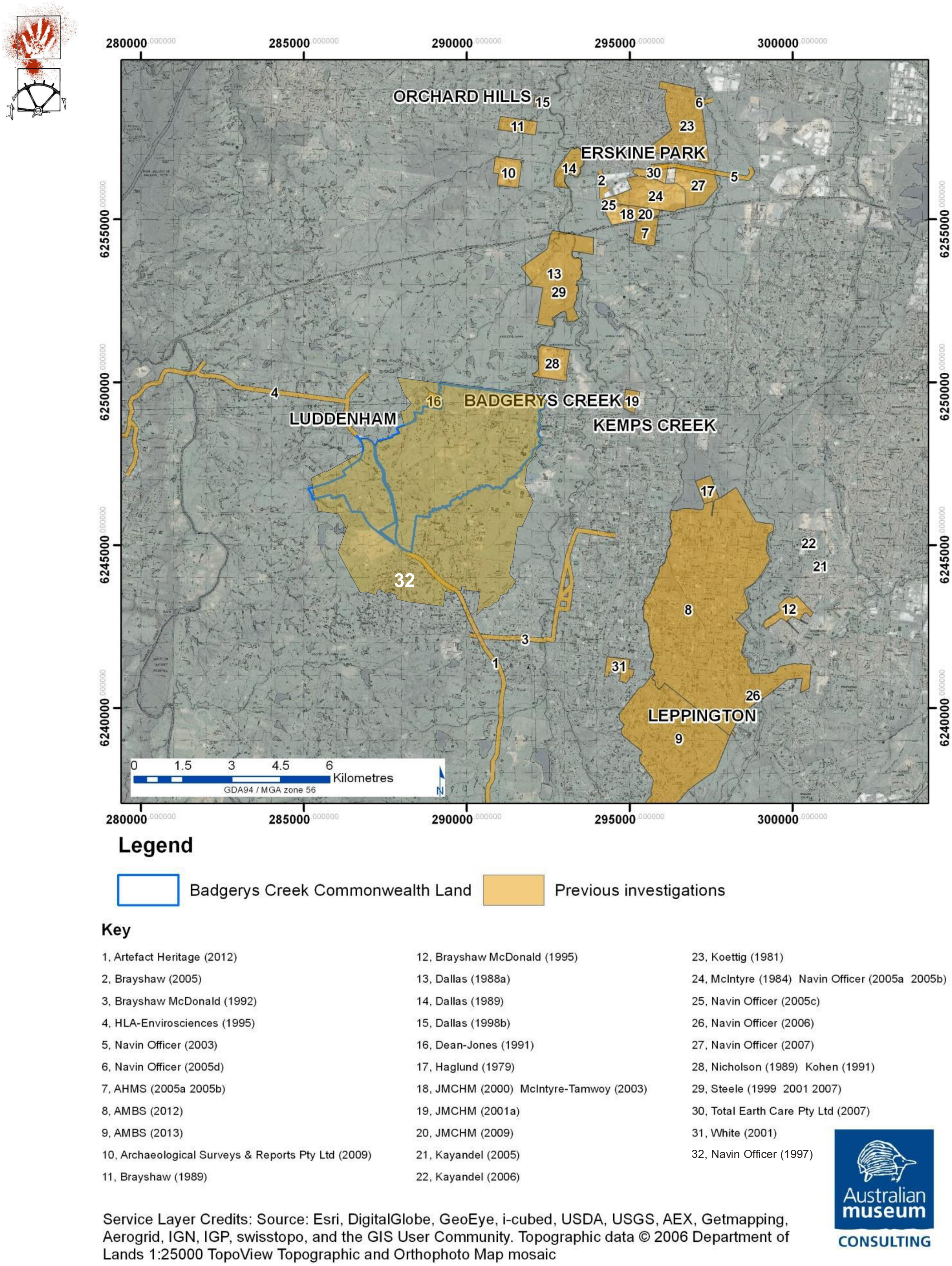
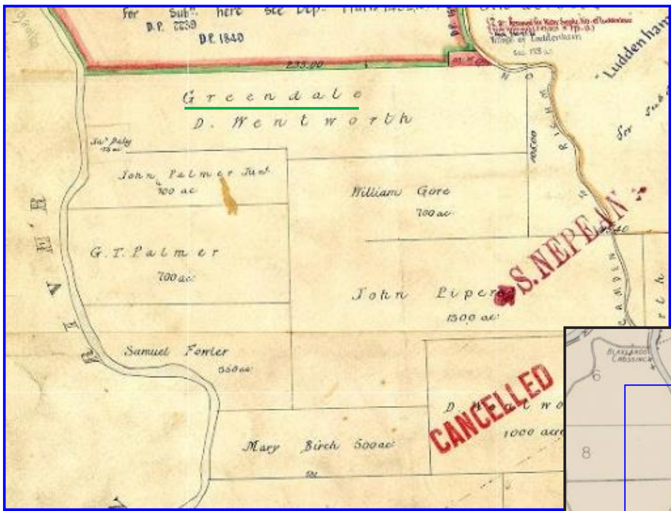


Figure 5.1 Previous archaeological investigations within the local district of the airport site (from AMC 2014, Figure 3.2).



Pre 1840s

1894

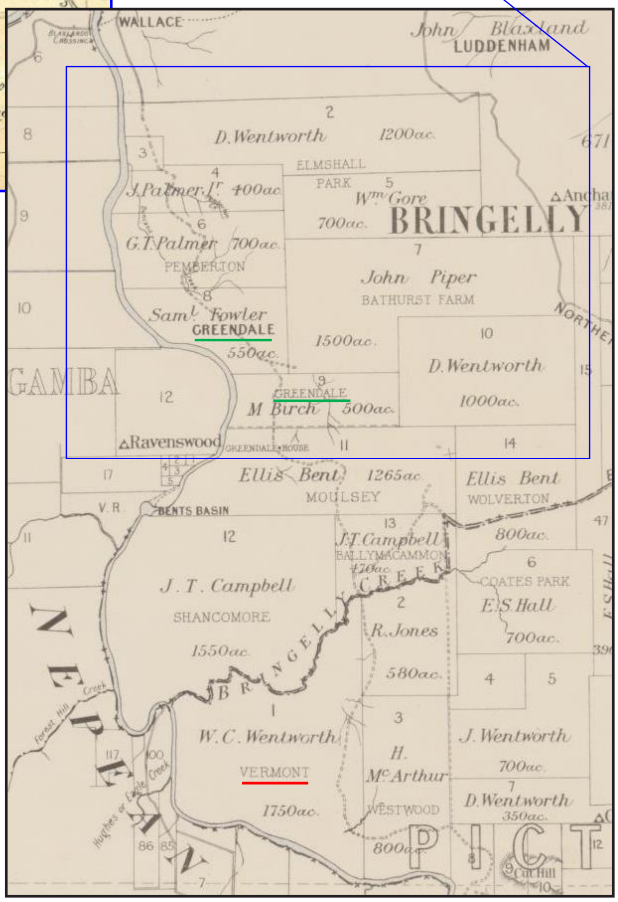


Figure 5.2

Salvaged sections of Aboriginal carved trees, collected from 'Greendale Estate, Vermont, near Narellan' in 1892 and conserved in the collection of the Australian Museum (E.3608 – 3615) (Etheridge 1918 Pl xiv and xvi).

Maps show locations of property names 'Greendale' (green underline) and Vermont (red underline) (Left: extract from pre 1840s Parish of Bringelly map http://images.maps.nsw.gov.au/pixel.htm# map no. 140710; Right: extract from 1894 County of Cumberland map, http://nla.gov.au/nla.map-rm2862-2 both NSW Department of Lands).

5.5 Previous archaeological investigations within the airport site

The airport site has been the subject of four previous archaeological investigations.

5.5.1 1978 MANS Study

A preliminary study of possible second Sydney airport locations was carried out in 1978. This study, which is generally referred to as the MANS (Major Airport Needs of Sydney) study, included an archaeological assessment (Haglund 1978).

Records of the areas subject to archaeological survey for this study have not survived; however no sites were recorded within the current airport site. Haglund located three sites (two artefact scatters: sites 45-5-213 and 214, and the South Creek grinding groove (site 45-5-215) north of Elizabeth Drive.

5.5.2 1985 Second Sydney airport site selection program

Anutech Pty Ltd undertook an archaeological assessment of a proposed airport site at Badgerys Creek and its surrounds as part of the Second Sydney Airport Site Selection Program in 1984-5. Lance and Hughes (1984) compiled a predictive study and Lance (1984) subsequently conducted a sample survey of the 1985 Badgerys Creek study area. Lance structured his survey to 'concentrate on areas in which prehistoric archaeological sites were considered most likely to occur' (Lance 1984). A comprehensive survey of the selected sample areas was conducted for the 1985 EIS (Department of Aviation 1985). This involved around 70 hectares and represented 4 percent of the 1985 study area (Figure 5.3). It was noted that there was ‘relatively little’ ground surface exposure adjacent to the creeks due to vegetation coverage, and ‘limited’ exposure on hillslopes.

One artefact scatter was located (Site 45-5-517) in the 1985 survey. The site comprised five silcrete flakes and flaked pieces and was found in a ploughed and devegetated area adjacent to Badgerys Creek.

Lance argued that the uniformity of landforms within the 1985 airport site and the low density of sites reported in similar locations suggested that the paucity of sites was a real archaeological pattern rather than a function of poor ground surface visibility in the study area.

Lance concluded that the only sites likely to have survived in his study area were stone artefact scatters which would have already been disturbed by the extensive land use in the area. Consequently, such artefact scatters would have little scientific importance. A possible exception to this was considered to be sites which occurred along the banks of Badgerys Creek and in areas which had incurred only 'minor surface damage and disturbance' (Department of Aviation 1985:206-208).

The proposed airport site was assessed as having relatively low archaeological sensitivity and no further archaeological assessment was recommended.

5.5.3 1997 Draft Environmental impact statement

In 1997, an archaeological investigation of two alternative potential airport locations was conducted by Navin Officer Heritage Consultants for PPK Environment and Infrastructure, on behalf of the Department of Transport and Regional Development (NOHC 1997). The two investigation areas were Badgerys Creek and the Holsworthy Military Training Area. The Badgerys Creek study area comprised the composite footprint of the three airport options (Figure 5.4). The assessment was based on Aboriginal cultural values reported by Aboriginal stakeholders and an archaeological survey of surface archaeological features. Due to the nature of the subject archaeological resource, and in particular the high value rock shelter deposits of the Holsworthy area, a decision was made to minimise the permanent impact of the EIS investigation assessment by excluding subsurface testing from the assessment methodology.

Survey coverage

The field survey aimed to cover a representative sample of all landscape units, and achieved a net coverage of 36.8 per cent of the combined area of all three options (14.22 km^2 surveyed out of 33.82 km^2). An estimated 9 per cent of the surveyed area provided archaeologically useful ground surface exposures. Taking into account survey coverage, usable exposures and visibility variables, the effective net survey coverage was around 5 per cent of the total study area (NOHC 1997:p5-13). The 1997 EIS survey areas are illustrated in Figure 5.4.

Survey results

One hundred and ten Aboriginal site recordings were made during the 1997 EIS field survey program of the three option composite Badgerys Creek study areas. To this was added the previously recorded site by Lance (Site B2, 45-5-517) producing a total inventory of 111 recordings.

Table 5.3 presents a summary of the 1997 site inventory.

The airport Option A, as defined for the 1997 assessment, corresponds relatively closely with the current airport site. Ninety two percent of all recordings comprised surface artefact occurrences (44 involving single artefacts and 58 with more than two visible artefacts). The remaining recordings consisted of eight scarred trees and one open potential archaeological deposit.

Within Option A, there were 55 open artefact occurrences (30 involving single artefacts and 25 with more than two visible artefacts), and five scarred trees (of which only two occur within the current airport site).

Table 5.3 Summary of the site inventory which formed the basis of the 1997 Badgerys Creek EIS assessment (after NOHC 1997: Table 5.1)

Recording Attribute	Number Recorded	Option A	All Options	Outside of Option boundaries
total no. recordings	111	60	97	14
open artefact scatters	58	25	48	10
scarred trees	8	5	7	1
isolated finds	44	30	41	3
site or isolated find associated with a potential archaeological deposit	9	5	6	3
potential archaeological deposit only (recorded during field survey)	1	0	1	0

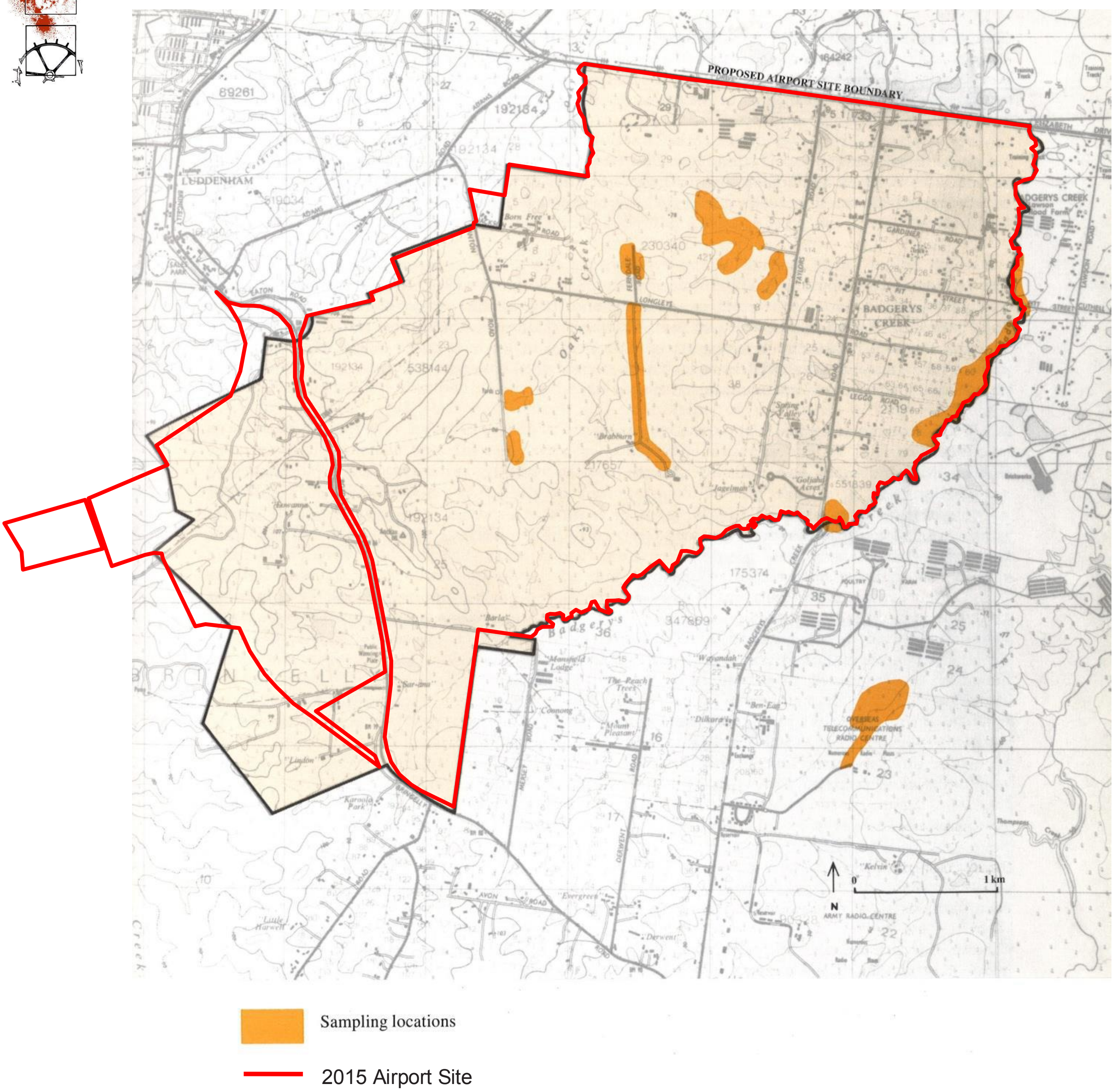


Figure 5.3 Areas of archaeological survey conducted in 1984-5 for the Second Sydney Airport Site Selection Program (Department of Aviation 1985:207). The 2015 airport site is indicated by a red boundary

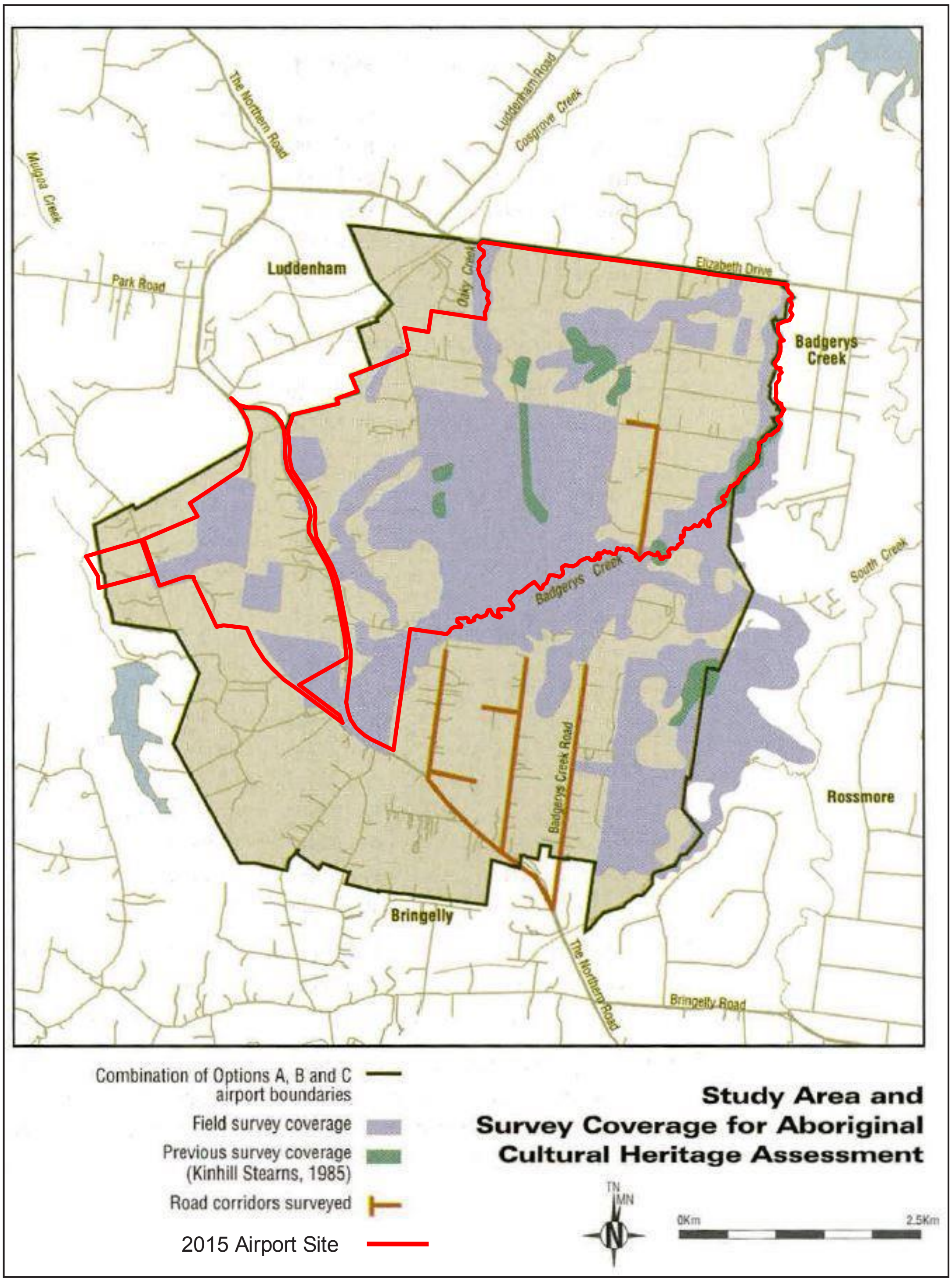


Figure 5.4 The archaeological survey areas conducted for the 1997 Second Sydney Airport EIS (after NOHC 1997: Figure 3-1). The 2015 airport site is indicated by a red boundary.

Artefact occurrences with more than two artefacts

Open artefact scatters, defined as surface artefact occurrences containing more than two surface artefacts, were the principal recording type within the 1997 Badgerys Creek study area. The surface characteristics of these sites were dominated by low artefact numbers and low artefact densities. The number of recorded artefacts ranged from 2 to 31, with 46 precent containing between 3 and 5 artefacts and 22 percent containing only 2 artefacts. Nineteen percent contained between five and 10 artefacts and 10 percent contained between 11 and 20 artefacts.

Average surface artefact densities per site were correspondingly low, with a maximum value of 1 artefact per square metre and a majority of sites recorded at less than 0.1 artefacts per square metre (55 percent), and between 0.1 and 0.5 (40 percent). Maximum recorded artefact densities per site were also low with a range of between one and six artefacts per square metre. The majority of sites had values of one (50 percent), or 2 (26 percent) artefacts per square metre.

It was considered that the low artefact frequencies, combined with relatively high degrees of ground surface visibility during the survey, provided generalised but reliable indication of the type and character of open artefact scatters within the Badgerys Creek study area. Most sites of this type were considered likely to contain only small numbers of artefacts and at low densities. Sites with larger numbers and greater densities were consistently found in valley floor and fluvial corridor contexts. This was consistent with surface site patterning identified elsewhere on the Cumberland plain.

It was noted, however, that subsurface testing programs in comparable Cumberland Plain contexts had indicated that artefact densities and the spatial extent of sites may be considerably higher below the surface, particularly within aggrading landscape contexts such as alluvial flats and basal valley slopes. It was conjectured that subsurface testing of open artefact scatters would identify higher artefact numbers and densities, particularly in contexts subject to consistent sedimentation, such as basal slopes and alluvial flats.

An assessment of the condition of each site was made based on the nature and extent of ground disturbance evident to the recorder. 76 per cent of open artefact scatters were rated to be in poor condition, with 21 percent rated as good, and only one classed as very good. None were considered to be in excellent condition. These ratings were considered to be a reliable indication of the condition of sub-surface artefactual material within the zone of ploughing and clearing disturbance. In contrast, it was noted that where sedimentary facies occur below this zone, mostly within valley floor and some basal slope contexts, the potential remained for artefactual material to remain unaffected by historic land-use impacts.

A set of field assessments into various aspects of the archaeological potential of an artefact occurrence were also conducted. These were: the potential to be larger than the recorded surface extent, the potential to contain more artefacts than those recorded, and the potential to contain undisturbed sub-surface (*in situ*) artefacts. The results of these assessments are presented in Table 5.4. A significant percentage of open artefact scatters were considered to have moderate or high potential to be larger in area and number of artefacts. This was related to the often limited extent of surface exposures in which artefacts were detected and the likelihood that the exposure boundaries are unrelated to the artefact distribution. In addition, the effects of ploughing and soil mobility were considered likely to have enlarged the artefact distribution. Just over half of the sites were assessed as having a moderate or high potential for *in situ* artefactual material. This assessment related predominantly to sites within fluvial corridor contexts.

Open artefact scatters in fluvial corridor contexts accounted for 53 percent of recordings of this type, despite fluvial corridors accounting for only 17 percent of the study area. Thirty one percent of sites occurred on alluvial flats or valley floor contexts within the corridor zone. Crests and ridgeline zones contained proportionately low artefact densities (12%), with highest percentages (7%) occurring on minor watersheds situated close to fluvial corridor zones.

Silcrete dominated the stone material types recorded at open artefact scatters, and was present in 86 per cent of sites, and accounted for more than 50 per cent of the recorded artefacts in 66 per cent of these locations. Other stone types rarely accounted for more than 50 per cent of recorded artefacts. Other important stone types were quartz, chert and tuff which were present in 41, 36 and

29 per cent of sites respectively. Quartzite, other volcanics, and rhyolite were recorded in a small number of sites.

Table 5.4 1997 assessments of archaeological potential for open artefact scatters in the Badgerys Creek study area

Type of potential	Low	Moderate	High	Not Recorded
to be larger	31%	41%	26%	2%
to contain more artefacts	29%	43%	26%	2%
to have in situ material	41%	33%	19%	7%

Isolated Finds

Isolated finds accounted for 69 percent of all Badgerys Creek recordings. The frequency of stone material types indicated a similar order of preference to open artefact scatters with silcrete dominating (48 percent), followed by chert (27 percent), quartz (14 percent) and tuff/mudstone (7 percent).

The condition of these single artefact occurrences also mirrored the ratings for open artefact scatters with 64 percent assessed as being poor, 25 percent as good, and two percent as very good. Nine percent were unassessed. This concurrence across recording categories was thought to be an indication of the homogeneity and widespread nature of the ground surface disturbance within the Badgerys Creek study area.

The assessed archaeological potential of isolated find localities was consistently lower than for open artefact scatters. The majority of locations had low potential, with only eleven percent assessed as having high potential for *in situ* artefactual material. These lower values were a reflection of the larger number of isolated finds recorded in shallow soil contexts, such as crests and upper slopes.

Although higher proportions of isolated finds were recorded from crest and watershed contexts compared to artefact scatters (approximately twice artefact scatter values), the relative sequence in landform occurrence was relatively similar. Highest frequencies occurred in secondary and minor fluvial corridors with 74 per cent of these recorded on alluvial flats. Seven per cent of isolated finds were recorded from major watershed ridgeline contexts (compared to three per cent of artefact scatters), suggesting that Aboriginal occupation of these topographies was more likely to result in the discard of isolated artefacts than in lower elevation and better watered contexts.

Artefact Traits

There were 102 recorded surface artefact occurrences, with a combined assemblage of 373 artefacts. Flakes were the most commonly recorded artefact type, and were noted in 73 percent of all artefact occurrences. This was followed by flaked pieces with 57 per cent, and cores with 17 percent. The high percentage of flaked pieces was interpreted to be indicative of the high degree of post depositional damage to artefacts from farming and other mechanical land-use impacts. Eighteen percent of sites contained artefacts with some form of secondary flaking, and six per cent included artefacts with use wear. Backed artefacts or microliths were noted in seven percent of occurrences. Bipolar reduction techniques were noted in only two percent of occurrences, and were probably under-represented in the sample due to difficulties in distinguishing artefactual quartz in highly disturbed surface contexts. This low frequency may also be a reflection of the predominance of silcrete working compared to quartz. Single platform cores were noted from 10 percent of locations, with multiplatform cores noted from eight percent.

Pebble cortex, mostly alluvial kin origin, was noted on artefacts from 25 percent of occurrences, providing a strong indication that pebble and gravel beds were a major source of stone used for flaking. Pebble cortex was noted on both silcrete and quartz primary flakes. Hammerstones were noted from one site only, and manuports from three.

Greater diversity in technological traits was evident from sites in fluvial corridor contexts, and particularly when adjacent to more permanent streamlines. Taken at face value, this breakdown of the distribution of artefactual traits suggested that the majority of artefact occurrences were indicative of non-intensive lithic working such as could be expected from small and low intensity occupation sites away from major camp sites or base camps. The latter are more likely to be situated adjacent to the larger stream beds and it is in these contexts that indications of more intensive stone use, such as utilised tools and cores are concentrated. It was concluded that although this pattern was supported by research conducted elsewhere on the Cumberland plain, further research and sub-surface sampling would be required to substantiate the trends within the Badgerys Creek study area.

Modified Trees

Eight scarred trees (also referred to by the more inclusive term of modified trees), were recorded from the Badgerys Creek study area. Five of these were interpreted as possibly of Aboriginal origin, two as probable, and only one as most likely to be an Aboriginal scar. The surety of an Aboriginal origin for the two recordings situated within the current airport site (B8 and B40) was assessed as possible. Seven of the trees occurred on rough barked Eucalypt species and one on a smooth barked Eucalypt.

The small number of recordings and the generally low degree of certainty regarding a possible Aboriginal origin, was not an unexpected result. This was because of the low survival rate of old-growth endemic trees and the high incidence of historic sources of scarring. Possible alternative causes of scarring included bird and domestic animal damage, disease, and impact from farming machinery and fencing. Two recordings were on dead trees, and a further two on trees in poor or very poor condition. Three trees were classed as being in good condition and only one was classed as excellent. The generally poor condition of the recorded trees was characteristic of the surviving older growth trees throughout the study area. These had been heavily impacted by land clearance, fire and agricultural practices. Most scarred trees were recorded from alluvial flats and valley floor contexts within fluvial corridor zones. It was thought that this pattern was more likely to reflect trends in non-Aboriginal tree clearance than any pattern in Aboriginal bark exploitation.

Potential Archaeological Deposits

The identification of potential archaeological deposits (PAD's) was based on the mapping of landforms which complied with predictive site location criteria, and the trends identified from the surface survey. Individual and site specific PADs were not systematically recorded during the field survey program.

The results of the surface survey indicated that core areas of archaeological potential were consistently situated on basal slope, locally elevated, and level or low gradient areas within, and immediately adjacent to, valley floor topographies and in close association (up to 100 m) with water sources. Wherever ground surface exposures into pre-historic sediments existed within these contexts, artefacts were consistently recorded. In addition, alluvial and colluvial sedimentation within the fluvial corridor zone provide the only significant areas in which subsurface artefactual material may remain undisturbed below a plough zone depth of approximately 20 centimetres. Zones and sites with archaeological potential identified as a result of the 1997 assessment are mapped in Figure 5.5.

Potentially exploited natural resources

Apart from the scarred trees, no other forms of site specific natural resource exploitation were noted from Badgerys creek. A local surface concentration of ochreous sandstone nodules with apparently high concentrations of iron oxide was noted along a section of Oaky Creek. No evidence for Aboriginal quarrying or exploitation of the nodules could be identified, however it remains possible that these nodules were used by Aborigines as a source of ochre. The source did not display outstanding quality, and any past exploitation was probably opportunistic and local in character.

Non-artefactual forms of silcrete in the form of relatively small flaked and rounded surface gravels were noted from many locations within the northern and north eastern portions of the 1997 EIS study area. Large scale sources of silcretes on the Cumberland Plain are associated with relict alluvial gravel beds of Tertiary age, however, no such sources are known from the study area (personal communication Tessa Corkill February 1997). The natural gravels encountered in the study area were interpreted as a remnant surface scatter from a now eroded source. If was conjectured that the dominance of silcrete in the Badgerys Creek artefactual assemblage was at least partly indicative of local Aboriginal exploitation of these surface gravels.

Aboriginal cultural and intangible values

All Aboriginal stakeholders consulted for the 1997 EIS assessment and subsequent supplements, expressed a strong view that sites and deposits associated with the archaeological record of Aboriginal occupation at Badgerys Creek were of high cultural value to Aboriginal people. In addition, the intangible cultural values of the landscape and its surviving biota were valued for their association with traditional culture and lore, and the sense of place and social identity derived from them. No sites or places of special cultural significance, unrelated to archaeological evidence, were identified during the assessment.

All stakeholder groups variously communicated a general opposition to the construction of a second airport in south western Sydney.

Conclusions

It was concluded that the results of the 1997 EIS investigation were fully consistent with previous findings for the Cumberland plain. Based on a comparison with the corpus of previous results, the known and predicted archaeological resource within the Badgerys Creek study did not stand out as having unique or outstanding features. Nor could the study area be reliably considered to represent a significant potential to include unique or outstanding features to any greater extent than comparable topographies elsewhere within the Cumberland plain.

The following points summarised the concurrence between the results of the 1997 investigation and previous conclusions:

- sites and varying artefact densities occur in all topographic zones;
- site density was found to be higher in topographies associated with permanent water sources;
- alluvial flats were a zone of high site density and appeared to have been a focus of Aboriginal occupation;
- basal slopes adjacent to valley floor contexts were also found to have relatively high site densities;
- sites in association with permanent water (secondary or higher order fluvial corridors), tended to be larger, and have higher artefact densities and greater technical complexity, than those associated with lesser order drainage lines;
- in line with the results of the Rouse Hill investigations (JMCHM 2005a), all of the fluvial corridor zones were identified as zones of archaeological potential relative to adjacent topographies. These zones were considered likely to contain larger and more complex sites, as well as the least disturbed sub-surface deposits below the plough zone;
- ridgetops in general contained fewer sites; and
- minor gullies (ie drainage lines outside of fluvial corridors), tended to have low site densities.

It was argued that the Badgerys Creek study area consisted mostly of an upper portion of the greater South Creek catchment, but did not include any section of this major Cumberland Plain stream line, or its associated flats and basal slopes. As such, the study area was comparable to many other similar upper catchment Cumberland plain topographies. It was observed that the extent of previous land surface disturbance, particularly from vegetation clearance, agricultural development, and recent residential developments in no way distinguished the Badgerys Creek area as a zone of better than average archaeological potential. The fluvial corridor and valley floor of South Creek, situated one kilometre to the east of the current airport site, was considered likely to contain larger sites, deeper sedimentary contexts and to provide a greater archaeological potential than comparable fluvial corridors within the study area.

The assessment concluded that the level of potential development impact associated with any of the Badgerys Creek airport options could be placed within a local scale and context. The Holsworthy airport options were, by contrast, placed within a regional, and national context. The loss of cultural heritage significance represented by the Holsworthy options would not normally be contemplated except in cases where no other viable alternatives existed.

Management and mitigation

The 1997 EIS investigation identified a range of Aboriginal heritage management measures in the event that airport development at Badgerys Creek proceeded. These included:

- surface survey of remaining unsurveyed areas within direct impact areas;
- conduct of a program of subsurface testing in areas of defined archaeological potential;
- salvage excavations to be conducted in a range of locations, according to the priorities and criteria identified in the preceding testing program;
- salvage of Aboriginal scarred trees after appropriate field recording, if appropriate;
- regular monitoring of indirect impacts on sites;
- environmental protection to be reviewed and, if necessary, redesigned to mitigate indirect impacts on sites;
- development of conservation and management plans for *in situ* site conservation;
- subsequent curation and care of salvaged materials; and
- monitoring of ground surface disturbance during construction activities
(NOHC 1997:20-11-20 13).

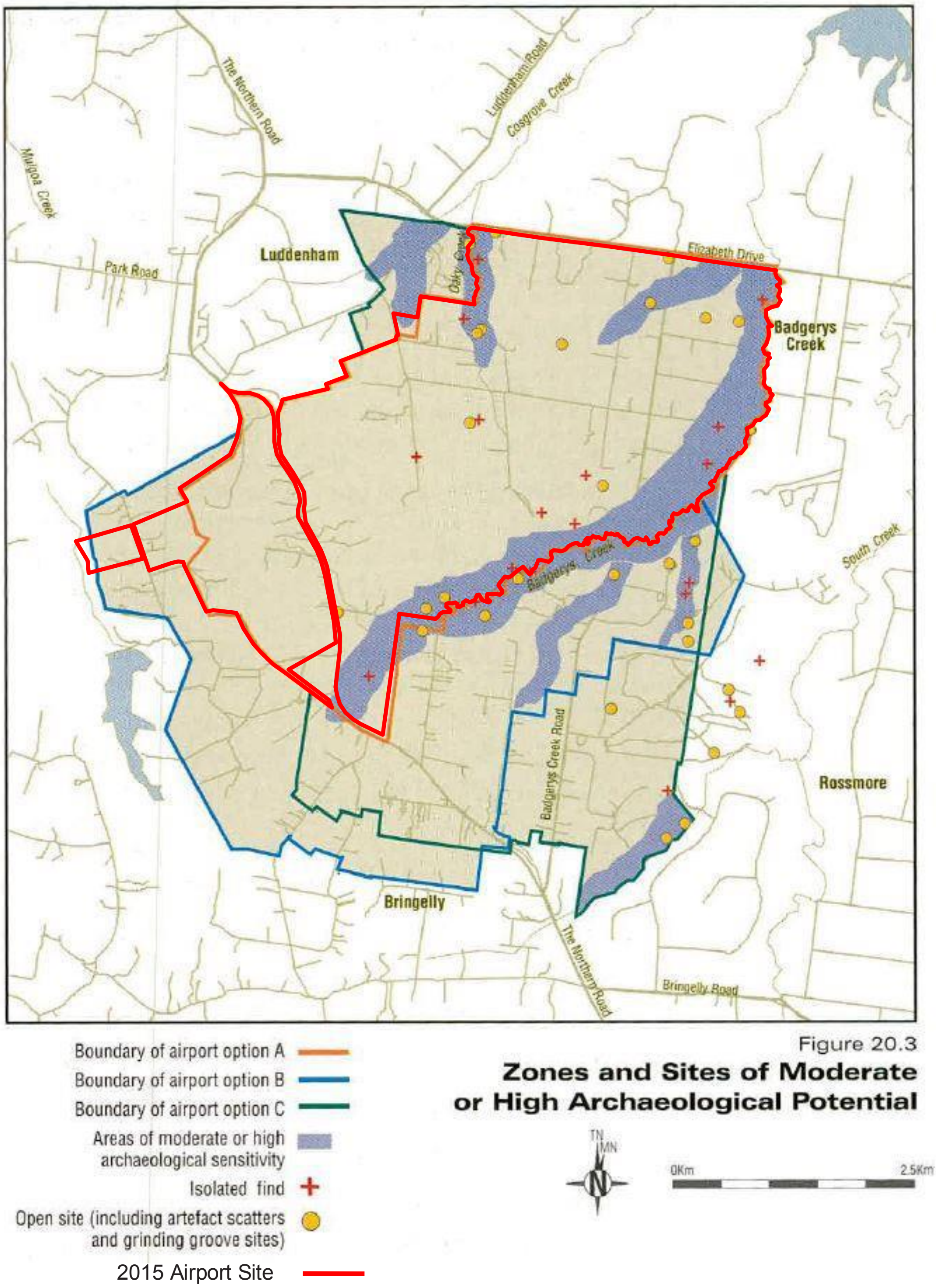


Figure 5.5 Zones and sites identified in the 1997 EIS assessment with predicted subsurface Aboriginal archaeological potential

5.5.4 1997 EIS Auditors report

The Draft EIS was the subject of an Auditor's report in 1997 (SMEC 1998). This review presented criticisms of a number of areas of the assessment including the logic employed, data (or lack thereof), interpretation (especially the work of others), presentation, the sampling strategy used in executing the field survey strategy, and the fact that no test excavations were carried out.

The Auditor's assessment was that the scientific (or archaeological) significance of the known and unknown cultural heritage resources in the Badgerys Creek area might well prove to be higher than that presented in the draft EIS. Despite this reservation, the Auditor concurred with inferences made in the Draft EIS that the scientific significance of the known and projected cultural heritage resources at Badgerys Creek is low. The Auditor also commented that a cultural heritage management plan would need to be prepared if the airport proposal was to proceed.

5.5.5 1999 Supplement to the 1997 EIS

A supplement to the 1997 EIS was completed in 1999. One additional field site was added to the EIS database. The supplement addressed comments submitted during the Draft exhibition period and criticisms presented in the Auditors report.

The supplement included an assessment of the cumulative impacts of an airport development on the existing Aboriginal cultural resource in the Badgerys Creek region. This analysis suggested that the development of any of the airport options would result in a significant impact on the archaeological resource of the Cumberland Plan. It noted however, that only a very small proportion of the Cumberland Plain had been subject to comprehensive field survey, and that this limited the ability to quantify this impact.

5.5.6 1999 Supplement auditor's report

The Auditor's Report on the Supplement to the Draft EIS (SMEC 1999) noted the EIS recommendation that once a preferred option was selected, a detailed and comprehensive program of subsurface testing and salvage would be conducted within the selected site. The Auditor suggested that the possibility that this testing may reveal items of greater significance than what had been identified on site to date should be considered.

The Auditor noted that the Supplement identified that all of the airport options would impact on sites that are valued by the local Aboriginal community for their cultural significance.

5.5.7 1999 Environment Australia assessment report

In 1999, at the end of the EIS process (which had commenced in 1997) Environment Australia conducted a review of the Draft EIS, supplement, final EIS and audit findings.

The following points were made in relation to the assessment of Aboriginal heritage:

- A higher priority could have been given to more detailed supporting anthropological and historical studies to assist in addressing issues relating to Aboriginal cultural significance more effectively.
- More detailed studies into contemporary Aboriginal heritage values, as opposed to archaeological values, would have helped to clarify the nature of the cultural heritage significance of the proposed airport site.
- Further work into contemporary Aboriginal heritage values should be done prior to construction of the airport as part of any conservation management plan.
- Information relating to the implications of native title claims for the airport development had not been provided.

- The survey methodology appears to have been adequate and in accordance with accepted methodological standards in NSW NPWS guidelines.

- The decision not to undertake subsurface testing for the EIS was appropriate as it could have resulted in unnecessary damage to cultural heritage sites and was in accordance with current best practice in the conservation of cultural heritage.

- A conclusion in Technical Paper 11 (Aboriginal Cultural Heritage) that 'below the plough zone and within the deeper sedimentary deposits of the lower Badgerys Creek fluvial corridor, the potential for significant archaeological deposits within a regional content cannot be wholly discounted' was not included in the main Draft EIS report.

- A regional survey of the archaeological and contemporary Aboriginal cultural heritage resources of the Cumberland Plain would assist in identifying the Aboriginal cultural heritage values of the Cumberland Plain and would allow a more accurate assessment of individual sites and suites of sites.

- The suggestion that regional trade-offs may assist in mitigating cumulative impacts induced by the airport development was not taken up in the environmental management measures proposed in the Supplement. The possibility of pursuing such initiatives could be explored in the context of regional environmental planning, in consultation with the local Aboriginal community.

It was concluded that the impact of the airport on the Aboriginal cultural heritage significance of the site, and potentially of the region, would be significant. Almost all of the archaeological resource in the airport site would be destroyed, and contemporary Aboriginal cultural heritage values would be damaged. It was recommended that a cultural heritage conservation management plan should be developed in consultation with the local Aboriginal community to guide the process of site documentation, destruction and management. To offset the loss of the cultural heritage of the site and region, consideration should be given to promoting measures which would identify and mitigate the effects of the airport on the regional resource (Environment Australia 1999: 19-10 – 19-11).

5.5.8 2014 AMC Environmental survey

In 2014 Australian Museum Consulting, on behalf of SMEC, undertook the Aboriginal heritage component of an environmental survey program which aimed to update existing baseline environmental information on the Commonwealth owned land at Badgerys Creek.

The following tasks were undertaken:

- A search and review of relevant OEH (AHIMS) database information.

- A review of relevant previous archaeological reports specific to the area.

- A review of relevant contextual environmental information and previous land use history.

- Field inspection of 21 of previously recorded Aboriginal heritage sites situated within areas of previously identified moderate and high archaeological potential with the aim of establishing their current status and condition.

- Preparation of a report describing the results of the assessment, identified information gaps and requirements for further investigations to support any future assessments.

Of the 21 Aboriginal heritage sites within areas of moderate and high archaeological potential, only seven sites could be re-found and verified. These were the two possible scarred tree sites and five stone artefact occurrences. It was reported that impacts described by the 1996 assessment have continued to affect the condition and visibility of the sites, and the majority of sites have either been actively impacted by water or stock movements, or are now overgrown and obscured by vegetation. These impacts have either obscured the previously recorded artefacts, or removed them from the immediate location of the original site recording.

The following observations were made regarding the reinspected sites:

- The two scarred trees of possible Aboriginal origin (B40 AHIMS site 45-5-2630 and B8, 45-5-2634), were found to be heavily impacted by ongoing rotting of the heartwood caused by previous damage and stock impacts respectively.

- No artefacts were visible at the following fifteen sites:

B4	AHIMS site no.	45-5-2638
B7	AHIMS site no.	45-5-2635
B41	AHIMS site no.	45-5-2768
B44	AHIMS site no.	45-5-2632
B46	AHIMS site no.	45-5-2699
B54	AHIMS site no.	45-5-2790
B55	AHIMS site no.	45-5-2693
B59	AHIMS site no.	45-5-2690
B74	AHIMS site no.	45-5-2685
B76	AHIMS site no.	45-5-2683
B81	AHIMS site no.	45-5-2679
B82	AHIMS site no.	45-5-2764
B86	AHIMS site no.	45-5-2781
B88	AHIMS site no.	45-5-2665
B94	AHIMS site no.	45-5-2789

  Reasons for the lack of visible artefacts at these locations were noted to be obscuring vegetation, displacement by stock trampling, removal by erosion agencies, and subsequent deposition of sediment. Difficulty in re-finding artefacts at seven of these locations was expected due to the original recording consisting of single artefacts.

- Three artefacts were recorded at site B45 (AHIMS site 45-5-2633), a site associated with an agricultural dam and originally recorded as comprising 12 artefacts. It was considered likely that impacts from water erosion had removed surface artefacts from the vicinity of the site.

- One artefact was recorded 120 metres from site B5 (AHIMS site 45-5-2637), and attributed to the original site recording which consisted of an isolated artefact (this recording has been allocated a new site designation, B136, for this study). The area of the find had been heavily impacted by ploughing and erosion.

- One artefact was recorded at site B95 (AHIMS site 45-5-2762), a site associated with a dam that was originally recorded as comprising six artefacts. The site was almost completely obscured by pasture grass.

- Only one site contained more visible artefacts than originally recorded. This was at site B80 (AHIMS site 45-5-2678) which was originally recorded as a scatter of 11 artefacts exposed within two small salt pan erosion areas. The AMC reinspection recorded 64 artefacts within extensive exposures caused by ongoing stock impacts and water erosion.

Following the AMC review of archaeological investigations which post-date the 1997 EIS assessment, it was concluded that refinements in the understanding of the nature of Aboriginal cultural heritage across the region now suggest that the Commonwealth lands at Badgerys Creek have greater potential to contain subsurface archaeological deposits than previously indicated. In addition, landforms with potential to contain such deposits are likely to be larger than those accounted for by the 1997 predictive model.

Cumberland Plain studies have provided further evidence substantiating the observation that the presence or absence of surface archaeological materials is not a wholly reliable indicator of the distribution of in situ archaeological deposits. Given that all of the Badgerys Creek recordings relate to ground surface exposures, created by erosional and human land-use disturbance, it was considered likely that substantial archaeological deposits remain present within landforms that have not experienced significant disturbance.

Current archaeological knowledge now provides a basis for challenging the 1997 EIS site location model which suggested that most Aboriginal heritage sites would be located within 50 m of water resources (NOHC 1997:59). Some instances are now known of Aboriginal heritage sites with dense subsurface archaeological deposits located up to 300 metres from water sources. This has important implications for future heritage significance and impact assessment, and for the development of appropriate heritage impact mitigation measures and research methodologies.

The AMC 2014 baseline assessment presented three recommendations:

- *Aboriginal community consultation should be carried out to ensure the appropriate involvement of Aboriginal stakeholders in the assessment and decision making regarding their heritage. Consultation should comply with the Australian Heritage Commission's Ask First: A guide to respecting Indigenous heritage places and values (Australian Heritage Commission 2002), and address the NSW Office of Environment and Heritage's* Aboriginal cultural heritage consultation requirements for proponents *2010 (DECCW 2010b), as appropriate.*

- *Full archaeological survey of the Commonwealth owned land at Badgerys Creek should be undertaken in consultation and engagement with Aboriginal community stakeholders. The survey and assessment should seek to assess a representative sample of all landforms within the area, and should comply with the requirements of the NSW Office of Environment and Heritage's Code of Practice for Archaeological investigation of Aboriginal Objects in New South Wales (DECCW, 2010)*

- *A program of archaeological test and salvage excavations should be carried out throughout impact areas resulting from future development or land use activities on the Commonwealth owned land at Badgerys Creek, in consultation and engagement with Aboriginal community stakeholders. The scope and methodology of the excavation should respond to the results of the archaeological survey and assessment, and should seek to recover and analyse an appropriate representative sample of the Aboriginal archaeological resource of the area.*

5.6 Current predictive regional model

The development of a predictive model of the location and content of Aboriginal archaeological sites on the Cumberland Plain has been a continuous process and involved constant evaluation against the results of increasingly sophisticated sampling and survey methodologies.

The following is a compilation of key trends and predictive statements derived from the corpus of previous investigations reviewed in the previous sections:

- Surface and subsurface stone artefacts occur at variable areal incidences in all landforms types.

- Site frequency together with artefact density and diversity are strongly related to landscape variables which determine access to fresh water and to other exploitable resources. This relationship is likely to be complex and to include multiple behavioural and environmental variables.

- Low surface artefact incidences may not accurately reflect the composition or density of subsurface archaeological deposits. Some areas with few or no surface artefacts have been found to contain archaeological deposits with relatively higher artefact densities and areal incidence.

- Intact archaeological material may remain below the plough zone (i.e. top 25 centimetres of soil).

- At a micro-topographic level, artefact distributions will most likely be situated on locally elevated, well drained ground with relatively level or low gradients.

- Micro-topographic contexts which are both low-lying and poorly drained, or comprise high gradient slopes are likely to contain no, or very low, artefact densities.

- Surface and subsurface artefact occurrences are mostly situated in relative proximity to permanent water sources such as creeks and rivers and wetland basins on alluvial flats. The majority of sites are located within 100 metres of a fresh water source.

- Sites in association with permanent water (secondary or higher order fluvial corridors), tend to be larger, have higher artefact densities and greater technical complexity, than those associated with lesser order drainage lines.

- Sites or potential archaeological deposits in the vicinity of lower order and ephemeral drainage lines are most likely to include archaeological deposits with low-to-moderate artefact densities.

- Regional trends indicate that Aboriginal sites are most frequently located in close proximity to permanent water courses on creek banks, alluvial flats and lower hillslopes (basal slopes), or on high ground such as ridges and knolls, and within range of food resources and the raw materials for manufacturing tools.

- Complex sites (defined as sites with more artefact types and more archaeological features in intricate arrangement) are usually located close to permanent water sources. These sites are probably indicative of intensive use by larger groups, or repeated use by smaller groups over a longer period of time.

- Stream order may provide a predictive framework for the incidence and nature of associated archaeological deposits (McDonald 2005a).

    - Fourth and Fifth order streamlines are likely to be associated with more complex and possibly stratified archaeological evidence which reflects more permanent and repeated occupation.

    - Third order streamlines are likely to be associated with evidence of frequent occupation such as knapping floors. Higher artefact densities will be found in the lower reaches of tributary creeks.

    - Second order streamlines are likely to be associated with sparse archaeological evidence, probably related to occasional use and/or occupation.

    - First order streamlines are likely to be associated with sparse archaeological evidence, and this may be indistinguishable from, or may define, a background level of artefact incidence.

- Creek junctions could provide foci for site activity and the size of the confluence (based on stream order) could influence the size and complexity of sites (McDonald and Rich 1993; JMCHM 1997, 2005a).

- High value potential archaeological deposits are most likely to be located on aggrading landforms within valley floor contexts and fringing basal slopes, on locally elevated and well-drained ground.

- Despite a general trend for relatively elevated landforms such as ridge and spurline crests to contain low site densities and artefact incidences, sites with large numbers of artefacts may still be present on ridge tops and hill crests.

- Sites situated in alluvial and aggrading sedimentary or colluvial contexts retain the potential to include high value stratified archaeological deposits.

- Artefact assemblages generally comprise a small proportion of formal tool types with the majority of assemblages dominated by unretouched flakes and debitage.

- Excavations conducted along higher order stream lines (particularly South Creek and Ropes Creek), have detected extensive archaeological deposits, thought to be the result of repeated occupation events, within c.150 metres of the stream banks (e.g. Brayshaw McDonald Pty Ltd 1995; Total Earth Care Pty Ltd 2007).

- Silcrete is the dominant raw material evident at most surface and subsurface artefact distributions, followed by tuff/chert. Substantial sources of silcrete, mostly associated with Tertiary gravel deposits, are located in the north western Cumberland Plain at places such as St Marys, Plumpton Ridge, Marsden Park, Schofields, Riverstone, Deans Park, Llandilo and Ropes Creek. However, a low areal incidence of surface silcrete gravels occurs across large areas of the Cumberland Plain and may have served as a low-key source of workable stone for knapping. Silcrete cobbles and amorphous naturally fractured gravels have been noted during surveys and excavations at Luddenham and Erskine Park (e.g. Dallas 1988a; Brayshaw 2005; NOHC 2005c; Steele 2007).

- Single trees and stands of remnant older growth vegetation retain the potential for evidence of Aboriginal modification (mostly scars resulting from the removal of bark). The large scale nature of historical vegetation clearance across the Cumberland Plain means that old-growth remnants are now rare.

- Grinding grooves (shallow linear grooves produced during the manufacture of ground edges on stone artefacts such as axes (hatchets)) are a rare site type on the Cumberland Plain and may occur wherever Minchinbury sandstone is exposed on the surface.

Australian Museum Consulting (2014) note that archaeological investigations continue to identify individual site characteristics which run contrary to these predictive statements. An example is the excavations conducted by ENSR Australia Pty Ltd at the Oran Park and Turner Road Land Release Precincts in 2009, approximately 12 km south of the airport site. It was concluded that:

> The archaeological landscape revealed by this investigation suggests that archaeological models derived from other regions or other areas should not be applied uncritically. There was no evidence for greater complexity (defined as intricacy) associated with confluences. There was no evidence of greater densities of archaeological material associated with higher order watercourses. Instead it appears that archaeological deposit in the south west [Cumberland Plain] is of relatively low density with occasional clusters in association with all areas of reliable water regardless of stream order. Future assessments in south west Sydney would benefit from paying greater attention to the investigation of areas within 300 metres of all reliable watercourses (i.e. more than the conventional 50 metres vicinity of watercourses) (ENSR 2009:66, cited in AMC 2014: 29, quoted in AMC 2014:29).

5.7 Previously recorded sites within the airport site

There are 51 previously recorded Aboriginal sites within the airport site. All of these are documented in the AHIMS register. Of these, one recording pre-dates and one post-dates, the 1997 EIS survey and assessment (B3, AHIMS site no. 45-5-2586 and B136). Due to a data error, the AHIMS register places an external site recording within the airport site (EG6, AHIMS site no. 45-5-2562). This recording has been excluded from this assessment.

There are no recorded sites or places on the Commonwealth or National Heritage Lists. These lists were established under the *Environment Protection and Biodiversity Conservation Act 1999* and are administered by the Commonwealth Department of the Environment.

Data relating to all previously identified Aboriginal sites within the airport site is presented in Table 5.6. The general location of sites is shown in Figure 5.6.

Table 5.6 Summary of previously recorded Aboriginal heritage sites located within Commonwealth owned land at Badgerys Creek (refer to Appendix 2 for map grid references)

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Arch'l subsurface potential (NOHC1997)
B3	45-5-2586	sao	1		stock track		0.3m wide	high
B4	45-5-2638	sao	1	nil	erosion gully platform		2.6 x 3.9	low
B5	45-5-2637	sao	1	1	creek ford		20 x 7	low
B7	45-5-2635	sao	1	nil	stock track and creek bank		1 x 1	moderate
B15	45-5-2705	sao	1		suburban road verge		4 x 4	low
B24	45-5-2642	sao	1		track from dam wall			not recorded
B25	45-5-2643	sao	1		grassed ploughed area (vineyard)			low
B31	45-5-2617	sao	1		dirt track		3 x 3	low
B32	45-5-2618	sao	1				10 x 2	not recorded
B39	45-5-2629	sao	1		ploughed zone between vines		100 x 2	low
B40	45-5-2630	modified tree						possible
B41	45-5-2768	sao	1	nil	BMX bike jump		2.5 x 2.5	moderate
B42	45-5-2631	sao	1		building (construction) site		6 x 2	low
B43	45-5-2783	sao	5		salt scald	30 x 30	10 x 5	high
B44	45-5-2632	sao	3	nil	erosion gully and horse track	150 x 25	150 x 25	moderate
B45	45-5-2633	sao	12	3	scald at gate and dam bank	120 x 30	18 x 4 7 x 4	moderate
B46	45-5-2699	sao	13	1	channel and erosion scour and agricultural dam wall	60 x 50	25 x 5 40 x 5 15 x 20	high
B54	45-5-2790	sao	2	nil	eroded gully margin	11 x 1	15 x 3	low
B55	45-5-2693	sao	2	nil	gateway and ant nest scald	23 x 2	4 x 3	low
B59	45-5-2690	sao	1	nil	road margin		16 x 15	not recorded
B66	45-5-2659	sao	16		scald	12 x 4	25 x 4	low

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Arch'l subsurface potential (NOHC1997)
B67	45-5-2658	sao	1		trampled and eroded soil exposure		2 x 6	moderate
B68	45-5-2623	sao	1		stock trail		200 x 30	high
B69	45-5-2771	sao	1		graded embankment for agricultural dam		10 x 5	not recorded
B70	45-5-2770	sao	5		drainage line scald and stock yards	7 x 3	16 x 8	moderate
B71	45-5-2687	sao	1		stock treadage		20 x 3	not recorded
B74	45-5-2685	sao	1	nil	recently ploughed field		100 x 200	moderate
B75	45-5-2682	sao	1		agricultural dam wall		25 x 6	moderate
B76	45-5-2683	sao	1	nil	side of bitumen road		100 x 5	low
B77	45-5-2681	sao	9		dry creek bed	10 x 2	11 x 5	high
B78	45-5-2680	sao	1		creek bed	10 x 15	10 x 15	high
B79	45-5-2663	sao	1		road cutting		50 x 10	low
B80	45-5-2678	sao	11	64	erosion scald above agricultural dam and creek bed	100 x 30	20 x 6 4 x 2	moderate
B81	45-5-2679	sao	1	nil	creek bed and banks		17 x 30	high
B82	45-5-2764	sao	1	nil	agricultural dam wall		40 x 5	low
B84	45-5-2782	sao	7		scald around dead tree	1.7 x 1.5	30 x 15	moderate
B86	45-5-2781	sao	5	nil	erosion scar	30 x 20	30 x 20	low
B87	45-5-2763	sao	5		graded vehicle track	20 x 4	20 x 4	high
B88	45-5-2665	sao	2	nil	excavated trench below dam	20 x 5	20 x 5	low
B90	45-5-2667	sao	2		vehicle track	10 x 0.5	2.5m wide	moderate
B91	45-5-2671	sao	2		ploughed marked garden	6 x 1	300 x 200	low
B92	45-5-2670	sao	4		disused vehicle track	25 x 3	3m wide	high

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Arch'l subsurface potential (NOHC1997)
B93	45-5-2668	sao	1		agricultural dam wall		20 x 1.5	low
B94	45-5-2789	sao	1	nil	salt scald/clay pan		2 x 1	high
B95	45-5-2762	sao	8	1	agricultural dam wall and margin		100 x 7	moderate
B101	45-5-2673	sao	1		gate exposure		2.5 x 1.5	indeterminate
B102	45-5-2656	sao	19		sheet wash areas in old horse training paddock	13.5 x 3.5	19 x 5	high
B103	45-5-2814	sao	1		gate exposure		7 x 2	low
B104	45-5-2813	sao	1		horse training track and adjacent spoil		100 x 10	low
B112	45-5-2788	sao	3		stock scar	10 x 1	20 x 1	moderate
B136		sao		1	vehicle track		20 x 7	

sao = surface artefact occurrence

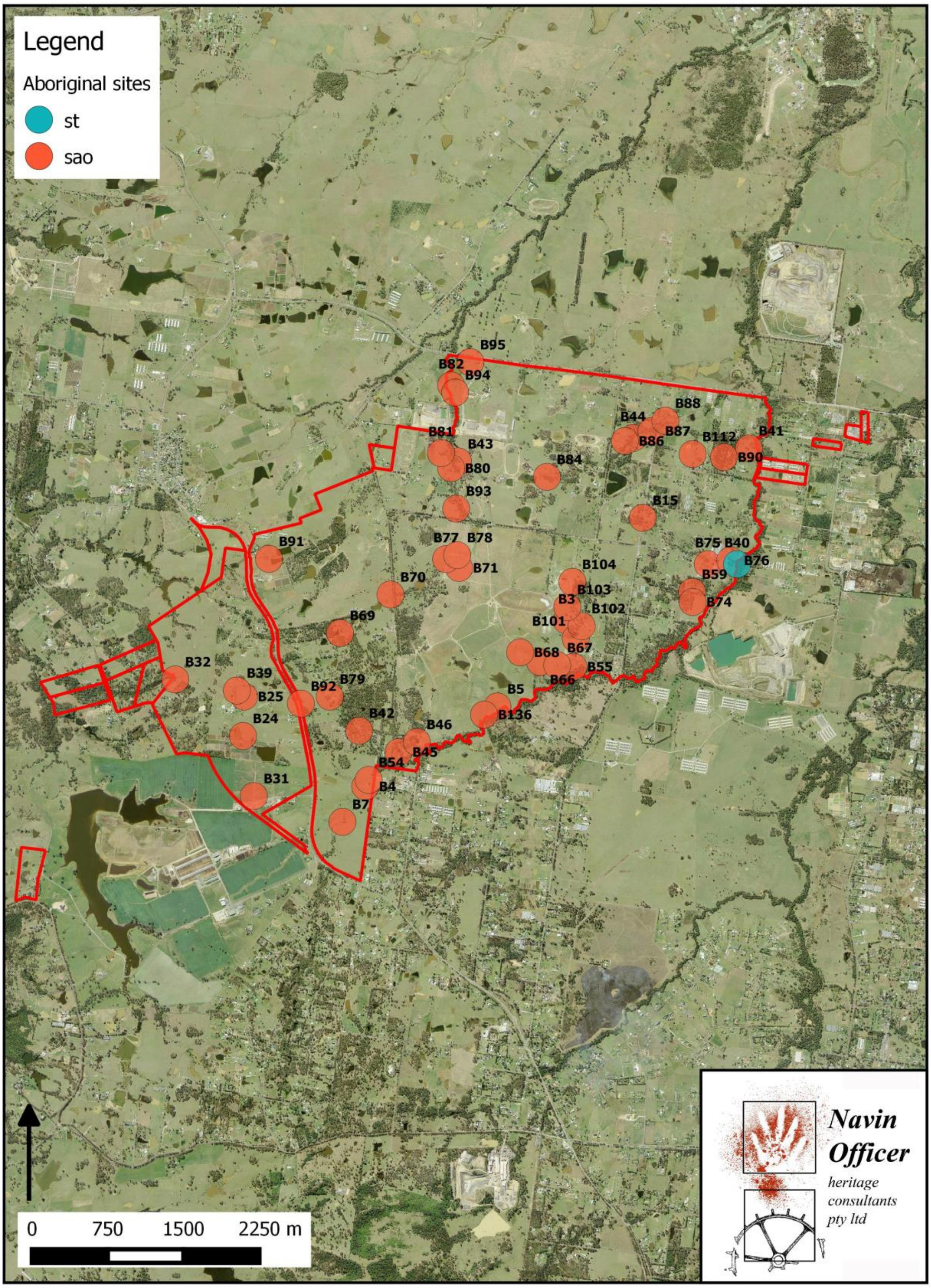


Figure 5.6 General locations of previously recorded Aboriginal sites within the airport site (sao = surface artefact occurrence, st = scarred tree). *Only generalised site locations are shown for this unrestricted access version of the report.*

6. Results of Archaeological Investigation

6.1 Survey and Test Excavation Locations

Survey

A number of previously recorded sites were inspected as part of reconnaissance coverage across the airport site, and a small number of surface artefact occurrences were recorded during the systematic inspection of potential test excavation locations. These recordings and inspections are presented in section 6.2.1.

Test Excavation

Archaeological test excavations were conducted at 13 of the 38 pre-selected potential test locations.

Four of these locations were paired to make a total of eleven test locations.

Test locations are shown in Figure 6.1.

Ten test pits (each 1 x 0.5 m, and totalling 5 m^2) were conducted at each test location (TL), with the exception of 26/27 where 14 pits were conducted. The extra pits at TL26/27 were a response to the extensive fill encountered at this location.

6.2 Site Recordings

Twenty-three new recordings of Aboriginal sites were made as a consequence of this assessment. These comprised:

- nine recordings with surface artefacts only (B113 – B120 and B122); and
- fourteen recordings where subsurface artefacts were confirmed through test excavation (B121, B123 - B135).

Within the latter category, one site also included surface artefacts (B121 at TL9).

One previously recorded site was subject to test excavation which confirmed the presence of subsurface artefacts (B88, AHIMS no. 45-5-2665, at TL26/27).

Five of the test locations revealed subsurface artefact occurrences which were recorded as two separate sites, due to micro-topographic divisions and/or a distance of greater than 100 metres (refer to Section 6.2.2).

Map grid references for these recordings are provided in Appendix 2.

A summary of all site recordings, based on surface and subsurface evidence, is provided in Table 6.2.

The location of all site recordings made as a result of this assessment are shown in Figure 6.2.

The location of all site recordings, including the 1997 EIS recordings, are shown in Figure 6.19.

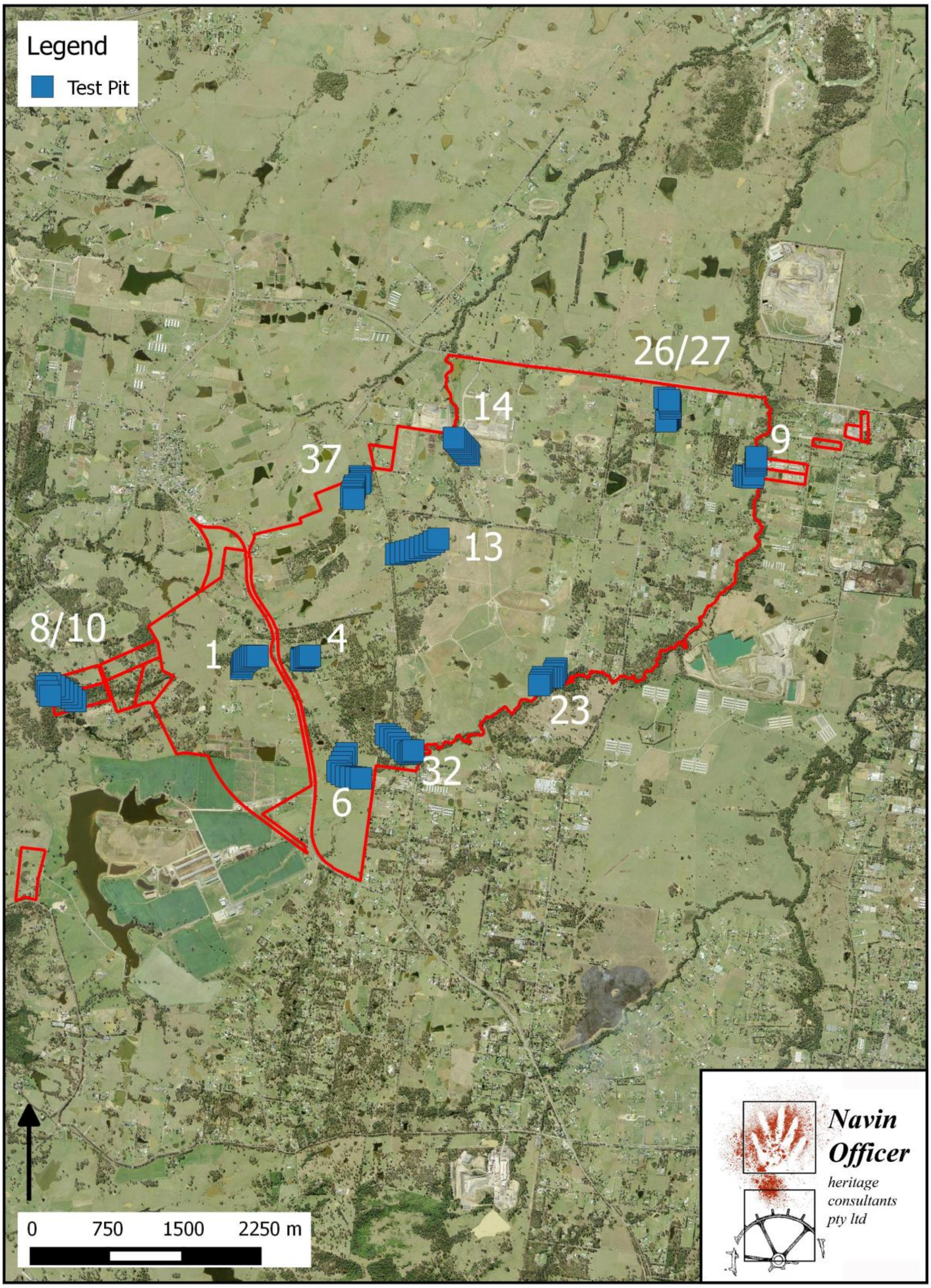


Figure 6.1 Approximate test excavation locations (large numbers) and pit locations (blue squares). Refer to Appendix 5 for large scale mapping. *Only generalised locations are shown for this unrestricted access version of the report.*

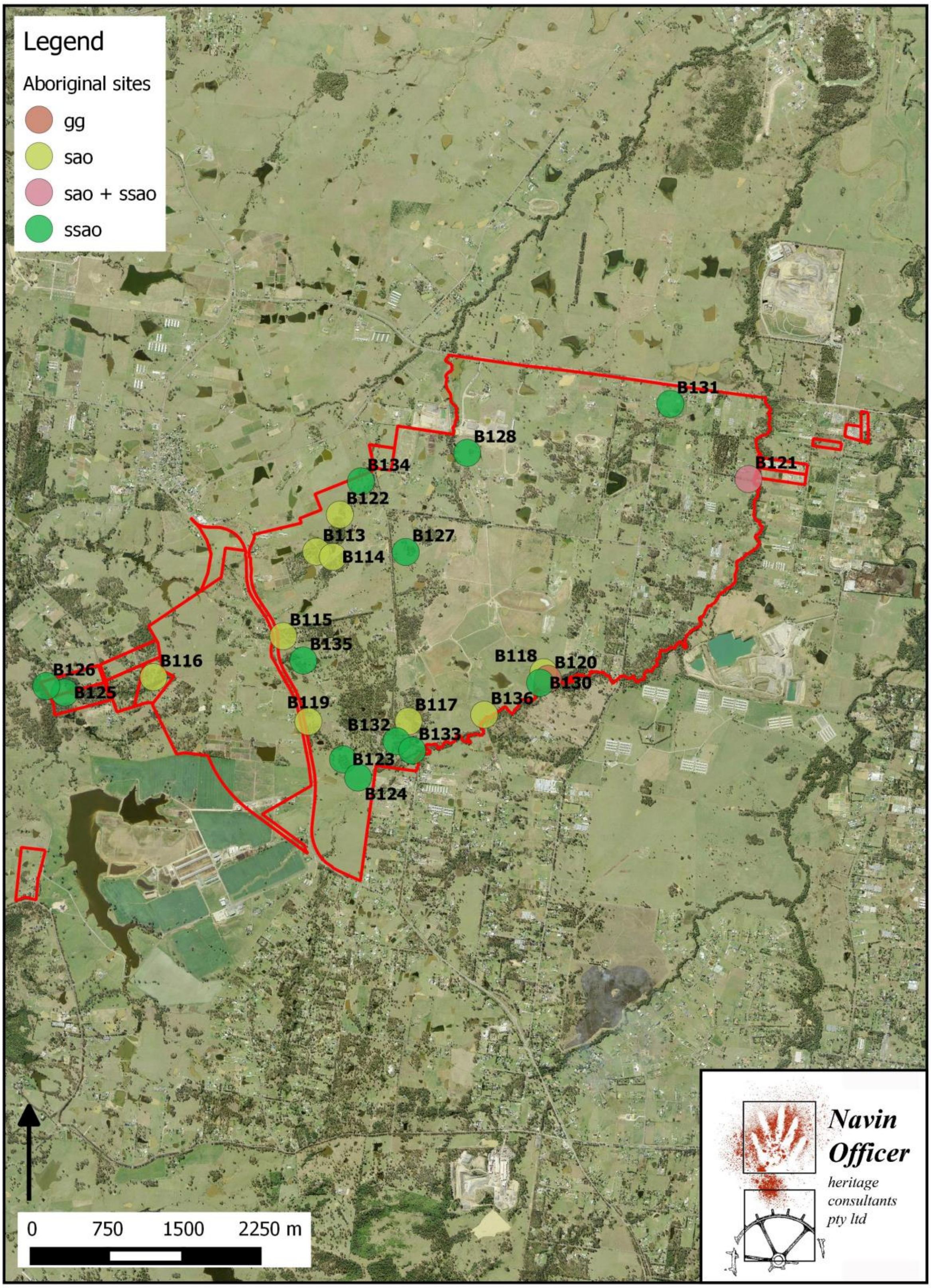


Figure 6.2 General location of sites recorded as a result of surface survey and subsurface investigation undertaken for this assessment (gg = grinding grooves, sao = surface artefact occurrence, ssao = sub-surface artefact occurrence). *Only generalised site locations are shown for this unrestricted access version of the report.*

6.2.1 Surface recordings

Site Re-inspections

B8 – Possible Aboriginal scarred tree (AHIMS site no. 45-5-2634)

The AHIMS site location for this recording (*GDA 288225.6245690)* was inspected by Australian Museum Consulting (AMC) in 2014 (AMC 2014). Although no trees were found to be present in the registered location, an isolated paddock tree was noted 35 m to the southeast which displayed extensive scarring. The tree is a Grey Box (*Eucalyptus macrocarpa*) standing approximately 18 m high, and is approximately two metres in girth at approximately 1.5 m high (Figure 6.3).

AMC noted that it was no longer possible to identify the scar as being cultural in origin. Bark had been removed from the tree to a height of approximately 1.6 m around 80 per cent of the trunk, probably as a result of impact with cattle, and it is no longer possible to identify the shape of the originally recorded scar (AMC 2014:53).

This tree was also inspected for the current assessment and the AMC interpretation that the evidence for Aboriginal scarring was now indeterminate was confirmed. Further research, including reference to the original B8 field recording (Figure 6.4), indicated that the tree under review could not be the subject of the original recording and that the original recorded map reference was in error.

Following correction of the original map reference, it can be confirmed that the B8 scarred tree is located outside of the airport site (*map grid reference removed from this version*). This site has therefore not been included in the assessment of the airport site.

Figure 6.3 The scarred tree situated 35 m southeast of the erroneous map grid reference for site B8 (scale: 10 cm intervals) (AMC 2014:Figure 5.17, p.53)

Figure 6.4 Image of the B8 scarred tree taken in December 1996; scale is just over 10 cm long (NOHC archive)

B40 – Possible Aboriginal scarred tree (AHIMS site no. 45-5-2630)

This tree was re-inspected by AMC in 2014 (AMC 2014:45). It is located on alluvial flats, at the eastern end of Longleys Road, on the break-of-slope of the western bank of Badgerys Creek, approximately 5 m east of the creek line. It occurs within a remnant margin of riparian vegetation.

AMC noted that the tree is approximately 10 metres east of a property fence line. It stands approximately 20 metres high, and its trunk was approximately 3.4 m in girth at approximately 1.5 m high. The tree is a Forest Redgum (*Eucalyptus tereticornis*) species.

The original recording of this tree in 1996 indicated that it was in very poor condition with a partially hollow and unstable trunk, a missing crown, and evidence of stock damage and insect attack. The original scar surface was partially missing and termite activity was noted (NOHC 1997, AHIMS site card attachment).

The scar was originally recorded with the following traits (NOHC 1997):

Aspect:	west
Length (excl. regrowth):	3.0 metres
Length (incl. regrowth):	3.3 metres
Width (excl. regrowth):	60 centimetres
Width (include. regrowth):	80 centimetres
Regrowth (max. width):	15 centimetres
Regrowth (max. depth):	17 centimetres
Height above ground:	base of inside scar 0 centimetres base of regrowth 0 centimetres

AMC noted that when the current condition of the tree was compared with the 1996 EIS survey photograph (Figure 6.5), it was clear that significant damage had occurred to that portion of the heartwood in the area of the scar. The site was located within a fenced margin of riparian vegetation adjacent to the creek bank and was not considered easily accessible, or exposed to stock activity.

Figure 6.5 Photo of the B40 scarred tree taken in 1996 (NOHC archive)

Figure 6.6 View of B40 scarred tree looking southeast in 2014 (AMC 2014:Figure 5.2, p.45).

Figure 6.7 View of unoccluded section of scar on B40, looking southeast (AMC 2014:Figure 5.3, p.45).

B136 – surface artefact occurrence

This recording of a single surface artefact was made by AMC in 2014 and ascribed to previously recorded site B5 (AHIMS site no. 45-5-2637). Following a refinement of the 1997 map grid reference for B5, based on original recording data, it has been determined that the AMC find is located more than 100 metres from the original B5 recording. As a consequence, this is considered to be a new recording of a separate site and has been designated as B136.

The site was described by AMC as an isolated silcrete artefact, on a waning lower slope, located within a vehicle track adjacent to a corner post of the property boundary, approximately 30-40 metres west of Badgerys Creek.

At the time of the recording the adjacent paddock was being ploughed, and the artefact location had been impacted by heavy vehicle access (Figure 6.8).

Based on the basal slope context of this find, in relative proximity to Badgerys Creek, this site is considered to have moderate subsurface archaeological potential away from exposures and eroded surfaces.

Artefact description:

1. red silcrete flake, 29 x 20 x 8 mm

Figure 6.8 General location of artefact find (by scale) at site B136, looking west (AMC 2014:Figure 5.25, p.59)

New Recordings

B113 – surface artefact occurrence

This recording consists of an open context artefact occurrence of at least 20 surface artefacts exposed along an eroded vehicle track and dam wall. The artefacts are situated on a low gradient minor (first order) spurline, and low rise, situated between and just upstream of the confluence of two second order streamlines (tributaries of Cosgroves Creek). This site is situated in a basal slope valley context (Figure 6.9).

This site is located at potential test location 34. The artefacts were located over an area of approximately 150 x 30 m. Subsurface archaeological potential away from exposures and eroded surfaces is assessed to be high.

Artefacts:

1. grey brown banded chert flake, 36 x 26 x 9 mm
2. brown banded chert flaked piece, 26 x 19 x 8 mm
3. red silcrete flake, 20 x 12 x 3 mm
4. grey brown silcrete flake, 20 x 9 x 7 mm
5. quartz flaked piece, 11 x 6 x 4 mm
6. possible axe, material may be sandstone, 116 x 87 x 30 mm

Figure 6.9 General view of eroded track at site B113 looking northeast (upslope)

B114 – surface artefact occurrence

This recording consists of an open context artefact occurrence of at least ten surface artefacts exposed along an eroded track and creek edge. The artefacts are situated on low gradient slopes adjacent to, and the western banks of, a secondary order streamline (a tributary of Cosgroves Creek). This site is situated in a basal slope valley context.

This site is located at potential test location 33. The artefacts were located over an area of approximately 110 x 20 m.

Subsurface archaeological potential away from exposures and eroded surfaces is assessed to be high.

Artefacts:

1. cream chert flake retouch, 12 x 11 x 4 mm
2. red silcrete flake, 10 x 13 x 2 mm
3. pink silcrete broken flake, 20 x 15 x 3 mm

B115 – surface artefact occurrence

This recording consists of an open context artefact occurrence of at least 20 artefacts exposed within a disturbed area in a former church yard. The church building has been demolished and the graves relocated. These past actions may have been the source of disturbance which have caused the artefacts to be exposed on the current ground surface. An alternative, though less likely possibility, is that the artefacts were imported onto the site in fill used to back fill graves following recovery of grave material.

The artefacts are situated on the crest of a prominent fourth order ridgeline, where it intersects with a major watershed fifth order ridgeline (Figure 6.10). The ridge has formed from a basaltic dyke.

The site is located at potential test location three. The artefacts were located over an area of approximately 5 x 5 m. Subsurface archaeological potential away from exposures and disturbed ground is assessed to be high.

Artefacts:

1. quartz flake, 17 x 5 x 6 mm
2. quartz flake, 12 x 8 x 5 mm
3. quartz flake, 15 x 10 x 4 mm
4. quartz flake, 12 x 8 x 4 mm
5. quartz flake, 10 x 9 x 2 mm
6. quartz flake, 9 x 10 x 1 mm

Figure 6.10 General view of location of site B115 looking south

B116 – surface artefact occurrence

This recording consists of an open context artefact occurrence of at least two artefacts exposed on an eroded vehicle track which steeply traverses low to moderately-graded mid slopes on the side of a spurline. The site is situated upslope of a dam which impounds a second order streamline (tributary of Duncans Creek).

The site is located adjacent to and downslope of potential test location seven. The two noted artefacts were located approximately five metres apart. Subsurface archaeological potential away from exposures and eroded surfaces is assessed to be low.

Artefacts:

1. quartz flake, 17 x 13 x 5 mm
2. cream chert broken flake, 20 x 10 x 3 mm

Figure 6.11 General view of location of site B116 looking north (upslope)

B117 - surface artefact occurrence

This recording consists of an open context artefact scatter of at least three surface artefacts exposed in erosion scalds along a low gradient crest of a (first order) minor spurline. The exposures are situated along the edge of a group of trees. The spurline crest faces south and descends to a narrow portion of the Badgerys Creek valley floor. This site is situated in a mid-slope valley context (Figure 6.12).

The site is located within potential test location 15. The artefacts were located approximately eight metres apart. Subsurface archaeological potential away from exposures and eroded surfaces is assessed to be high.

Artefacts:

1. black basalt flake, 26 x 15 x 7 mm
2. basalt hammerstone, 36 x 27 x 12 mm
3. red silcrete flake, 18 x 13 x 6 mm

Figure 6.12 General view of location of site B117 looking north (upslope)

B118 – surface artefact occurrence

This recording consists of an open context artefact occurrence of at least two surface artefacts exposed on a recently ploughed track on the southern edge of a ploughed field (Figure 6.13). This site is situated just above the break-of-slope of a broad crest of a third order ridgeline. It is approximately 150 metres north of Badgerys Creek.

This site is situated to the west of potential location 23. The artefacts were located approximately one metre apart. Subsurface archaeological potential is assessed to be moderate, although repeated ploughing of this landform may have significantly disturbed the vertical context of subsurface artefacts.

Artefacts:

1. quartz flake 25 x 17 x 5 mm
2. quartz flake 27 x 15 x 6 mm

Figure 6.13 General view of B118 looking northeast

B119 - surface artefact occurrence

This recording consists of an open context artefact occurrence of at least two artefacts exposed in a scoured area on the eastern side of a gate situated between a house paddock and the paddock behind (to the east). The site is located approximately 50 metres east of The Northern Road. The artefacts are situated on a minor (first order) spurline located between, and just upstream of, the confluence of a third and a second order streamline (tributaries of Badgerys Creek).

This site is situated in a basal slope valley context. Subsurface archaeological potential away from exposures and eroded surfaces is assessed to be moderate to high.

Artefact:

1. yellow chert flake, 35 x 27 x 10 mm

B120 – Grinding grooves

This recording consists of at least four Aboriginal grinding groves located on a series of small sandstone outcrops situated on, and just below, the break-of-slope of a mid-valley context ridge-side bench. The bench is relatively narrow (around 40 metres wide), faces south, and extends for approximately 400 metres along the middle portion of a third order ridgeline which rises 26 m above the creek. The bench is situated 14 m above and 100 metres to the north of Badgerys Creek (Figure 6.14).

The grinding grooves are located on a discontinuous and low surface outcrop of Minchinbury sandstone which is mostly exposed on the steep slope immediately downslope of the bench. There are at least four grooves of definite Aboriginal origin and two others of probable Aboriginal origin.

The grooves are located on three separate sandstone outcrops, two with one definite groove each and the (western most) third with two definite and two probable grooves (Figures 6.15, 6.16 and 6.17). The three sandstone outcrops form part of an east-west aligned group of low, near ground level outcrops, and extend across a distance of 33 m.

This site is located in test location 23. A number of test pits were situated on the level ground of the ridge-side bench in relative proximity to the grinding grooves. No subsurface artefacts were detected on the bench. One stone artefact was detected at this test location, and this was situated on basal slopes 4.5 m above Badgerys Creek (site B130).

Figure 6.14 General view of site B120 grinding groove site, looking west. Note alignment of low sandstone exposures (left) along break-of-slope.

Figure 6.15 The eastern most B120 sandstone exposure with grinding groove (left of scale)

Figure 6.16 the middle B120 sandstone exposure with grinding groove (right of scale)

Figure 6.17 The western most B120 sandstone outcrop with at least two definite and two probable grinding grooves

B121 – surface and subsurface artefact occurrence

This recording consists of an open context artefact occurrence of at least two surface artefacts. The site is located on alluvial flats adjacent to Badgerys Creek, in a valley floor context. The artefacts, which were approximately five metres apart, were visible in erosion scalds in a road reserve at the eastern end of Pitt Street (Figure 6.18). The exposures are adjacent to a gate on the northern side of the easement.

The surface artefacts are located at the southern end of test location nine.

Artefacts:

1. red silcrete flake, 26 x 15 x 7 mm
2. red silcrete flake, 12 x 8 x 5 mm

Figure 6.18 General view of the location of site B121 (test location 9), looking east from test pit one towards Badgerys Creek (in distance)

B122 - surface artefact occurrence

This recording consists of an open context artefact occurrence of a single surface artefact exposed on the wall of an agricultural dam which impounds a third order streamline (tributary of Cosgroves Creek).

This site is situated in a valley floor context, and in relative proximity to the natural course of the creek line. The subsurface archaeological potential away from the disturbed ground of the dam wall and impoundment is assessed to be moderate to high.

The site is located between potential test locations 36 and 37.

Artefact:

1. red silcrete flake, 20 x 16 x 7 mm

6.2.2 Subsurface recordings

Aboriginal artefacts were recovered from ten of the eleven test locations; the exception was TL1.

Thirty-nine (34%) of the 114 test pits contained Aboriginal artefacts.

Three test locations included only one test pit with artefacts (TL4, 13, and 23), and three included more than five test pits with artefacts (TL6, 9 and 26/27).

Ninety-one Aboriginal artefacts were recovered from 39 test pits.

The highest number of artefacts from a test location was 36.

The highest number of artefacts from a single test pit was seven from pit 9, TL9.

A summary of test location and test pit artefact numbers is provided in Table 6.1.

Some test locations with recovered artefacts have been recorded as more than one site recording, due to landform and distance variables. These divisions are presented in Table 6.2.

Table 6.1 Summary of artefact recovery data from test locations and test pits

test locn	pit	no. of artefacts	spit(s)	total pit depth (cm)	areal incidence of artefacts by pit (artefacts per m^2)	broad scale landform	fine scale landform
1	1	0	1	10	0	major watershed ridgeline	crest
	2	0	1	5	0	major watershed ridgeline	crest
	3	0	1	10	0	major watershed ridgeline	crest
	4	0	1	10	0	major watershed ridgeline	crest
	5	0	1	5	0	major watershed ridgeline	crest
	6	0	1	10	0	major watershed ridgeline	crest
	7	0	1	6	0	major watershed ridgeline	crest
	8	0	1	10	0	major watershed ridgeline	crest
	9	0	1	10	0	major watershed ridgeline	upper slope
	10	0	1	7	0	major watershed ridgeline	upper slope
total	*0 of 10*	*0*					
4	1	0	1	10	0	secondary watershed ridgeline	crest
	2	0	1	10	0	secondary watershed ridgeline	crest
	3	0	1	10	0	secondary watershed ridgeline	crest
	4	0	3	30	0	secondary watershed ridgeline	crest
	5	1	2	23	2	secondary watershed ridgeline	crest
	6	0	1	10	0	secondary watershed ridgeline	crest
	7	0	1	10	0	secondary watershed ridgeline	crest
	8	0	1	10	0	secondary watershed ridgeline	crest
	9	0	1	10	0	secondary watershed ridgeline	crest
	10	0	1	10	0	secondary watershed ridgeline	crest
total 4	*1 of 10*	*1*					
6	1	1	2	20	2	mid slope	minor spur crest
	2	3	2	15	6	mid slope	minor spur crest
	3	2	2	17	2	basal slope	slope
	4	1	3	30	2	basal slope	slope
	5	0	3	25	0	valley floor	alluvial flats
	6	0	3	25	0	valley floor	alluvial flats
	7	0	3	25	0	valley floor	alluvial flats
	8	0	3	25	0	valley floor	alluvial flats
	9	2	3	25	4	valley floor	alluvial flats
	10	1	4	35	2	valley floor	alluvial flats
total 6	*6 of 10*	*10*					
8/10	1	0	2	14	0	mid slope	minor spur crest
	2	0	2	20	0	mid slope	minor spur crest
	3	1	2	16	2	mid slope	minor spur crest
	4	1	1	20	2	mid slope	minor spur crest
	5	0	2	16	0	mid slope	minor spur crest
	6	0	4	40	0	basal slope	minor spur crest
	7	1	5	50	2	valley floor	alluvial flats

test locn	pit	no. of artefacts	spit(s)	total pit depth (cm)	areal incidence of artefacts by pit (artefacts per m^2)	broad scale landform	fine scale landform
	8	0	3	27	0	valley floor	alluvial flats
	9	1	4	35	2	valley floor	alluvial flats
	10	0	5	50	0	valley floor	alluvial flats
total	*4 of 10*	*4*					
9	1	0	4	35	0	basal slope	slope
	2	1	3	30	2	basal slope	slope
	3	6	2	20	12	valley floor	alluvial flats
	4	6	5	50	12	valley floor	alluvial flats
	5	4	5	45	8	valley floor	alluvial flats
	6	1	4	35	2	valley floor	alluvial flats
	7	3	4	37	6	valley floor	alluvial flats
	8	5	3	30	10	valley floor	alluvial flats
	9	7	4	35	14	valley floor	alluvial flats
	10	3	4	34	6	valley floor	alluvial flats
total 9	*9 of 10*	*36*					
13	1	0	2	25	0	secondary spurline crest	knoll
	2	0	1	10	0	secondary spurline crest	crest
	3	1	1	10	2	secondary spurline crest	crest
	4	0	1	10	0	secondary spurline crest	crest
	5	0	2	30	0	secondary spurline crest	shoulder
	6	0	1	10	0	secondary spurline crest	shoulder
	7	0	1	4	0	secondary spurline crest	shoulder
	8	0	2	20	0	secondary spurline crest	shoulder
	9	0	2	18	0	secondary spurline crest	shoulder
	10	0	2	15	0	secondary spurline crest	shoulder
total 13	*1 of 10*	*1*					
14	1	4	2	29	8	mid slope	minor spur crest
	2	0	3	25	0	basal slope	minor spur crest
	3	2	3	30	4	basal slope	minor spur crest
	4	0	2	20	0	basal slope	minor spur crest
	5	0	2	20	0	basal slope	minor spur crest
	6	0	3	25	0	valley floor	elevated rise
	7	0	3	25	0	valley floor	elevated rise
	8	2	3	30	4	valley floor	elevated rise
	9	0	2	20	0	valley floor	elevated rise
	10	0	4	40	0	valley floor	elevated rise
total 14	*3 of 10*	*8*					
23	1	0	2	15	0	upper slope	break-of-slope
	2	0	1	12	0	upper slope	slope
	3	0	2	20	0	upper slope	slope
	4	0	3	30	0	mid slope	bench
	5	0	2	20	0	mid slope	minor spur crest
	6	0	2	20	0	mid slope	minor spur crest
	7	0	3	25	0	mid slope	minor spur crest
	8	0	4	40	0	mid slope	fan
	9	1	4	40	2	basal slope	fan
	10	0	4	40	0	basal slope	fan
total 23	*1 of 10*	*1*					

test locn	pit	no. of artefacts	spit(s)	total pit depth (cm)	areal incidence of artefacts by pit (artefacts per m^2)	broad scale landform	fine scale landform
26/27	1	0	3	30	0	floor	alluvial flats
	2	4	3	30	8	valley floor	alluvial flats
	3	0	2	20	0	floor	alluvial flats
	4	0	3	30	0	floor	alluvial flats
	5	3	3	34	6	valley floor	alluvial flats
	6	5	2	20	10	valley floor	alluvial flats
	7	3	2	20	6	valley floor	alluvial flats
	8	1	2	20	2	valley floor	alluvial flats
	9	0	3	30	0	basal slope	slope
	11	1	2	20	2	upper slope	slope
total 26/27	*6 of 14*	*17*					
32	1	0	2	20	0	mid slope	minor spur crest
	2	0	2	20	0	mid slope	minor spur crest
	3	1	2	15	2	basal slope	minor spur crest
	4	1	2	25	2	basal slope	minor spur crest
	5	0	3	25	0	basal slope	minor spur crest
	6	0	2	20	0	valley floor	alluvial flats
	7	0	3	28	0	valley floor	alluvial terrace
	8	0	1	10	0	valley floor	alluvial terrace
	9	2	1	15	4	valley floor	alluvial terrace
	10	3	2	26	6	valley floor	alluvial terrace
total 32	*4 of 10*	*7*					
37	1	1	6	60	2	valley floor	elevated rise/terrace
	2	2	4	40	4	valley floor	elevated rise/terrace
	3	0	4	40	0	valley floor	elevated rise/terrace
	4	2	4	35	4	valley floor	elevated rise/terrace
	5	1	4	37	2	valley floor	elevated rise/terrace
	6	0	5	50	0	valley floor	elevated rise/terrace
	7	0	3	30	0	valley floor	elevated rise/terrace
	8	0	4	35	0	valley floor	elevated rise/terrace
	9	0	3	30	0	valley floor	elevated rise/terrace
	10	0	3	33	0	basal slope	minor spur crest
total 37	*4 of 10*	*6*					

Table 6.2 Summary of Aboriginal heritage sites recorded in the airport site as part of this assessment (refer to Appendix 2 for map grid references)

Site No.	Site type	No. surface stone artefacts (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Dimensions of ground surface exposure (2015)
B113	sao	20		eroded track and dam wall	150 x 30
B114	sao	10		eroded track, creek edge	110 x 20
B115	sao	20		erosion and disturbance	5 x 5
B116	sao	2		track	
B117	sao	2		erosion scald	
B118	sao	2		edge of ploughed field	
B119	sao	2		gate exposure	
B120	gg	at least 4 grooves		sandstone outcrop	
B121	sao +ssao	3	TL9 pits 2-10	track/gate exposure	
B122	sao	1		dam wall	
B123	ssao		TL6 pits1-4		
B124	ssao		TL6 pits 9&10		
B125	ssao		TL8/10 pits 3&4		
B126	ssao		TL8/10 pits 7&9		
B127	ssao		TL13 pit 3		
B128	ssao		TL14 pits 1&3		
B129	ssao		TL14 pit 8		
B130	ssao		TL23 pit 9		
B131	ssao		TL26/27 pit 11		
B132	ssao		TL32 pits 3&4		
B133	ssao		TL32 pits 9&10		
B134	ssao		TL37 pits 1,2,4 & 5		
B135	ssao		TL4 pit 5		

sao – surface artefact occurrence

ssao – sub-surface artefact occurrence

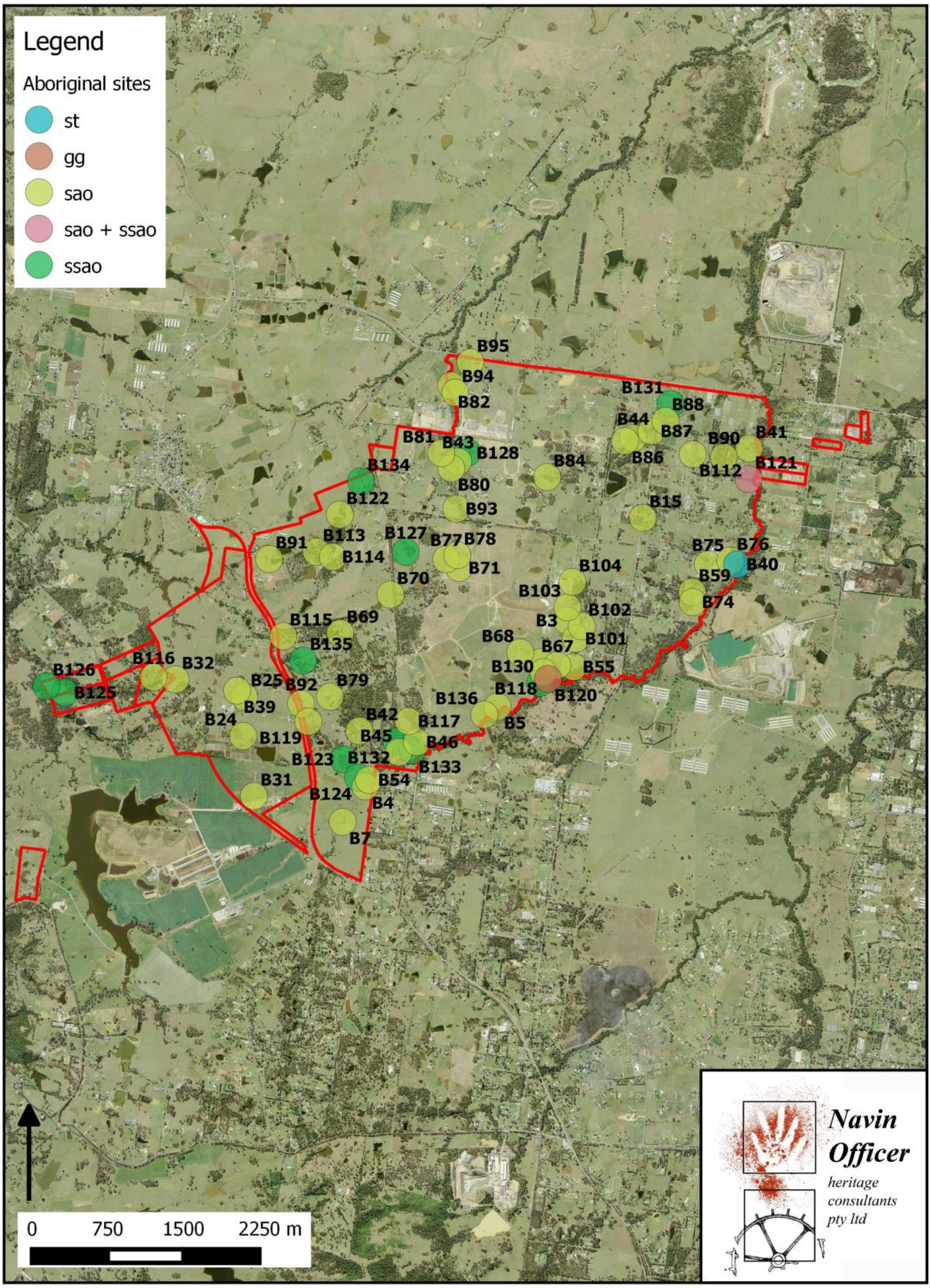


Figure 6.19 General location of all Aboriginal sites recorded to date in the airport site (gg = grinding grooves, sao = surface artefact occurrence, ssao = sub-surface artefact occurrence). *Only generalised site locations are shown for this unrestricted access version of the report.*

6.3 Analysis

6.3.1 Overview of the artefact assemblage, by test location

In this section, artefacts from each excavated test location (shortened to 'location' throughout this report) are pooled together, so that each location is treated as a single data set. This enables the assemblages recovered from the different excavated locations to be compared.

The sample of artefacts recovered from the study location is dominated by unretouched flakes, with retouched flakes, cores and flaked pieces also present (Table 6.3). No ground artefacts were recovered from test excavations. The ratio of retouched flakes to unretouched flakes is quite high relative to typical stone artefact assemblages in south east Australia, with 11 retouched flakes and 76 unretouched flakes. Retouched flakes make up 12 per cent of the total assemblage. As a point of comparison, a number of excavated sites documented in the Mangrove Creek catchment all contained assemblages in which retouched flakes made up less than one per cent (Attenbrow 2004, table 4.7).

The assemblage is distributed unevenly between the different locations, with a small number of the locations yielding high numbers of artefacts. The majority of locations yielded fewer than ten artefacts each. The notably rich locations were location nine (36 artefacts) and location 26/27 (17 artefacts). The same number of test pits (ten) were excavated in each of the locations, and so the number of artefacts recovered from each location is proportional to the average density of artefacts in that location. Comparing the total number of artefacts recovered from the different locations, in other words, is equivalent to comparing the average density of artefacts between the different locations. For example, location 14 has twice the density of artefacts as location 8/10 (8 artefacts and 4 artefacts in total, respectively).

The uneven distribution of artefacts between the different locations is clear when the total count of artefacts is plotted according to location (Figure 6.20). Plotting the locations in descending order of their artefact counts, reveals that the distribution of artefacts across the separate locations resembles a very strongly skewed normal distribution, or a Poisson distribution. The distribution of artefact counts between locations is consistent with what would be expected from a random sampling of a population that is sparsely and unevenly distributed. In such situations, the expected pattern of sample sizes is for the majority of samples to contain relatively low counts, with a small number of samples containing much higher counts. The distribution of sample sizes between the different test locations, therefore, is consistent with the distribution that would be expected when sampling a random and representative sample of a population of artefacts that is unevenly distributed across the landscape.

The sample of retouched flakes consists mainly of backed artefacts (Table 6.4). Backed artefacts are a common type of retouched flake in south east Australia, and it is not unusual for a stone artefact assemblage to have a high proportion of backed artefacts in its set of retouched flakes (Attenbrow 2010).

Backed artefacts are a distinctive artefact type, within which the artefacts display considerable internal homogeneity in their shape and patterns of retouch present, and which are distinctively different in shape and retouch patterns from other artefacts found in Australian sites. They are found across the continent, with the exception of the northern tip of West Australia, the northern half of the Northern Territory, and Cape York (Smith and Cundy 1985).

Similar artefacts are found in the Indian subcontinent, the Middle East, Europe and southern Africa, but it has not been established that backed artefacts in these regions have any relationship to the appearance of backed artefacts in Australia – at this stage it is generally thought that Aboriginal populations invented backed artefact technology independently of other prehistoric populations (Hiscock 2008).

Table 6.3 All stone artefacts recovered, by location and technological type

location	unretouched flake	retouched flake	core	flaked piece	row total
4	0	0	0	1	1
6	7	3	0	0	10
8/10	4	0	0	0	4
9	29	4	2	1	36
13	1	0	0	0	1
14	5	3	0	0	8
23	1	0	0	0	1
26/27	16	1	0	0	17
32	7	0	0	0	7
37	6	0	0	0	6
column total	76	11	2	2	**91**

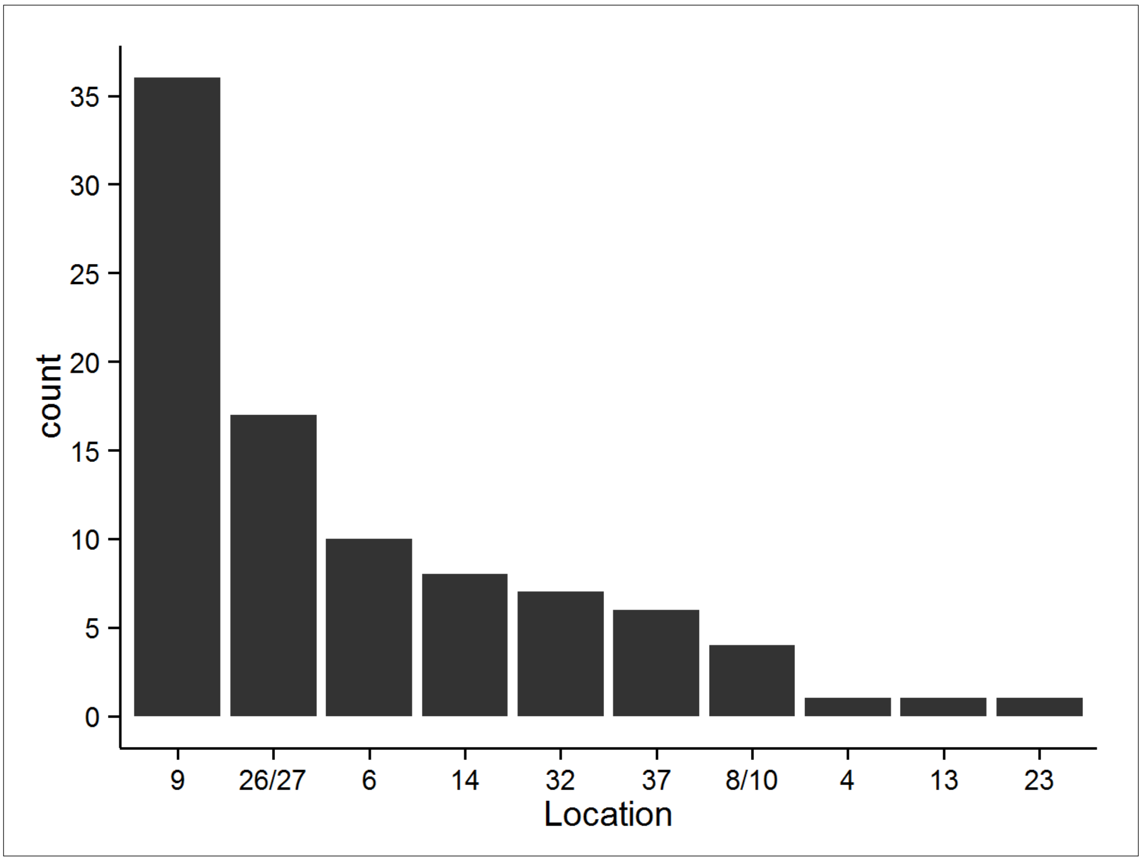


Figure 6.20 Count of stone artefacts by location

The backed artefacts recovered from the test excavations are subdivided into several different shapes: triangles, a crescent and trapezes are all present in the total assemblage (Figures 6.23 – 6.28). One backed artefact of indeterminate shape was recovered. Two woakwines were recovered: woakwines are backed artefacts on which the backing retouch is restricted to one end of the artefact.

One burin was recovered from location 14. A burin is a retouched flake with retouch scars that run along the margin (Noone 1938). The retouch scars can be initiated from existing surfaces on the flake, from break surfaces or from surfaces prepared through previous retouch (Barton et al. 1996; Tomášková 2005). Although there has been a long history of assuming that burins were functional tools, used for engraving purposes (e.g. Stafford 1977), it has been demonstrated that in many contexts they served to produce flakes that could be recruited as tools, and had no functional use themselves (Barton et al. 1996; Cochrane et al. 2013; Hiscock 1993).

The burin recovered from location 14 has retouch scars travelling along one of its lateral margins, initiated from a break at the distal end of the flake (Figure 6.22). Several of these scars are step-terminated, and it is possible that the occurrence of these step terminations caused the reduction of the artefact to be ceased. Step terminations create a problem for flake removal, in that they make it likely that further flakes struck from the same platform will also step or hinge terminate (Macgregor 2005).

The remainder of the retouched flakes are flakes with amorphous retouch. Amorphous retouch refers to retouch that has not functioned to shape the artefact to conform to any implement type that is generally recognised by archaeologists. The two retouched flakes that fell into this category were both broken flake fragments. One was possibly a fragment of a backed artefact: the size and angle of retouch scars is consistent with retouch found on backed artefacts, but the artefact is too incomplete to be sure that it can be classified as a backed artefact.

Table 6.4 Retouched flakes recovered, by location and retouched artefact type

location	backed triangle	backed woakwine	backed crescent	backed indeterminate	backed trapeze	burin	retouched flake (other)	row total
6	1	0	0	0	1	0	1	3
9	0	2	1	1	0	0	0	4
14	1	0	0	0	0	1	1	3
26/27	0	0	0	0	1	0	0	1
column total	2	2	1	1	2	1	2	**11**

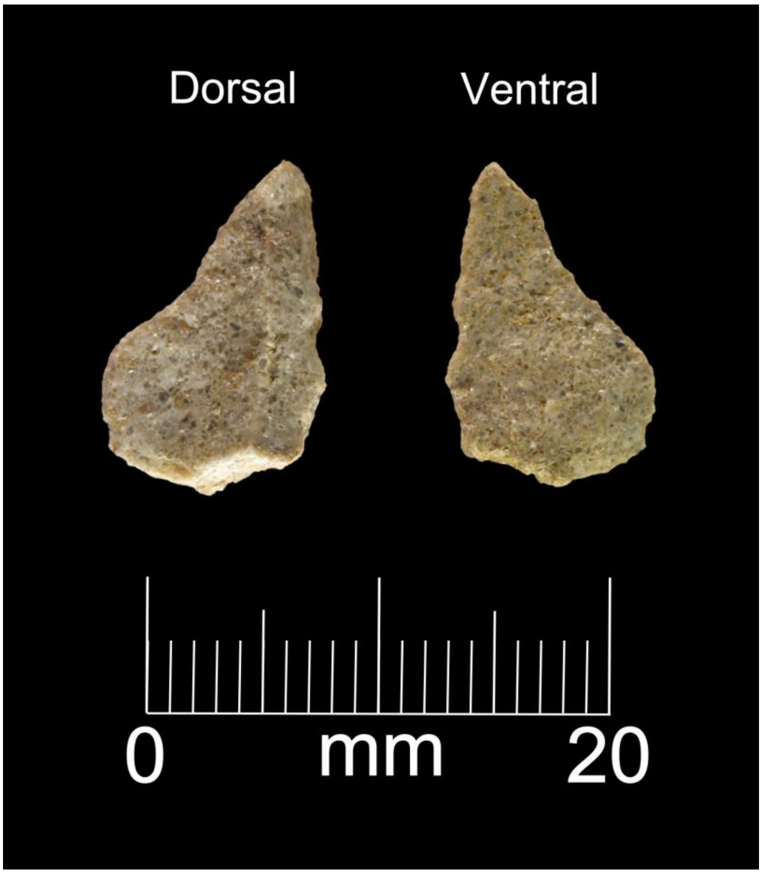


Figure 6.21 Silcrete retouched flake,
possibly a broken backed artefact, from Location 1

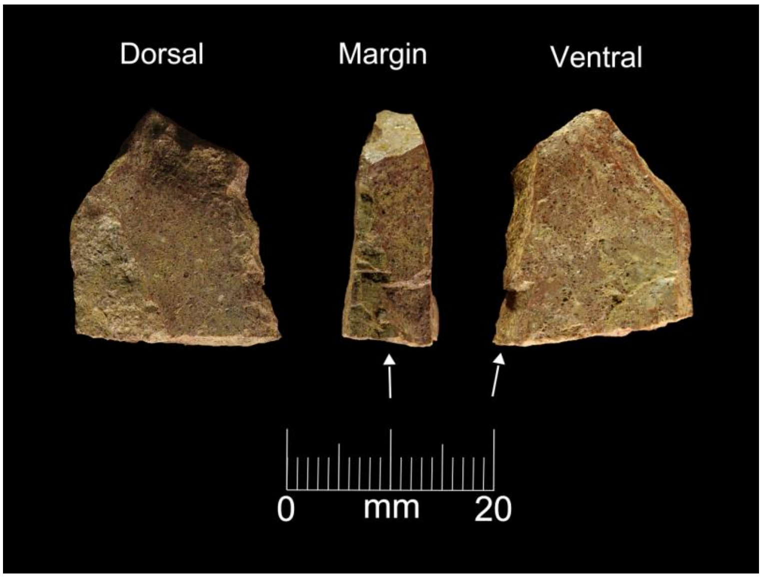


Figure 6.22 Silcrete burin from Location 14.
Arrows show burin flake scars

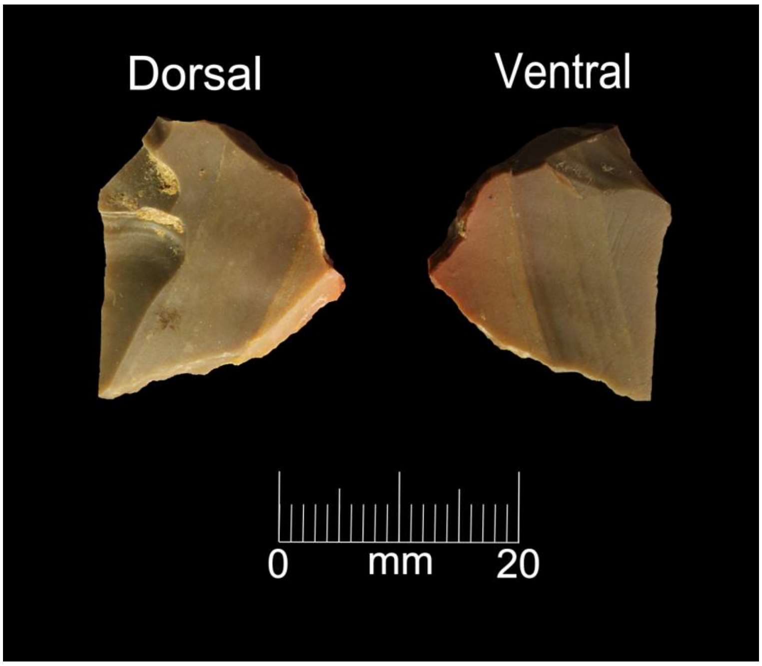


Figure 6.23 FGS backed triangle from location 14

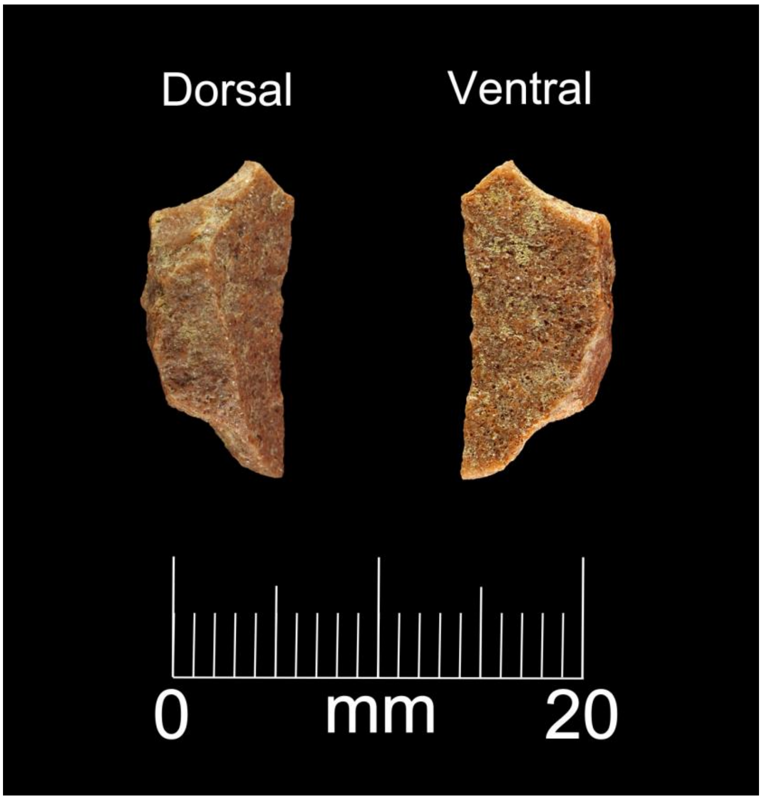


Figure 6.24 Silcrete backed trapeze from location 26/27

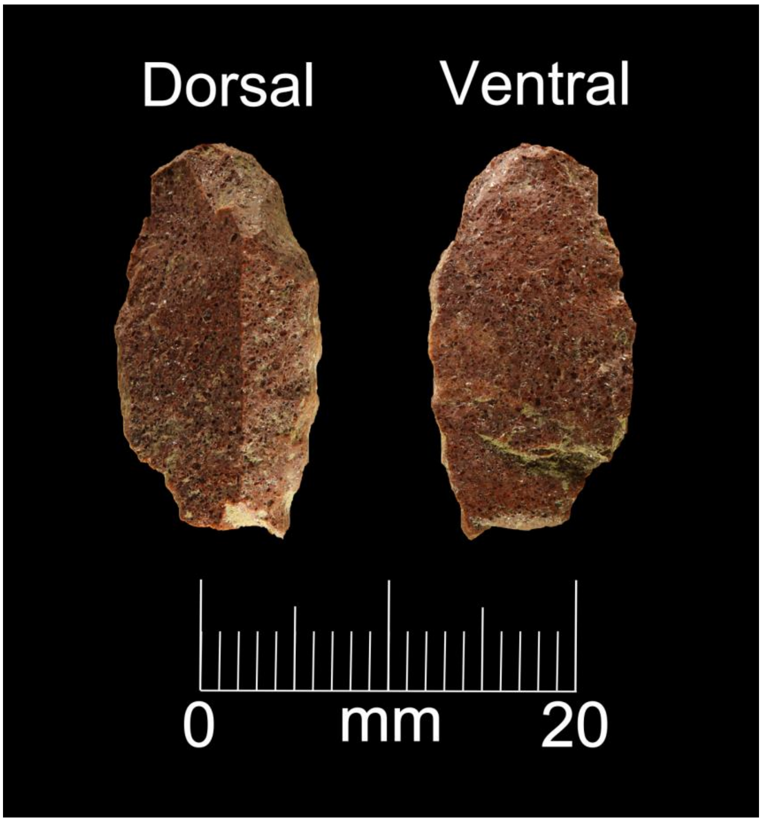


Figure 6.25 Silcrete broken backed artefact, indeterminate shape, from location 9

Figure 6.26 Silcrete backed woakwine from location 9

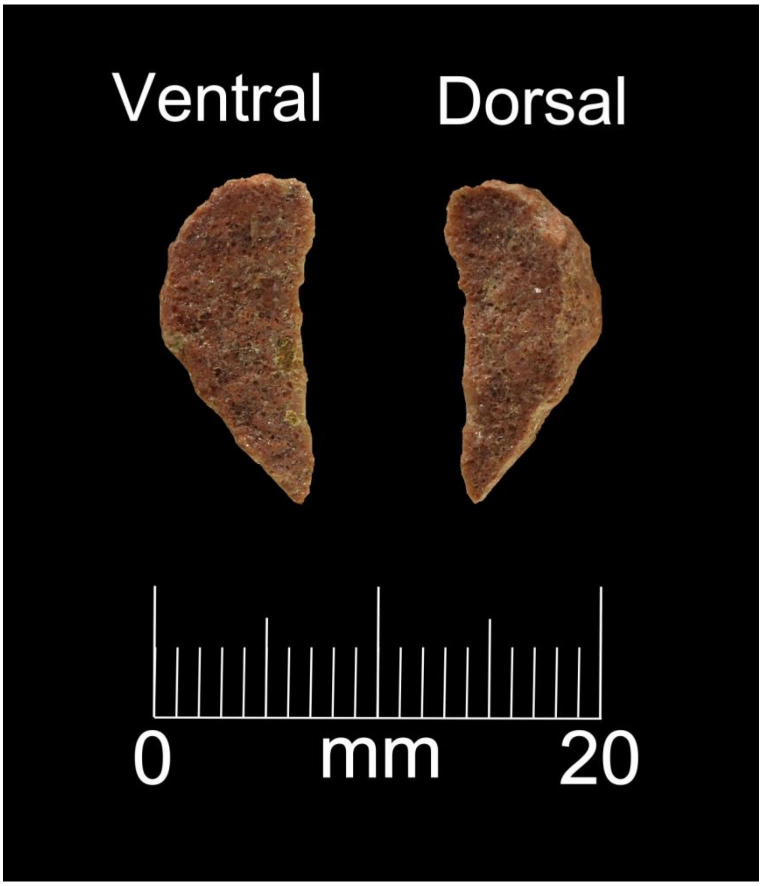


Figure 6.27 Silcrete backed crescent from location 9

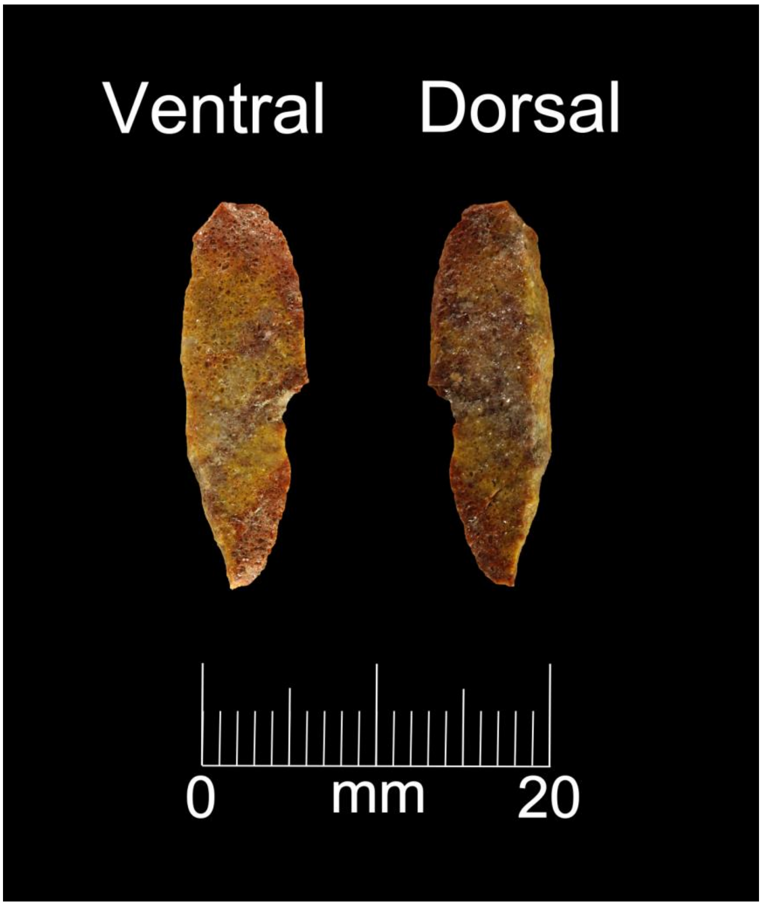


Figure 6.28 Silcrete backed woakwine from location 9

Four different raw material types were identified within the stone artefacts recovered:

- silcrete;
- vein quartz;
- igneous; and
- fine grained siliceous (FGS).

FGS is a category that encompasses all artefacts made of material in which no grain structure can be identified.

Silcrete is the material from which the majority of the assemblage of artefacts is made (Table 6.5). Silcrete artefacts make up the highest proportion of the assemblage from almost all of the individual locations.

Fine grained siliceous materials are the next most common material. FGS artefacts could be chert; fine grained sedimentary rock such as mudstone or redeposited volcanic ash; tuff; or fine grained metamorphics.

Quartz and igneous materials are present, with a small number of artefacts being made from these materials.

The proportion of materials is generally equivalent across the locations, with no statistically significant association between individual locations and the proportion of different materials recovered (Fisher's exact test, p=0.104).

Table 6.5 All stone artefacts recovered, by location and material

location	silcrete	FGS	quartz, vein	igneous	row total
4	0	1	0	0	**1**
6	4	4	2	0	10
8/10	2	1	1	0	4
9	28	8	0	0	36
13	0	1	0	0	1
14	4	4	0	0	8
23	1	0	0	0	1
26/27	15	1	0	1	17
32	6	1	0	0	7
37	4	2	0	0	6
column total	64	23	3	1	**91**

6.3.2 Overview of assemblage characteristics

In this section, artefacts recovered from all test pits and all locations are pooled together and examined as a single data set. This provides an overview of the complete sample of artefacts recovered during the test excavation program. The pooled data set is large enough to allow statistical testing of relationships that might exist between different artefact characteristics within the combined assemblage.

No detectable association exists between the material and technological type of stone artefacts (Fisher's exact test, p=0.365). The data provide no reason to conclude that the any material was used with higher frequencies in the production of some artefact types and not others. In other words, there is no evidence from the data that different artefact types are preferentially produced from different materials (Table 6.6).

Table 6.6 All stone artefacts recovered, by material and technological type

material	unretouched flake	retouched flake	core	flaked piece	row total
silcrete	54	9	1	0	64
FGS	18	2	1	2	23
quartz, vein	3	0	0	0	3
igneous	1	0	0	0	1
column total	76	11	2	2	**91**

No detectable association exists between breakage and material type (Fisher's exact test, p=0.68). The data do not indicate that different types of artefact have suffered different extents of damage (Table 6.7). More than half of the flakes (both unretouched and retouched) are broken fragments. Breakage of artefacts can occur during production, during use (if the artefact was used as a functional tool) or following discard. The proportion of broken artefacts in the assemblage could be indicative of a high frequency of breakage in any or all of these contexts.

The ratio of broken to complete artefacts is not unusual relative to other archaeological sites in south east Australia. The study location falls within the range of breakage frequencies commonly observed on open sites. The data do not indicate that the artefact assemblage from the study area is unusually undamaged and intact, or that the artefacts have suffered unusually high frequencies of artefact breakage.

Table 6.7 All artefacts recovered - by completeness and technological type

completeness	unretouched flake	retouched flake	core	flaked piece	row total
complete	28	6	2	2	38
proximal fragment	7	3	-	-	10
medial fragment	4	1	-	-	5
distal fragment	24	1	-	-	25
marginal fragment	5	0	-	-	5
LCS left	4	0	-	-	4
LCS right	4	0	-	-	4
column total	76	11	2	2	**91**

Examining flakes alone, the proportions of complete and broken artefacts are similar between material types (Table 6.8). There is no detectable association between material type and completeness category (Fisher's exact test, p=0.819). The data do not indicate that artefacts made of different materials have suffered different extents of damage.

Table 6.8 Flakes - by material and completeness

material	complete	proximal fragment	medial fragment	distal fragment	marginal fragment	LCS left	LSC right	row total
silcrete	25	7	3	18	3	3	4	63
FGS	6	3	2	7	1	1	0	20
quartz, vein	2	0	0	0	1	0	0	3
igneous	1	0	0	0	0	0	0	1
column total	34	10	5	25	5	4	4	**87**

The amount of cortex on the dorsal surfaces of flakes in an assemblage is indicative of the stage in the reduction process in which the flakes were produced (Marwick 2008). Assemblages of flakes produced early in the process of core reduction will have high proportions of their dorsal surfaces covered by cortex, while assemblages produced later in the core reduction process will have no cortex. The proportion of dorsal cortex on flakes was characterised using several categories recording both the amount and location of cortex on the dorsal surface (following Marwick 2008). In addition to this variable, the percentage of the dorsal surface covered in cortex was estimated for each flake, to the nearest ten percent.

Tertiary flakes make up the great majority of the assemblage of flakes, with cortex being vanishingly rare across all material types (Table 6.9). No detectable association exists between material and cortex distribution (Fisher's exact test, p=0.16). There is a significant association between material and dorsal cortex percentage (Kruskal-Wallis chi-squared=11.14, d.f.=3, p=0.011) however this is caused by the single igneous flake, which has a high percentage of dorsal cortex (Table 6.10). When this flake is removed, there is no significant association between material type and cortex percentage (Kruskal-Wallis chi-squared=0.615, d.f.=2, p=0.735). With the exception of the single igneous flake, therefore, the different materials show similar proportions of dorsal cortex on flake surfaces, with tertiary flakes being the dominant proportion of the sample of flakes of each material type.

The single igneous flake recovered from the test excavations indicates that igneous flakes in the study area were produced at an earlier stage in the reduction process than flakes made from other material types. The very small sample size of only one igneous flake, however, means that very little confidence can be placed in this inference. A larger sample of flakes would be required before robust inferences could be made on the differences in dorsal cortex on igneous flakes relative to flakes made from other materials.

The high frequency of tertiary flakes, and the generally low proportions of dorsal cortex on secondary flakes, is consistent with an assemblage produced in a situation where accessing sources of stone was costly. An assemblage of flakes produced under circumstances where obtaining replacement nodules of stone involves a cost (in terms of time or energy expended), would be expected to have a low frequency of cortex, as the nodules that people have to hand would be more intensively flaked and reduced. This could be the case if the study area is located at a substantial distance from the nearest sources of stone.

Table 6.9 Flakes recovered - by material and dorsal cortex distribution

material	tertiary	distal only	patch right	crescent left	primary	row total
silcrete	57	3	1	1	1	63
FGS	19	0	0	0	1	20
quartz, vein	3	0	0	0	0	3
igneous	0	0	1	0	0	1
column total	79	3	2	1	2	**87**

Table 6.10 Flakes - by material and dorsal cortex percentage

material	0	10	20	30	40	50	60	70	80	90	100	row total
silcrete	57	1	2	2	0	0	0	0	0	0	1	63
FGS	19	0	0	0	0	0	0	0	0	0	1	20
quartz, vein	3	0	0	0	0	0	0	0	0	0	0	3
igneous	0	0	0	0	0	0	1	0	0	0	0	1
column total	79	1	2	2	0	0	1	0	0	0	2	**87**

Flake platforms are mostly simple, single surfaces (Table 6.11). Multiple-surface and facetted platforms are quite frequent also. This could be indicative that the flakes in the assemblage have been produced from small, heavily reduced cores. Small, heavily reduced cores are more likely to have densely clustered surfaces, and striking flakes with multiple surfaces preserved on their platforms will be more common as a result of this.

Facetting platforms is generally employed as a strategy of reducing the risk of problems occurring during flake production (Whittaker 1994). The high frequency of facetted platforms in the assemblage could be indicative of a situation in which Aboriginal people were employing risk-reduction strategies in order to maximise the reduction potential of the stone they had available. This is consistent with the data on dorsal cortex, being indicative of a situation in which obtaining replacement stone was costly for Aboriginal groups occupying the study area.

The frequency of platform types is generally similar across the different materials, with no significant association between material and platform type (Fisher's exact test, p=0.664). The data do not indicate that different platform types were being employed with differing frequencies in the flaking of different materials.

Table 6.11 Flakes - by material and platform type

material	single	shattered	multiple	facetted	focalised	cortical	none	row total
silcrete	19	6	5	3	1	1	28	**63**
FGS	5	1	1	2	1	0	10	**20**
quartz, vein	1	1	0	0	0	0	1	**3**
igneous	0	1	0	0	0	0	0	**1**
column total	**25**	**9**	**6**	**5**	**2**	**1**	**39**	**87**

The assemblage is composed of small flakes, with the largest flake being only 23.38 millimetres long, and the median flake length being 12.28 millimetres (Table 6.12). Other dimensional variables exhibit ranges that are similarly restricted in their upper limit. The small size of flakes is consistent with the inference that the assemblage consists of flakes that were struck from small, and most likely heavily reduced cores.

The presence of small flakes indicates that knapping was carried out within the study location. The assemblage contains flakes with length lower than 10 millimetres, which is generally accepted as evidence of in-situ knapping (flake production) having taken place on location. Knapping usually produces a large number of small flakes relative to a small number of big flakes (Ahler 1989; Andrefsky 2007). The presence of small flakes also indicates that the assemblage was produced by knapping that occurred on-location, as small flakes are unlikely to have been transported into locations from elsewhere.

Generally, the presence of flakes under 10 millimetres is seen as indicating that knapping was carried out on location, as these flakes are unlikely to have been functional as tools and consequently are unlikely to be objects that would be transported from place to place (Dibble and McPherron 2006; Nadel 2001). Small flakes will not be found (or will be uncommon) on locations where knapping was not carried out, or was not a major component of the activities being carried out at that location. An example of this situation would be locations where large tools have been selectively gathered in a particular location and cached for future use (Hiscock 1988).

Locations with specific prehistoric uses, relating to resource-gathering (for example camps of hunting groups or carcass processing locations) could also have assemblages with size distributions skewed towards large artefacts, due to the absence of non-functional flakes (Andrefsky 2005).

Table 6.12 Descriptive statistics for dimensional variables of complete flakes

	valid n	minimum	25th percentile	median	75th percentile	maximum
length	34	4.25	8.14	12.28	15.76	23.38
width	34	4.22	6.61	7.22	11.06	22.58
thickness	34	0.67	1.68	2.78	3.73	10.25
platform width	27	2.37	4.04	5.29	8.46	19.67
platform thickness	24	0.48	1.11	1.75	3.04	8.36

The only apparent difference between flakes made from the different material is that the quartz flakes seem to be smaller than those made of other materials. A boxplot of the distributions of flake length illustrates this apparent size difference between materials (Figure 6.29). The single igneous flake is the largest flake in the assemblage, but the fact that this sample is only a single flake means that it is difficult to draw conclusions with any confidence as to whether igneous rock was being flaked in different ways to other materials. Statistically, there is no significant difference in any of the dimensional variables between flakes made from the different materials (Table 6.13: all p-values are greater than 0.1). This means that the apparent difference in distributions of flake size could be the result of random sampling effects. The data cannot be used to infer that any differences exist in the population of flakes within the study area.

The samples of artefacts made from the three most common materials (Silcrete, FGS and vein quartz) all contain flakes that are less than 10 millimetres in length. This indicates that all three materials were being knapped in-situ on the locations in the study location. This is consistent with an interpretation that these locations were associated with activities involving artefact production or maintenance.

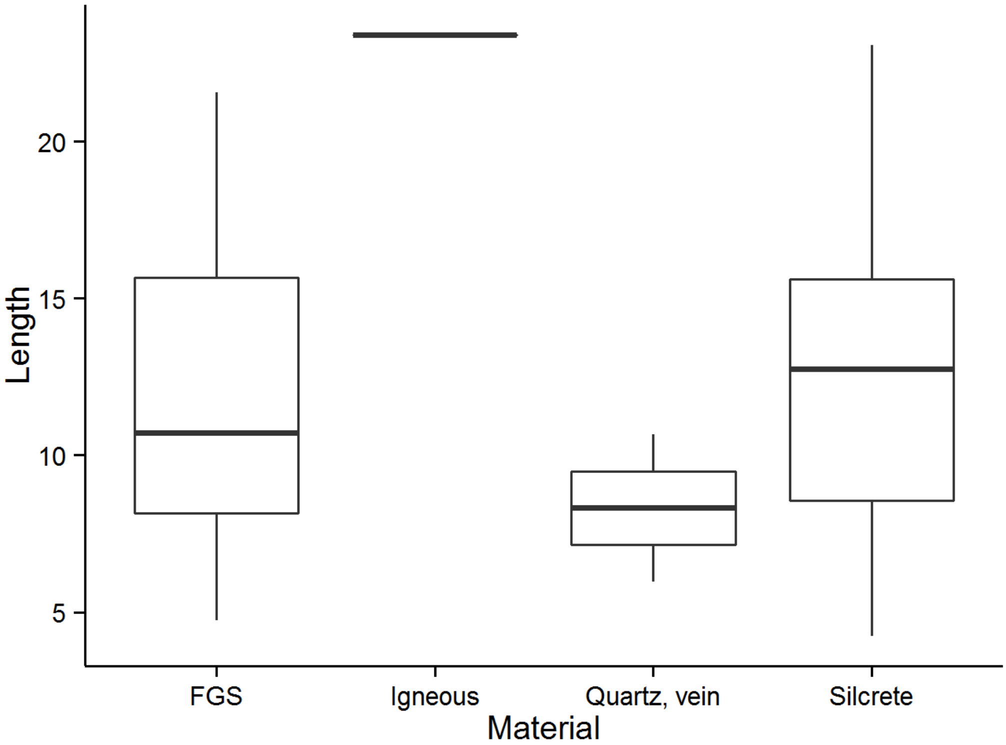


Figure 6.29 Boxplot of flake length by material type (complete flakes only)

Table 6.13 Kruskal-Wallis tests for differences in dimensional variables between all material types (complete flakes only)

	Kruskal-Wallis chi-squared	df	p-value
length	10.89	7.00	0.143
width	7.15	7.00	0.413
thickness	10.80	7.00	0.148
platform width	5.55	6.00	0.476
platform thickness	6.68	6.00	0.351

Flakes in the assemblage exhibit a wide range of variation in their shape. The relationship between flake length and flake width (referred to as a flake's 'elongation') quantifies the general shape of flakes in plan view. Plotting the length and width of flakes as a scatterplot illustrates that the elongation of flakes in the assemblage is highly variable, with some flakes being wider than they are long, and other flakes more than twice as long as they are wide (Figure 6.30).

There is a positive relationship between the two variables (shown by the linear trend-line fitted to the data). This relationship is not a statistically significant correlation, however (Spearman's rho=0.314, p=0.07). This means that it cannot be confidently inferred that flake length increases with increasing flake width in the overall population of flakes within the study area – the apparent relationship between the two variables could be the result of random chance. The individual data points are widely scattered above and below the trend-line.

Elongation of flakes is indicative of the types of core the flakes were produced from, and is also indicative of the degree to which the flake production process was standardised. Cores that are repeatedly flaked in the same orientation, and which develop worked surfaces with parallel dorsal ridges, tend to produce highly elongate flakes (Crabtree 1968). Cores that are frequently rotated between flake removals, or which are not elongate in shape, will produce flakes that are not elongate (Brantingham and Kuhn 2001; Shimelmitz et al. 2011).

The variability in flake elongation exhibited in the assemblage indicates that patterns of core reduction in the study area were similarly variable. The presence of both elongate and non-elongate flakes, and the wide range in elongation values, indicates that there was substantial variability in the morphology of core surfaces from which flakes were struck. The data indicate that patterns of core reduction were not standardised, and the production of flakes was not geared toward the production of flakes of any particular shape.

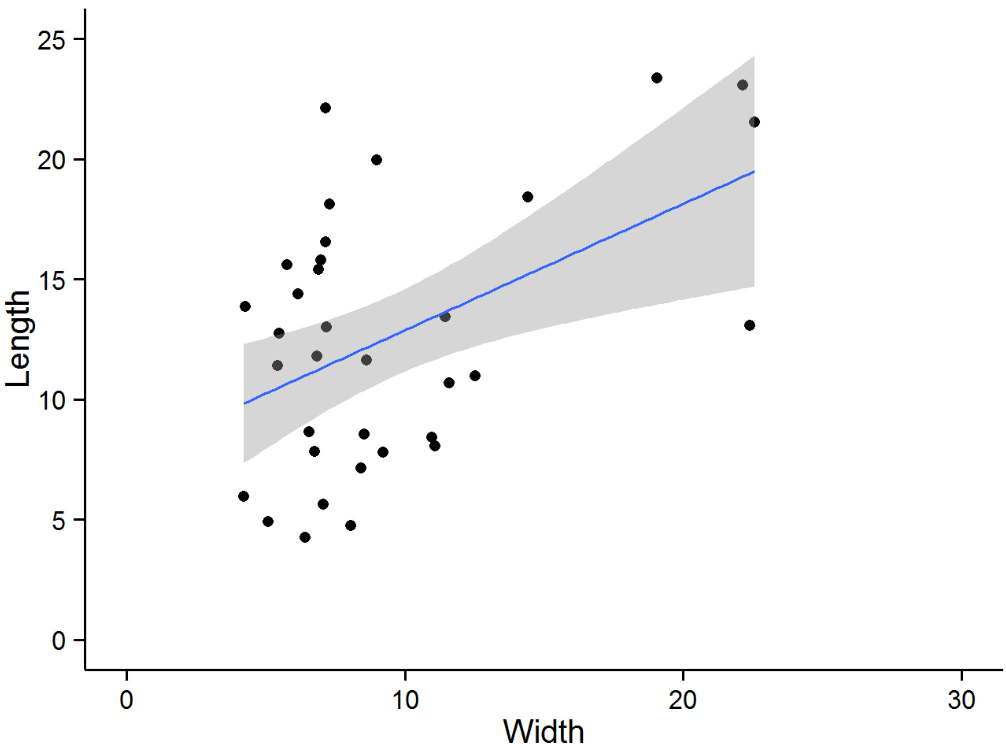


Figure 6.30 Scatterplot of flake length vs flake width (complete flakes only)

The relationship between a flake's platform width and its quarter width (the width of the flake, as measured one quarter along its length) shows how pronounced the expansion of the flake's margins are. Flakes struck from cores with flat or shallowly curved surfaces have margins which expand outwards in plan view, meaning that the width of the flake increases relative to the width of its platform, along the flake's length (Speth 1972, 1975). In contrast, flakes struck from cores with steeply curved or ridged surfaces have margins which do not expand as greatly – these flakes tend to have margins that are parallel to one another, meaning that the width of the flake doesn't increase along its length (Inizan et al. 1999).

The sample of complete flakes recovered from the test excavations exhibits substantial variability in terms of the degree to which their margins expand. All but one of the flakes has expanding margins (in that their quarter width is greater than their platform width) but the degree to which the flakes' quarter widths are greater than their platform widths is highly variable. Figure 6.31 plots each flake's quarter width against its platform width to illustrate this. Two lines have been drawn on the graph: the black line shows the values where quarter width and platform width are the same. Flakes lying below this line have contracting margins, in that their quarter width is less than their platform width. Flakes lying on the line have parallel margins, with their quarter width and platform width being equal. Flakes lying above the black line have expanding margins: their quarter width is greater than their platform width. The red line shows the values where quarter width is twice the platform width. Flakes lying on or above the red line have margins that expand dramatically, to the extent that the width of the flake doubles over one quarter of its length.

Most of the flakes in the assemblage fall above the black line, but below the red line. Three flakes fall above the red line, and one flake falls below the black line. The flakes between the two lines are scattered more or less evenly between the two lines, with no evident clustering of data points around either line. The data from this sample indicates that flakes in the study location are not standardised in terms of the degree to which their margins expand, which indicates that they were struck from cores which were variable in terms of the shapes of their worked surfaces. The data show no indication that flake production on the airport site was focused on the production of flakes of any particular shape, which is consistent with the data on flake elongation discussed above.

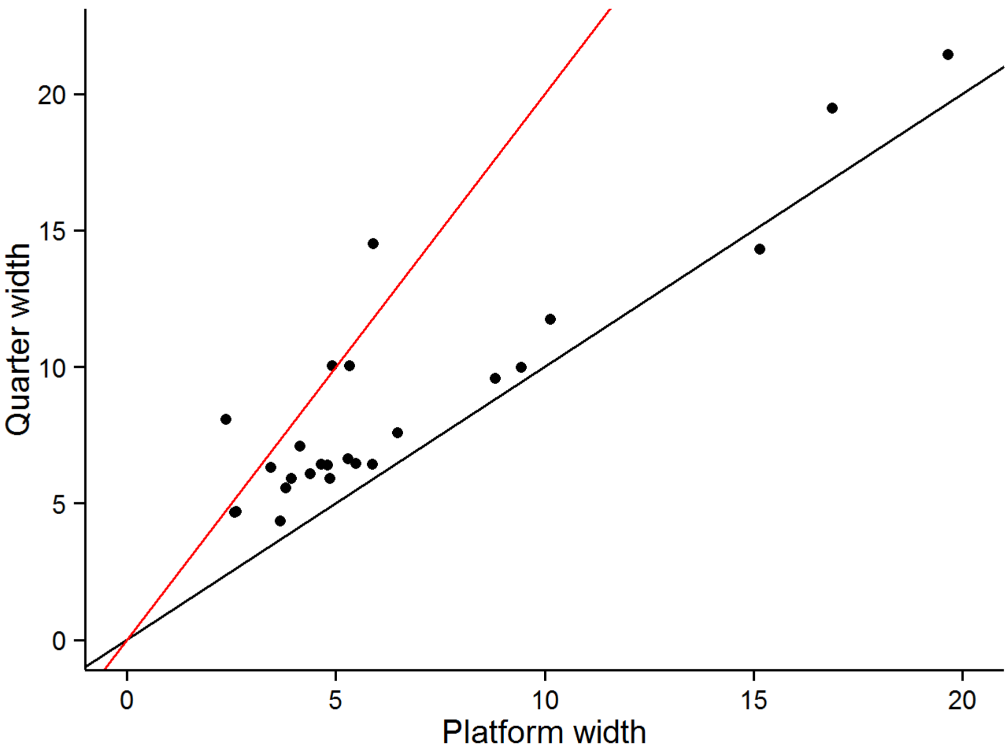


Figure 6.31 Scatterplot of flake quarter width vs platform width (complete flakes only). Drawn lines mark arbitrary thresholds

Both methods of examining flake shape – elongation, and comparing platform width with quarter width – indicate that patterns of flake production being employed by the groups occupying the study area were not standardised. The data do not provide any evidence for flake production systems being organised with the aim of producing standardised and regular flakes of any particular shape or morphology.

6.3.3 Analysis of assemblage variation across landforms

The relationship that people feel to the landscape and their appreciation for landform, functionally and spiritually, is documented as existing in the present, and is assumed to have operated, possibly in similar ways, in the past (Kiernan 2015). Terrain unit analyses are employed here to investigate the distribution and variation of archaeological materials relative to the landforms in which they are found. This analyses deal exclusively with lithic technologies (stone tools), noting where European heritage items or non-artefactual stone was recovered in order to describe the extent of subsurface disturbance and its natural or cultural origin.

This section of the report will provide a general introduction to the broader Badgerys Creek landscape and then discuss each of the terrain units within the project location that yielded subsurface artefacts testing program, finishing with a summary of the results of the terrain unit analysis.

Landform categories and sample size

The landscape has been subdivided according to several different landform variables. Each of these variables was categorical, meaning that a given location of ground would be classified as one of a number of mutually exclusive categories within each variable.

The number of test pits excavated from the different categories of each landform was not always equal between categories. This is because test pits were preferentially placed on landforms considered to have the potential to contain subsurface archaeological material. The primary aim when designing the placement of test pits in the landscape was not to sample the different landform categories equally. Instead, this aim was secondary to the aim of targeting locations of high archaeological potential.

The landform variables utilised in this study, as well as the categories which each landform was subdivided into and the number of test pits excavated within each of these landform categories, are summarised in Table 6.14.

A total of 114 test pits were excavated, each of which was assigned to one of the categories within each of the nine landform variables.

In addition to these categorical variables, the elevation of each excavated pit was recorded, both in absolute terms (elevation above the Australian sea level datum) and in relative terms (elevation above the nearest drainage greater than 1st order).

Table 6.14 Summary of the landform categories sampled, and the number of test pits excavated (n) within each category

landform variable	categories												
broad scale	valley floor (n=45)	basal slope (n=17)	mid slope (n=15)	upper slope (n=5)	minor spurline crest (n=1)	secondary spurline crest (n=11)	2nd watershed ridgeline (n=10)	major watershed ridgeline (n=10)					
fine scale landform category	alluvial flats (n=26)	alluvial terrace (n=4)	bench (n=1)	break-of-slope (n=1)	crest (n=21)	elevated rise/terrace (n=9)	fan (n=3)	knoll (n=1)	minor spur crest (n=22)	saddle (n=2)	shoulder (n=6)	slope (n=10)	upper slope (n=10)
watershed spurline order	1 (n=27)	2 (n=13)	3 (n=4)	4 (n=10)	5 (n=10)								
slope category	flat (n=71)	low (n=29)	low to moderate (n=9)	moderate (n=5)									
within 100 m of 1st order drainage	no (n=43)	yes (n=71)											
highest drainage line order within 100m	1 (n=28)	2 (n=11)	3 (n=26)	4 (n=10)	5 (n=30)								
order of closest drainage line	1 (n=47)	2 (n=15)	3 (n=12)	4 (n=21)	5 (n=19)								
overall valley context	lower (n=68)	middle (n=26)	upper (n=20)										
aspect	e (n=5)	ne (n=4)	nw (n=9)	o (n=71)	s (n=10)	se (n=2)	sw (n=10	w (n=3)					

6.3.4 Assemblage density relative to landform

The consistent dimensions of the excavated test pits, each of which was 1 m x 0.5 m, means that the number of artefacts recovered from each pit provides data on the areal density of artefacts within the landform in question. Areal density is the number of artefacts found on a location of ground, regardless of the depth at which the artefacts were found. The depth at which artefacts were recovered is ignored in this analysis, as all artefacts were recovered from shallow depths, and the depth from which individual artefacts were recovered was not interpreted as being indicative of the age of the artefacts (see Appendix 1).

A statistically significant difference exists between the number of artefacts recovered from excavated pits according to the broad scale landform category the pits were located in (Kruskal-Wallis chi-squared=21.89, d.f.=7, p=0.003).

For each broad scale landform category, the majority of excavated pits yielded no artefacts, with a small number of pits yielding one or more artefacts (Figure 6.32).

The valley floor landform contained the most archaeologically productive pits, with the richest pit yielding seven artefacts.

Mid slope and basal slope landforms were the landforms with the next highest densities, with all other landforms yielding a maximum of one artefact per pit.

When the valley floor category is removed from the data, all other landforms show no statistically significant difference in their distributions of artefacts recovered per pit (Kruskal-Wallis chi-squared=10.01, d.f.=6, p=0.124). In other words, the data do not provide any evidence to conclude that the other landforms are different in terms of their areal density of artefacts. The statistically significant difference detected in comparing all landforms with one another is due to the pits excavated on the valley floor being archaeologically richer than the pits excavated on other landforms.

A statistically significant difference exists between the number of artefacts recovered from pits across the different fine-scale landform categories (Kruskal-Wallis chi-squared=29.5, d.f.=13, p=0.006). Within each landform category, the majority of excavated pits yielded zero artefacts, causing each landform category to have a very low median number of artefacts recovered per pit (Table 6.15). Only two categories, alluvial flats and alluvial terraces, have a median value one artefact per pit, with all other categories having a median value of zero artefacts per pit.

The distribution of artefacts recovered per pit is highly skewed for most landform categories: in most categories, there were a small number of pits that yielded a much greater number of artefacts than the median or mean for that landform. The distribution of artefacts recovered from pits within each landform can be seen in more detail by tabulating the number of excavated pits relative to the number of artefacts recovered (Table 6.16). In this table, each column designates the number of artefacts recovered from a pit, and the values in the table are a count of the number of pits excavated that yielded that number of artefacts.

The frequency table indicates that alluvial flats were substantially more productive than other landform categories, with more than half of the pits within this landform yielding artefacts (in other landforms, at least half of the pits were sterile). Repeating a statistical test for difference between landforms, after removing the alluvial flats pits, reveals that other landforms are not statistically different in terms of their distribution of the number of artefacts recovered per pit (Kruskal-Wallis chi-squared=13.74, d.f.=12, p=0.318). This means that the data do not provide any evidence to indicate that the other landforms are different from one another, in terms of the areal density of artefacts.

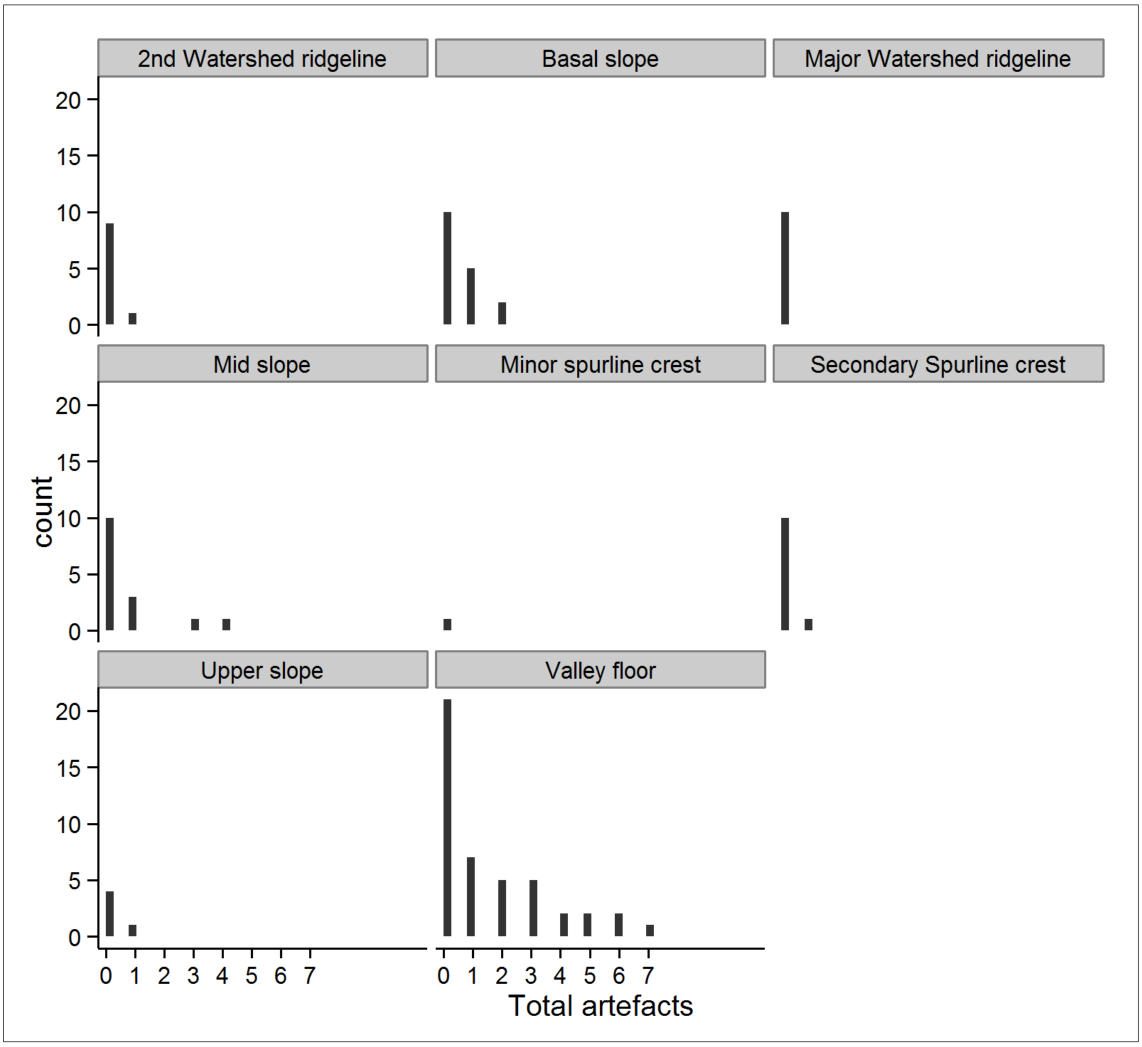


Figure 6.32 Boxplots of the frequency of total artefacts recovered per pit, broken down by broad scale landform category

Table 6.15 Descriptive statistics of the number of artefacts recovered per pit, by fine scale landform category.

fine scale landform category	valid n	minimum	median	mean	maximum
alluvial flats	26	0.00	1.00	2.1538	7.00
alluvial terrace	4	0.00	1.00	1.2500	3.00
elevated rise/terrace	9	0.00	0.00	0.6667	2.00
minor spur crest	22	0.00	0.00	0.6364	4.00
slope	10	0.00	0.00	0.5000	2.00
elevated rise	6	0.00	0.00	0.3333	2.00
fan	3	0.00	0.00	0.3333	1.00
crest	21	0.00	0.00	0.0952	1.00
bench	1	0.00	0.00	0.0000	0.00
break-of-slope	1	0.00	0.00	0.0000	0.00
knoll	1	0.00	0.00	0.0000	0.00

fine scale landform category	valid n	minimum	median	mean	maximum
saddle	2	0.00	0.00	0.0000	0.00
shoulder	6	0.00	0.00	0.0000	0.00
upper slope	2	0.00	0.00	0.0000	0.00

Table 6.16 Frequency table of the number of pits excavated in each fine scale landscape category, by the total number of artefacts recovered per pit

fine scale landform category	0	1	2	3	4	5	6	7	row total
alluvial flats	9	5	1	4	2	2	2	1	26
alluvial terrace	2	0	1	1	0	0	0	0	4
bench	1	0	0	0	0	0	0	0	1
break-of-slope	1	0	0	0	0	0	0	0	1
crest	19	2	0	0	0	0	0	0	21
elevated rise	5	0	1	0	0	0	0	0	6
elevated rise/terrace	5	2	2	0	0	0	0	0	9
fan	2	1	0	0	0	0	0	0	3
knoll	1	0	0	0	0	0	0	0	1
minor spur crest	14	5	1	1	1	0	0	0	22
saddle	2	0	0	0	0	0	0	0	2
shoulder	6	0	0	0	0	0	0	0	6
slope	6	3	1	0	0	0	0	0	10
upper slope	2	0	0	0	0	0	0	0	2
column total	75	18	7	6	3	2	2	1	**114**

The landscape was divided into three categories of 'overall valley context': lower, middle and upper. These three categories exhibit a statistically significant difference in the distribution of artefacts recovered per pit (Kruskal-Wallis chi-squared=17.34, d.f.=2, p<0.001).

Plotting the frequency of pits according to the total number of artefacts recovered per pit shows clearly why this significant difference exists: pits excavated in lower valley contexts were substantially richer, and more frequently yielded artefacts, than pits excavated in middle and upper valley contexts (Figure 6.33).

When lower valley context pits are removed from the data, the other two landforms exhibit no statistically significant difference in the number of artefacts recovered per pit (Kruskal-Wallis chi-squared=2.07, d.f.=1, p=0.15). The significant difference in the total data set is due to the greater richness of pits excavated in lower valley contexts.

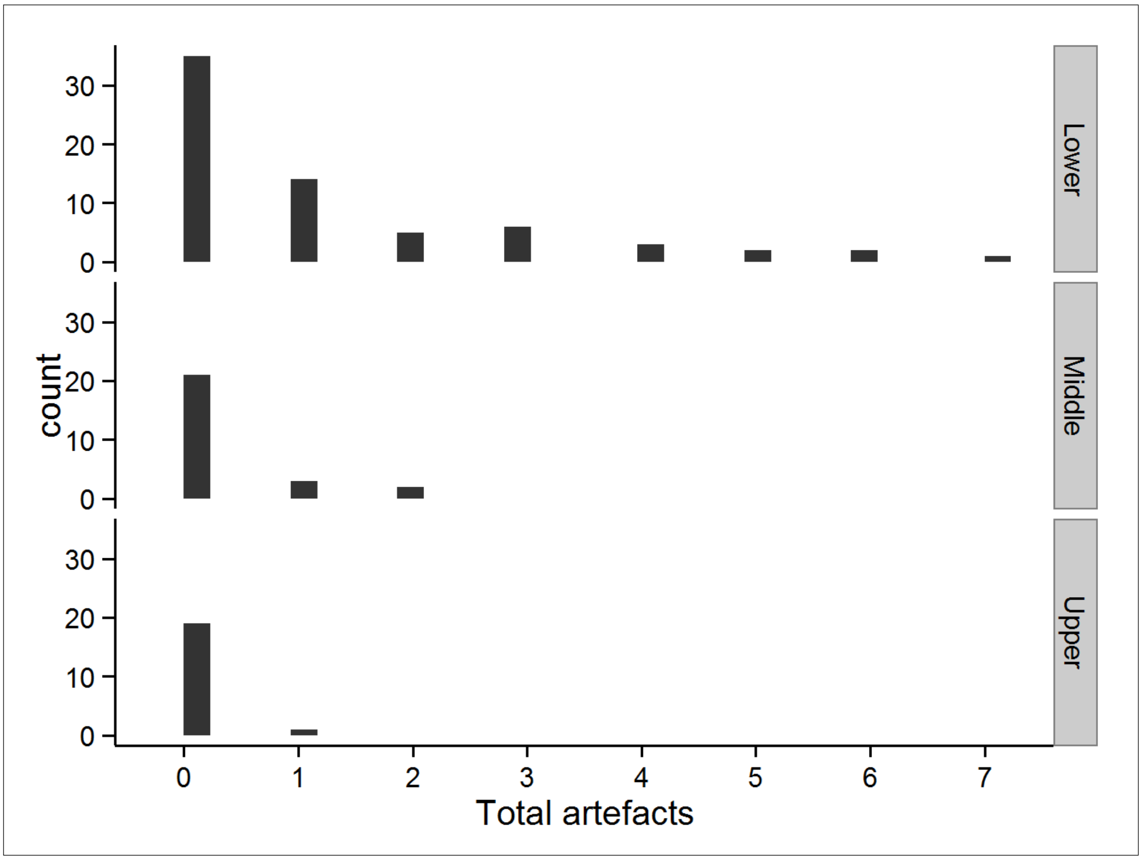


Figure 6.33 Frequency of pits excavated, by overall valley context and total number of artefacts recovered

A number of different landscape variables were designed to investigate the effect that proximity to drainage lines, and the size of drainage lines, has on the archaeological richness of the landscape.

For each of the excavated locations, the order of the closest drainage line was identified, using the established methods of designating drainage line orders: 1st order drainages being the smallest, with each confluence of drainage lines increasing the order of the downstream drainage line by one.

For each of the excavated locations, the highest drainage order within 100 metres was also identified. These variables, which categorise each excavated pit according to the proximity and size of the drainage lines in the surrounding landscape, provide data on the accessibility of water to Aboriginal groups occupying that particular region of the study location.

The numbers of artefacts recovered per pit was significantly different according to the order of the closest drainage line (Kruskal-Wallis chi-squared=24.92, d.f.=4, $p<0.001$).

A plot of the frequency of pits excavated by the number of artefacts recovered per pit shows that greater numbers of artefacts were more frequently recovered from pits near to higher order drainage lines (Figure 6.34). Pits excavated near lower order drainage lines were more frequently sterile.

The positive correlation between the order of the nearest drainage line and the number of artefacts recovered per pit is statistically significant (Spearmans rho=0.446, $p<0.001$).

The data indicate that proximity to a high order drainage line has a strong influence on the areal density of artefacts across the study location.

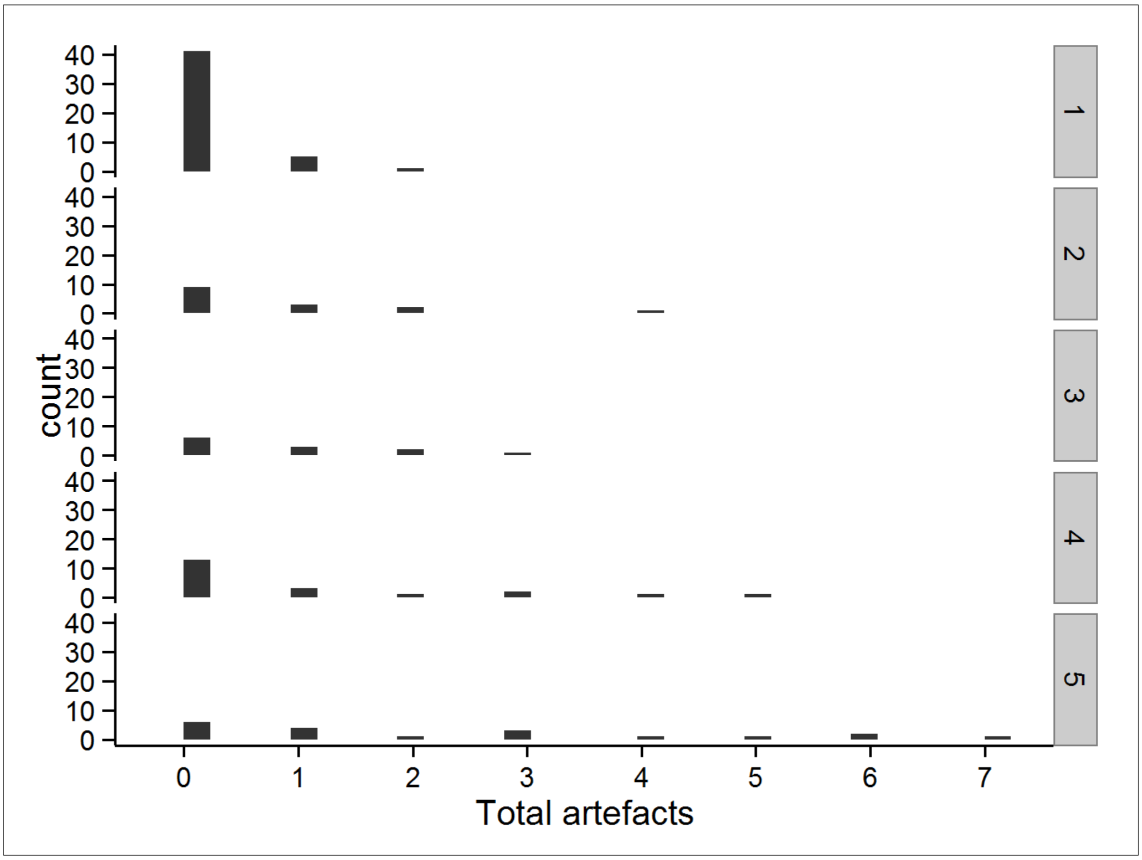


Figure 6.34 Frequency of pits excavated, by order of closest drainage line and total number of artefacts recovered

The order of the highest drainage line within 100 metres of excavated pit exhibits a similar effect on the numbers of artefacts recovered per pit.

The number of artefacts recovered is significantly different according to the order of the highest drainage line within 100 metres (Kruskal-Wallis chi-squared=13.44, d.f.=4, p=0.009).

A plot of the frequency of excavated pits according to the number of artefacts recovered per pit shows that locations with higher order drainage lines within 100 metres were more likely to yield higher numbers of artefacts (Figure 6.35). In locations where the highest order drainage line within 100 metres was only a 1st order drainage, by contrast, the majority of excavated pits were sterile.

The positive correlation between the highest order of stream within 100 metres and the number of artefacts per pit is statistically significant (Spearman's rho=0.308, p=0.001).

These data again indicate that proximity to a high order drainage line influences the areal density of artefacts.

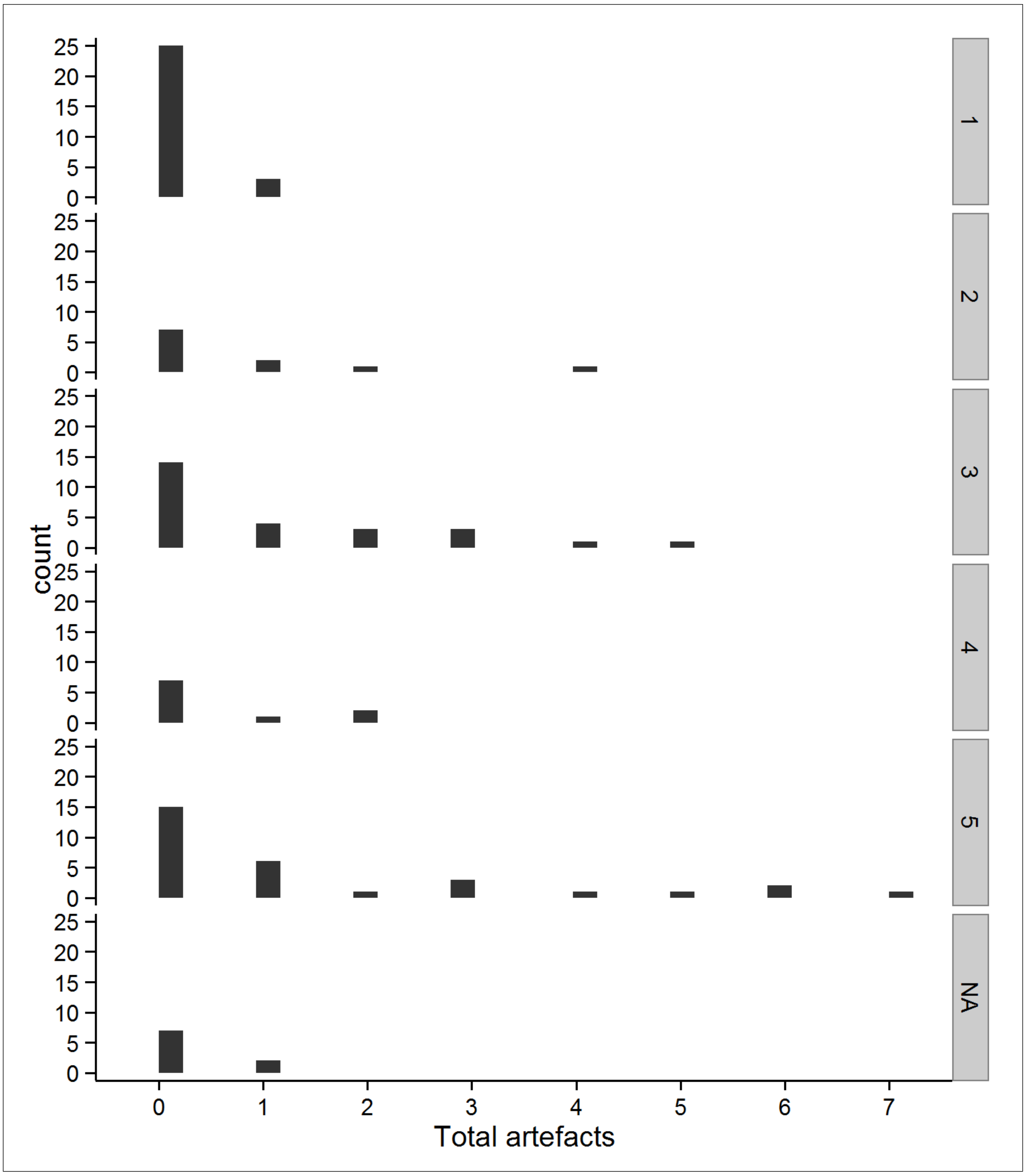


Figure 6.35 Frequency of pits excavated, by the highest order of drainage line within 100 metres and total number of artefacts recovered

A negative correlation exists between the elevation of excavated pits and the number of artefacts recovered per pit, with lower pits yielding greater numbers of artefacts.

The absolute elevation of excavated pits is negatively and significantly correlated with the number of artefacts recovered per pit (Spearman's rho=-0.451, p<0.001).

A scatterplot of artefacts recovered against the elevation of each individual pit shows that pits placed at low elevations contained artefacts more frequently than pits placed at higher elevations (Figure 6.36).

These data indicate that lower lying parts of the study location have a greater areal density of artefacts than higher locations of the landscape.

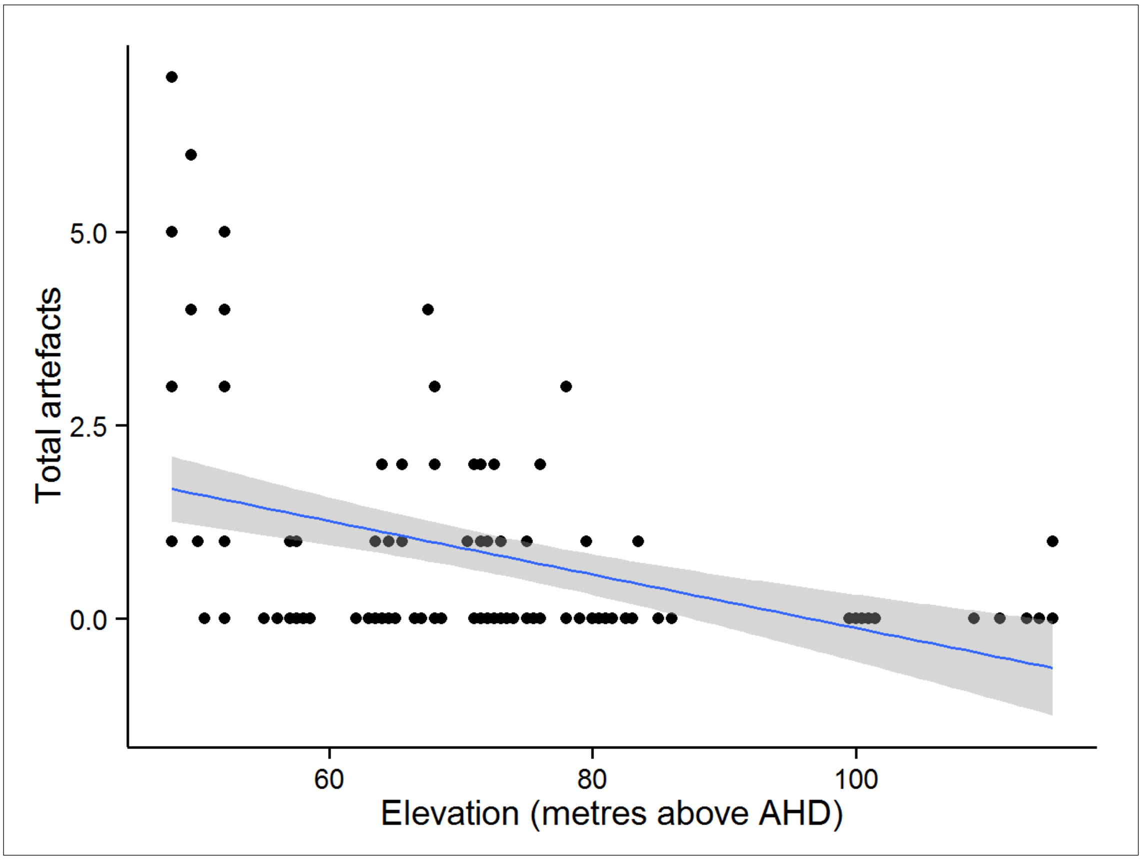


Figure 6.36 Scatterplot of the total number of artefacts recovered per pit against the elevation of the pit. Linear trend-line with 95 per cent confidence intervals drawn

The elevation of excavated pits relative to the nearest >1st order drainage line is also negatively correlated with the number of artefacts recovered per pit, and this correlation is statistically significant (Spearmans rho=-0.369, p<0.001).

A scatterplot of these two variables shows that pits located more than 10 metres above the nearest >1st order drainage line were almost invariably sterile, while pits at lower elevations contained artefacts more frequently (Figure 6.37).

These data are consistent with the pattern seen in artefact numbers relative to absolute elevation of pits.

Both data sets indicate that more elevated locations of the landscape have a lower areal density of artefacts, while lower lying locations have a higher areal density.

For locations on or near ridgelines, the watershed spurline order of the nearest ridgeline was recorded. The watershed spurline order is determined on the basis of the order of the drainage lines between which the ridge or spurline acts as a watershed. Consequently, a spurline separating two locations that drain into two different 5th order streams would be designated as a 5th order spurline. If a spurline only separated two 1st order drainages, however, which did not flow into two separate 2nd order drainages, then it would be designated as a 1st order spurline.

The spurline ridge order associated with excavation pits is negatively correlated with the number of artefacts recovered per pit, and this negative correlation is statistically significant (Spearman's rho=-0.342, p=0.006). This means that excavated locations associated with major watersheds yielded fewer artefacts per pit than locations associated with more minor watersheds.

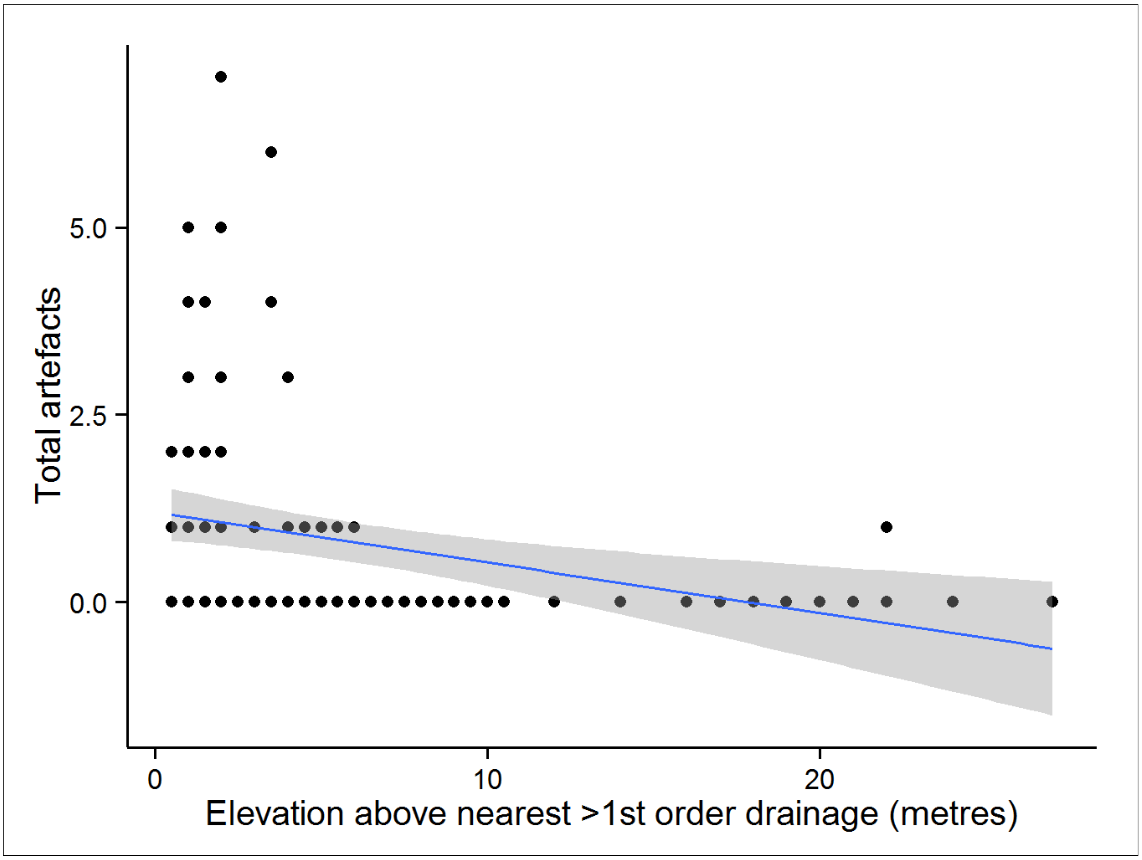


Figure 6.37 Scatterplot of the number of artefacts recovered per pit against the elevation of the pit above the nearest >1st order drainage line. Linear trend-line with 95 per cent confidence intervals drawn

A scatterplot of these two variables (Figure 6.38) shows that pits associated with low order spurlines contained greater numbers of artefacts than pits associated with high order spurlines, which were more frequently sterile. These data indicate that locations associated with higher order spurlines have lower areal density of artefacts than locations associated with lower order spurlines. The reason for this negative correlation is that higher order spurlines are generally located further away from drainage lines.

These major watersheds are usually highly elevated, and consequently further from water sources. Lower order drainage lines, by contrast, are more likely to occur on lower lying locations, and be in locations where streamlines are closer, and consequently more accessible. This is confirmed if the data-points shown in Figure 6.38 are divided into pits that are within 100 metres of a drainage line greater than 1st order, or not (Figure 6.39).

The resulting scatterplot is of a drainage line that is larger than 1st order. The pits located within 100 metres of a 2nd order or larger drainage line are more likely to contain artefacts than other pits.

These data strongly indicate that the correlation between spurline order and areal density is a result of minor spurlines being more likely to be located close to water sources, while major spurlines are more likely to be located further away from water sources.

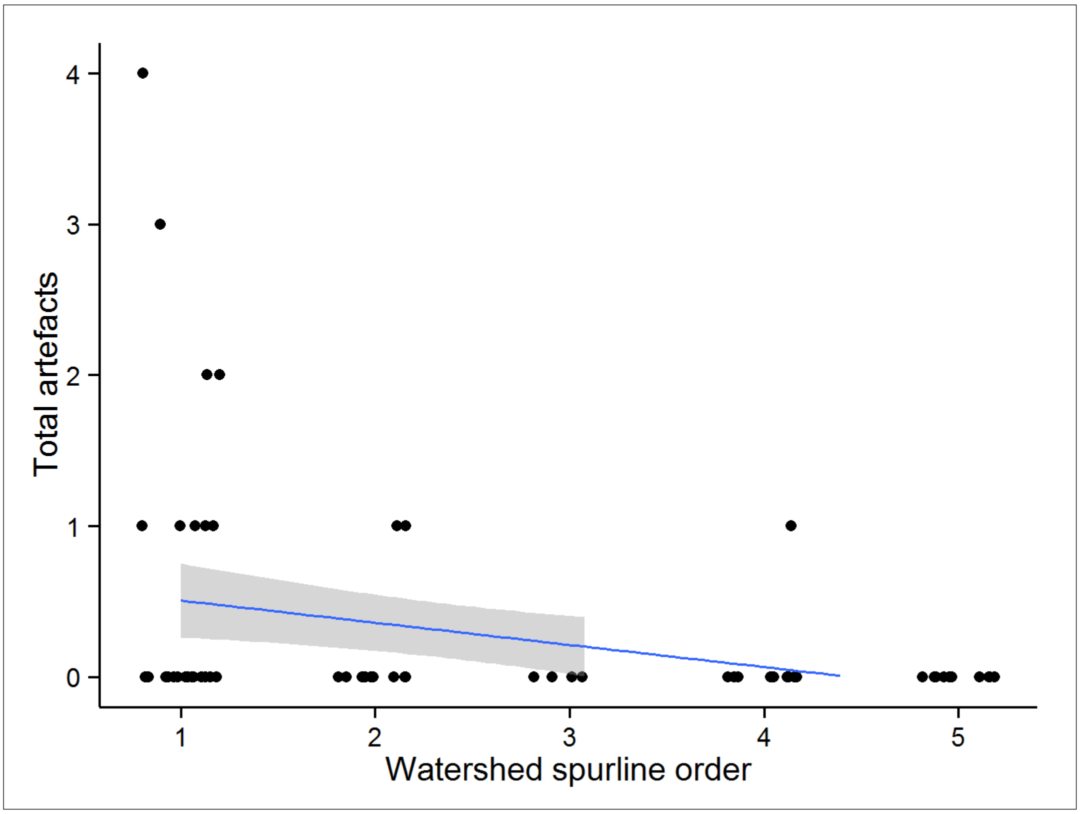


Figure 6.38 Scatterplot of the number of artefacts recovered per pit against watershed spurline order. Linear trend-line with 95 per cent confidence intervals drawn.

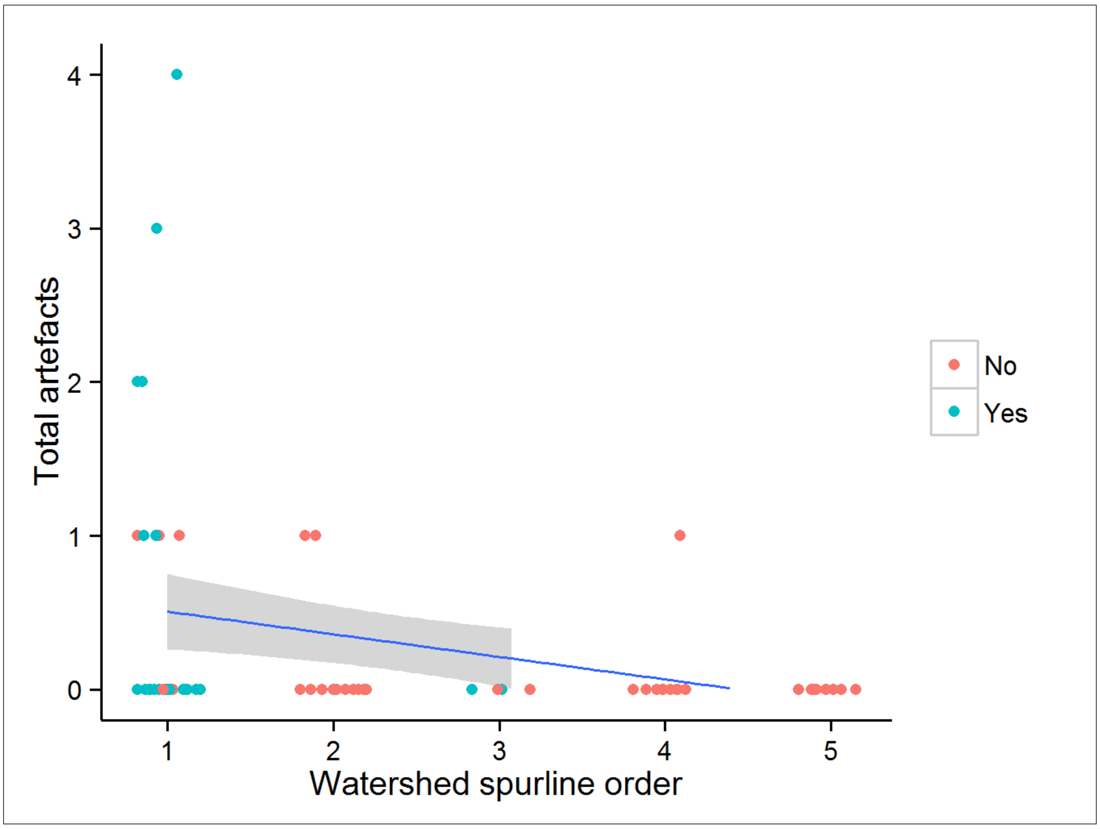


Figure 6.39 Scatterplot of the number of artefacts recovered per pit against watershed spurline order. Pits are coloured by whether they are located within 100 metres of a 2nd order or larger drainage

A number of landform categories are not associated with any differences in the numbers of artefacts recovered from pits. The number of artefacts recovered per pit showed no detectable difference according to the slope category (designated as flat, low, low to moderate, or moderate) on which pits were located (Kruskal-Wallis chi-squared=6.10, d.f.=3, p=0.107). These data indicate that the gradient of the landform is unimportant in determining the areal density of artefacts located on it. It must be noted, however, that only flat to moderate slopes were subjected to excavation in the course of this study.

No excavation was carried out on steeper slopes, as these locations were judged to have low archaeological potential at the outset of this study. The data obtained do not allow us to fully test whether the gradient of slopes affects areal artefact density across the full range of slope gradients in the study location.

The number of artefacts recovered per pit did not differ significantly according to the aspect of the ground surface on which they were located (Kruskal-Wallis chi-squared=8.66, d.f.=7, p=0.278). This is likely to be due to the gentle undulating nature of the terrain. In the absence of high or steep-sided landforms, the sunlight experienced by locations with different aspect would not be particularly variable. As a consequence, the aspect of the ground surface is unlikely to have been an important criterion in the selection by Aboriginal people of places in which to camp.

6.3.5 Discussion of assemblage density relative to landform

The results of the statistical tests conducted to explore the variation in areal density (measured as total number of artefacts per pit) across different landform categories are summarised in Table 6.17. Following general convention, a “significant” result is interpreted as being one in which the p-value falls below the arbitrary 0.05 threshold (Fisher 1925). The p-values are included in the table to show when values are strongly significant (<0.01) or non-significant.

The exploration of artefact density relative to the different landform categories defined in this study indicates consistently that proximity to water is the major factor influencing the areal density of artefacts. The first two variables analysed (broad scale landform category; fine scale landform category) both detected a statistically significant increase in artefact densities in valley floor (and more specifically, alluvial flat) contexts relative to all other locations. The increase in artefact density on valley floors is most simply explained as resulting from Aboriginal groups preferentially occupying locations close to water. All else being equal, valley floor contexts are closer to drainage lines than other landforms such as slopes and crests.

Variables that relate excavated locations to the size of nearby drainage lines support this interpretation, and also indicate that the size of the drainage line has an influence on artefact density. Artefact density is positively correlated with the order of the closest drainage line, and with the order of the largest drainage line located within 100 m. Higher order drainage lines are likely to be less ephemeral than low order drainage lines, and more likely to develop ponds and wetland environments, simply due to the greater volume of water that flows along them.

All else being equal, higher order drainage lines are more likely to be a predictable and stable source of water, and of associated animal and plant resources, as a consequence of this. The correlation between the density of artefacts in the landscape and the size of nearby drainage lines is therefore unsurprising, and can be explained as a result of Aboriginal groups preferentially carrying out activities in locations where water and associated resources was easily accessible.

The changes in artefact density with elevation add supporting data to the interpretation that artefact densities increase in locations associated with higher order drainage lines. A significant inverse correlation was found between artefact density and elevation, measured in absolute terms (metres above AHD) and in relative terms (metres above the nearest >1st order drainage line). Both results indicate that lower-lying locations in the landscape have higher artefact densities.

Table 6.17 Summary of tests exploring areal density across landform categories

Landform variable	Significant difference between landform categories (Kruskal-Wallis test)	Significant correlation with landform category (Spearman's correlation)	Notes
broad scale landform category	yes: p=0.003	na (ordinal variable)	density higher on valley floors than other categories
fine scale landform category	yes: p=0.006	na (ordinal variable)	density higher on alluvial flats than other categories
overall valley context	yes: p<0.001	na (ordinal variable)	density higher in lower valley contexts than other categories
order of closest drainage line	yes: p<0.001	yes: p<0.001	density positively correlated with drainage line order
highest order drainage line within 100 m	yes: p=0.009	yes: p=0.001	density positively correlated with drainage line order
elevation above AHD	na (continuous variable)	yes: p,0.001	density inversely correlated with elevation
elevation relative to nearest 1st order drainage line	na (continuous variable)	yes: p<0.001	density inversely correlated with elevation
watershed spurline order	no: p=0.095	yes: p=0.006	density inversely correlated with spurline order
slope category	no: p=0.107	na (ordinal variable)	
aspect	no: p=0.278	na (ordinal variable)	

All else being equal, it would be expected that locations within the landscape that have lower elevation are more likely to be located closer to drainage lines. In addition, as elevation decreases, the order of drainage lines in the landscape would be expected to increase, as drainage lines converge. The elevation of the excavated locations might, therefore, be providing a proxy for the accessibility of water in the landscape. Empirically, when the elevation of excavated locations is compared with the order of the closest drainage line, it is found that these variables are correlated with one another.

Absolute elevation of the excavated pits is inversely correlated with the order of the nearest drainage line (Figure 6.40). The correlation is strong, and highly significant (Spearman's rho=-0.796, p<0.001). Elevation of pits above the nearest >1st order drainage line is also inversely correlated with the order of the nearest drainage line (Figure 6.41). This correlation is also strong, and also highly significant (Spearman's rho=-0.504, p<0.001). Both of the elevation variables, in other words, are closely associated with the size of the nearest drainage line. As elevation (both in absolute and relative terms) decreases, the size of the nearest drainage line increases.

The increase in artefact density observed with decreasing elevation is also associated with an increase in the order of nearby drainage lines. The increase in artefact densities observed with decreasing elevation, therefore, is likely to be the result of increased Aboriginal activity in locations associated with higher order drainage lines. The linkage between elevation and drainage line order means that data on artefact density relative to elevation provides supporting evidence for preferential occupation of locations with access to more stable water sources.

A similar linkage exists between the overall valley context of the excavated pits and the order of their closest drainage line. There is a significant difference in the order of the closest drainage line across the three categories of valley context (Kruskal-Wallis chi-squared=51.99, d.f.=2, p<0.001). A scatterplot of the two variables shows why this is the case (Figure 6.42): pits located in upper valley contexts all have a 1st order stream as the closest drainage line, while only pits located in lower valley contexts have 4th or 5th order drainage lines nearby. This is an unsurprising result: lower valley contexts by definition occur in lower-lying locations of the landscape, where there is a greater likelihood of a number of drainage lines having converged to create higher-level drainage lines.

As a consequence, upper valley contexts are generally populated by 1st order drainage lines, while middle and lower valley contexts are more likely to have higher order drainage lines running through them. The pits excavated in lower valley contexts yielded significantly higher artefact densities than pits excavated in middle and upper valley contexts.

The fact that lower valley contexts are associated with higher level drainage lines means that the high artefact densities encountered in lower valley contexts is most simply explained as a result of Aboriginal groups preferentially occupying locations near to higher order drainage lines.

The data on artefact density relative to overall valley context provides supporting evidence for the preferential occupation by Aboriginal groups of locations with access to more stable water sources.

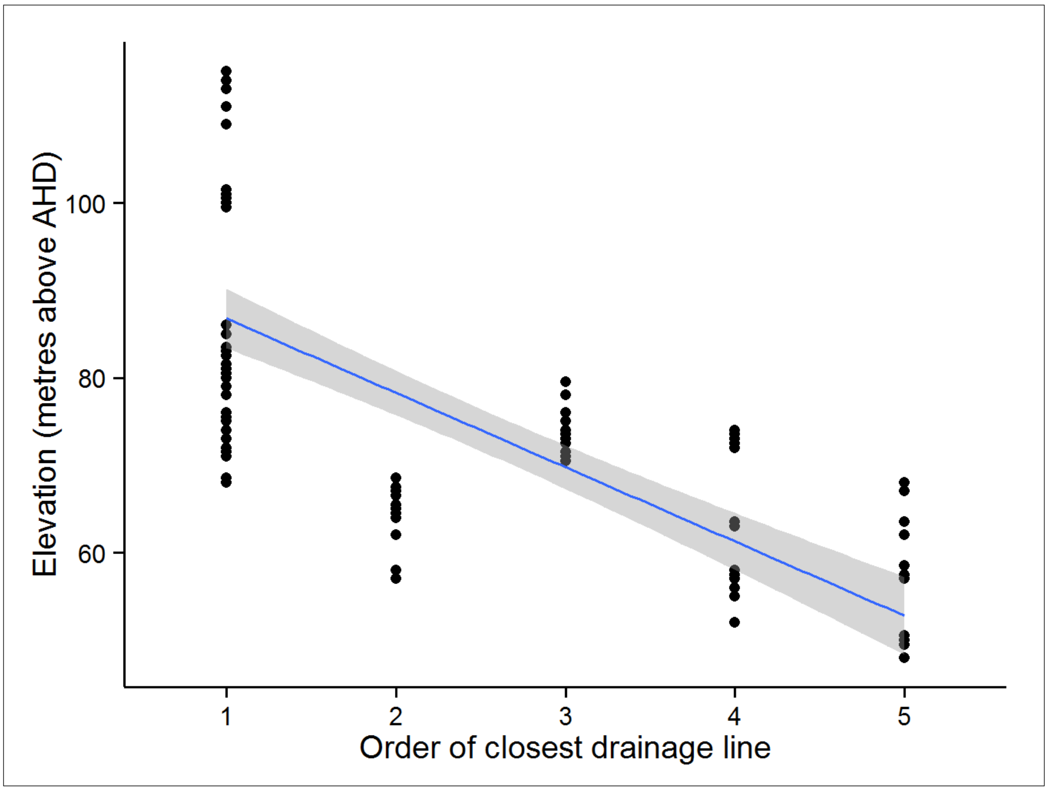


Figure 6.40 Scatterplot of the elevation of pits and the order of the closest drainage line. Linear trend-line and 95 per cent confidence intervals drawn

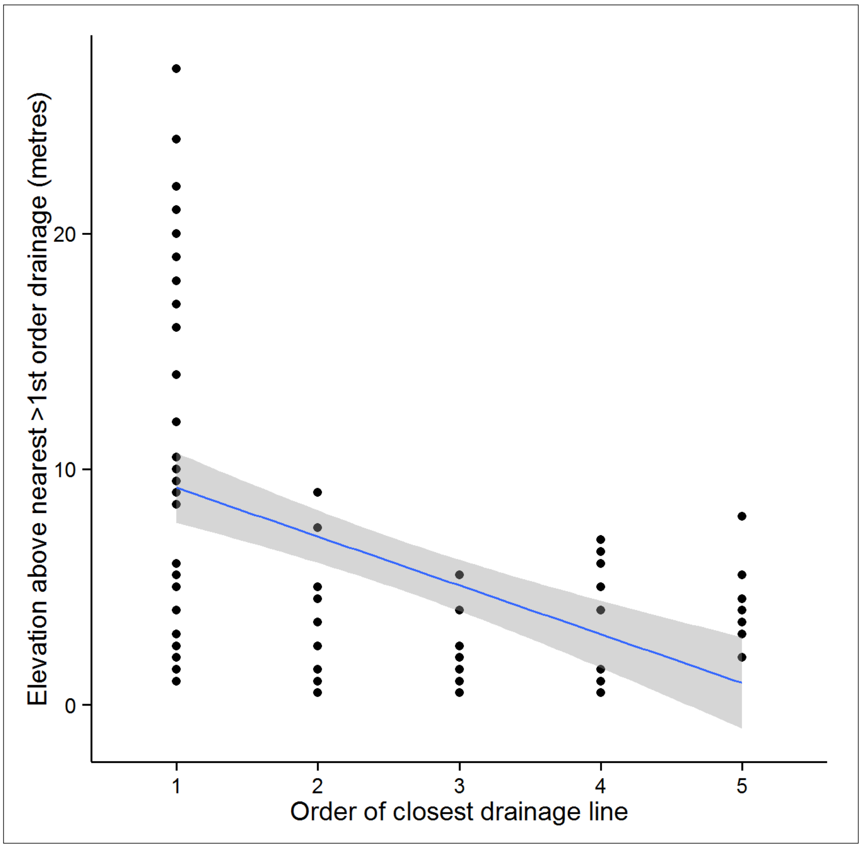


Figure 6.41 Scatterplot of the elevation of pits above the nearest >1st order drainage line, and the order of the closest drainage line. Linear trend-line and 95 per cent confidence intervals drawn

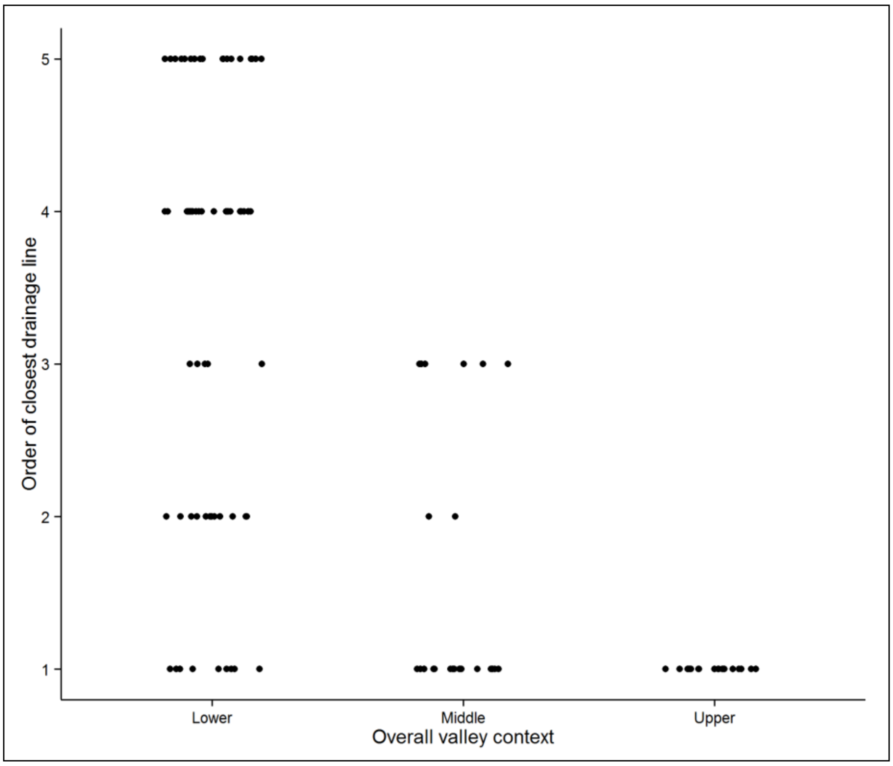


Figure 6.42 Scatterplot of the order of closest drainage line against overall valley context. Data points jittered horizontally for clarity

Watershed spurline order is inversely correlated with the order of the closest drainage line (Spearman's rho=-0.561, p<0.001). Excavated pits located on high order watershed spurlines are more likely to be associated with lower order drainage lines. By contrast, pits excavated on low-order watershed spurlines are more likely to be associated with higher order drainage lines. The inverse correlation between watershed spurline order and drainage line order means that this variable also provides a proxy measure of the order of drainage line associated with the excavated pits.

The finding that artefact density is higher in pits associated with low order watershed spurlines can therefore be explained by the fact that these spurlines are more likely to be associated with higher order drainage lines. The data on artefact density relative to watershed spurline order provides supporting evidence that Aboriginal occupation was focused on locations associated with higher order drainage lines, and consequently with access to more stable water sources.

The landform variables investigated in this study consistently indicate that proximity to water, and the size of nearby water sources, was the major factor influencing where Aboriginal groups chose to focus their activities. Direct measures (such as the order of the nearest drainage line, and the size of the largest drainage line within 100m) show that artefact density increases with the size of nearby drainage lines. Other variables (such as elevation and valley context) that are also associated with changes in artefact density, are closely linked to the size of drainage lines in the landscape. These variables therefore provide proxy data on the order of nearby drainage lines.

The fact that these variables are associated with changes in artefact density provides supporting evidence to the conclusion that the proximity of higher order drainage lines is associated with an increase in artefact density. Examining the data on all the landform variables in concert, there is a consistent signal of increasing artefact density being associated with proximity to water, and proximity to higher order drainage lines. The data strongly indicate that access to the stable sources of water, and associated plant and animal resources, that higher order drainage lines are likely to have provided, was the major determining factor in where Aboriginal activity was focused. Access to water appears to be the strongest deciding factor for Aboriginal groups in choosing where to focus their activities across the study location.

6.4 Discussion: stone artefact analysis and the predictive model

The data gained from the test excavation program provide support for many of the principles of the predictive model detailed in section 5.6. Some of the predictive statements in the model are not supported by the results of the test excavation program, but in these cases this is because the excavation program was unsuited to testing these statements. The results of the test excavation program do not provide evidence contradicting any of the principles of the predictive model.

The starting point of the predictive model is the statement that artefactual material can occur in any landform context. In other words, there is no landform within the study area and the wider Sydney Basin in which prehistoric artefacts will never be present. This does not mean that all landform categories have an equal probability of containing artefactual material, but that none of them lacks any possibility. The findings of this study are consistent with this principle, in that the majority of landform categories subjected to test excavation yielded artefacts. While some landform categories yielded no artefacts, the number of test pits excavated to sample each landform category was certainly not great enough for these negative results to prove a complete lack of artefactual material in these landforms.

Establishing a complete lack of archaeological material within a sampled area or landform requires a very large number of samples to be taken, since by definition the lower the density of artefacts, the more likely it is to be missed by a given sample. As artefact density approaches zero, the sample size required to detect it approaches 100 per cent. As a consequence, demonstrating an absence of archaeological material with any confidence would require a large sample size, and is not within the scope of this study.

The excavations provided strong support for the statement that surface artefact density does not accurately reflect the density of subsurface artefacts. The majority of the excavated areas had no visible surface artefacts, and the density of surface artefacts was not a predictor of the density of subsurface artefacts within or between the different excavated areas. The presence and abundance of visible surface artefacts within the study area seems to be primarily a product of the nature and extent of sediment erosion, rather than a result of the richness of artefactual material remaining in subsurface sediments.

The general makeup of the artefact assemblage recovered from the test excavations conforms to the predictive model. The model predicts that the majority of an assemblage of flaked stone artefacts found on an archaeological site will be made up of unretouched flakes, with other artefact types (retouched flakes and cores) being much less abundant. This was the case in the assemblages recovered from all of the excavated areas. It was noted, however, that the proportion of retouched flakes in the combined assemblage of artefacts recovered during test excavations is higher than that usually found on archaeological sites in this region of Australia.

The uneven distribution of artefacts between different landform categories provides strong support for various statements in the predictive model. The predicted association between archaeological sites and sources of water is strongly supported by the results of this study. The great majority of the excavated pits that yielded artefacts were situated within 100 metres of a drainage line, and are therefore likely to have been within 100 metres of a source of water (either ephemeral or permanent) in the prehistoric period. In addition to the general association between archaeological material and drainage lines, there is also a strong association between the density of subsurface artefacts and the order of the drainage lines nearby.

Areas near to higher order drainage lines yielded more artefacts per pit than areas near to lower order drainage lines, an association that was significant and measurable using both of the variables employed that quantified the size of an area’s neighbouring drainage lines. Comparing the numbers of artefacts recovered per pit with the order of the nearest drainage line, and the highest order drainage line within 100 metres both resulted in a statistically significant positive correlation. These data strongly signal that the density of subsurface archaeological material is associated with the order of drainage lines in the neighbouring landscape.

In addition to the order of neighbouring drainage lines, the subsurface artefacts recovered are predominantly located on landform types that are the most likely to have been associated with water sources throughout the prehistoric period. Pits excavated on valley floors, and in particular on alluvial flats, yielded significantly higher numbers of artefacts than pits located in other landform contexts. Valley floor contexts are likely to have consistently been associated with sources of water, despite any possible movement of drainage lines across these valley floors that might have occurred during the prehistoric period, or after European colonisation and the consequent clearing of the land and increase in sedimentation along watercourses.

Although we cannot be certain that the current location and ordering of drainage lines accurately reflects the prehistoric situation, and might have varied through time through prehistory, it is more safe to assume that the overall patterning of hills, ridgelines and valleys has remained constant across the post-contact and prehistoric periods, and that these features of the landscape reflect the situation that existed prehistorically. Valley floors have a greater likelihood of being close to sources of water, such as drainage lines, ponds and swamps, than slopes and ridgelines. The higher densities of subsurface artefacts on valley floor and alluvial flat landforms is a good indicator that archaeological material in the study area is associated with areas that were close to sources of water during the prehistoric period.

Similarly, the association between artefact yields and lower valley contexts (as opposed to middle and upper valley contexts) is a robust indicator of an association between subsurface artefact densities and proximity to water sources. Although the patterning of drainage lines, and the location of water-holding features such as ponds and swamps, might have changed following European contact, it is safe to assume that the lower valley contexts have consistently been more likely to hold permanent sources of water than areas in middle and upper valley contexts. The association between artefact numbers and lower valley contexts discovered in this study is consequently a robust indicator that subsurface artefact densities in the study area are associated with landforms with the greatest likelihood of possessing permanent sources of water throughout the prehistoric period.

It is noted that the surface artefact occurrence site B115 is an exception to two general site location trends:

- low numbers and low areal incidences of artefacts on the surface and subsurface of ridgeline crests (3rd order ridges and greater); and
- sites with relatively larger artefact numbers or areal incidence mostly occur within 100 metres of a substantial water source (2nd order streamline or greater).

B115 contains at least 20 surface artefacts within an area of 5 x 5 m. A possible explanation is that the site is representative of a minority category for higher incidence artefact occurrences located on high ground with strategic importance. This importance may be manifest in the viewshed afforded by the landform, or its amenity in across-country movement and access. The landform context of B115 is consistent with both of these characteristics, having an elevation of 120 metres (AHD), close to the maximum in the airport site, and situated at the junction of two major watersheds – the Nepean River and Badgerys Creek.

The data gathered by this study do not allow us to draw conclusions regarding the association between the technological complexity of artefact assemblages relative to their proximity to water. The model predicts that archaeological sites associated with higher order drainage lines (and which are consequently inferred to have had readier access to permanent water sources) will have greater technological complexity in addition to being larger and more dense.

Unfortunately, the overall low numbers of artefacts recovered from each individual excavated pit do not allow an informative analysis of complexity (which could be measured in the number of raw materials, or the number of artefact types) of the assemblages recovered from each pit, and whether this is associated with the landform variables recorded. It has been shown, however, that the excavation locations that yielded the highest number of artefacts also yielded assemblages with the greatest variety of material types and artefact types, a result that is outlined in section 6.3.1. There is, therefore, a general correlation between assemblage size and assemblage complexity, which is a pattern frequently observed in archaeological sites (Grayson and Cole 1998; Plog and Hegmon 1993; Hiscock 2001; Rhode 1988; Langley, Clarkson, and Ulm 2011). Given this correlation, it can cautiously be inferred that the landforms that are richer in subsurface artefacts are likely to contain more varied and complex assemblages. The limitations of the size of the available sample, however, do not allow us to test this proposition directly.

The data gathered by this study do not allow us to evaluate the predictive statement that sites will be focused on creek junctions in preference to other streamline morphologies. The placement of excavated pits was not designed to sample areas near to and removed from creek junctions, and consequently, a comparison of the richness of subsurface artefact assemblages between these two landform types could not be made.

The predicted dominance of silcrete as a material from which stone artefacts are produced has been strongly supported by the data gained in this study. Across all excavated areas, the assemblages of stone artefacts recovered were mostly produced from silcrete, with ambiguous fine-grained material being the second most common material utilised. Other projects in the Sydney basin have identified cherts and tuffs as being commonly utilised materials, and it is likely that the FGS artefacts recorded in this study are made from one or both of these materials.

This study supports the general finding of archaeological research in the Sydney basin that sources of silcrete are plentiful across the landscape, occurring in the form of outcrops or transported nodules deposited in river gravels. The preferential utilisation of this material for the production of flaked stone artefacts is a typical feature of sites across the Sydney basin, and this project's study area conforms to this pattern.

In summary, not all of the predictive statements made by the model can be evaluated using the data gathered in this study. In the case of assemblage complexity, this is due to the small size of the artefact assemblage recovered from all excavated pits in total. Simply, some questions require a larger body of data than can practicably be gathered in the course of a program of test excavations.

The predictive model's statement that assemblages will be denser close to creek junctions could not be evaluated, as a consequence of the placement of excavation pits not being designed to test this prediction. In order to enable a robust testing of the majority of the predictive model's statements, resources were not available to test this particular prediction.

Where sufficient data was gathered to evaluate the predictive statements made by the model, the test excavation program provided support for these statements. The multiple lines of data showing the association between the density of subsurface artefacts and the proximity of water sources is the primary example of this.

Multiple predictions of the model relate to the principle that sites will preferentially occur near water sources, and that the size of archaeological sites is directly correlated with the size and permanence of nearby water sources. The analysis of artefact numbers recovered from the excavated pits relative to the landform variables recorded for each pit provide a strong basis for inferring that these predictions accurately describe the distribution of artefacts across the study area.

Several other predictive statements, such as the dominance of silcrete and the predominance of unretouched flakes over other artefact types, are also supported by the data gathered by the test excavation program.

6.5 Conclusions of the artefact analysis

As a result of the analysis of the stone artefacts recovered during the test excavation program, it has been established that:

- Subsurface artefacts were unevenly distributed between the different excavated areas, with the majority of areas yielding relatively few artefacts, and a small number of the excavated areas being relatively rich.
- Assemblages from all excavated areas were dominated by silcrete over other raw materials, and by unretouched flakes over other artefact types.
- Retouched artefacts make up 12 per cent of the combined artefact assemblage, with the majority of these being backed artefacts.
- The majority of flakes in the combined assemblage have little or no dorsal cortex. Flakes are generally small in size, with a diverse variety of platform types. It is inferred from this that the flake assemblage was produced from small parent rocks, which had been heavily reduced (by the removal of flakes), and which were being treated economically (ie exploited as a valuable resource).
- There is no evidence that the production of flakes within the study area was geared toward the preferential production of any particular flake morphology.

The analysis of landform variables relative to the tested subsurface archaeological resource provided the following findings:

- Subsurface artefact density is unevenly distributed between landform categories, with valley floors and alluvial flats having significantly higher artefact densities than other landforms.
- Subsurface artefact density is significantly higher in lower valley contexts than it is in middle and upper valley contexts.
- Subsurface artefact density is positively correlated with the order of the closest drainage line, and with the order of the largest drainage line within 100m.
- Subsurface artefact density is inversely correlated with elevation, with lower-lying areas having higher densities of subsurface artefacts. These areas are also associated with higher order drainage lines.

- Subsurface artefact density is inversely correlated with watershed spurline order, with areas associated with lower spurline orders having higher artefact densities. Low order spurlines are generally associated with higher order drainage lines.
- As a general inference from multiple lines of data, subsurface artefacts are associated with areas likely to have had easier access to sources of water.

6.6 The archaeologically sensitive landscape

The average areal incidence (artefacts per square metre) of subsurface artefacts according to key landform units is presented in Table 6.18. These figures provide an effective means of gauging archaeological sensitivity across the airport site.

With one exception, landforms with a relatively high average artefact incidence (equal to or greater than 1.0 artefacts per square metre) are:

Valley floor..3.1 a/m^2
Basal slopes ....1.1 a/m^2
First order spurlines ....1.2 a/m^2
Within 100 m of a second order streamline........1.5 a/m^2
Within 100 m of a third order streamline ....2.2 a/m^2
Within 100 m of a fourth order streamline ....1.0 a/m^2
Within 100 m of a fifth order streamline ....3.0 a/m^2

The exception is the mid slope category with an average incidence of 1.3 artefacts per square metre. This figure is not considered to accurately reflect the full geographic scope of this category because most of the test pits conducted in this landform were situated adjacent to basal slopes and are therefore only representative of the lower and down-slope portion of this unit.

Evidence from surface recordings and elsewhere across the Cumberland Plain (as evidenced in the predictive model) indicate that mid slope contexts are unlikely to contain sites with relatively high artefact incidence.

The net areas of those landform units with an average areal subsurface artefact incidence of 1.0 a/m^2 or greater (excluding the mid slope result) are tabulated in Table 6.19.

Table 6.18 Parametric statistics of areal incidence (artefacts per square metre) of subsurface artefacts per pit, according to key landform categories

Broad scale landform	Valid N	Mean	Standard Deviation
Valley floor	45	3.066	3.922
Mid slope	15	1.3334	2.468
Basal slope	17	1.0588	1.434
Upper slope	5	0.400	0.894
2nd Watershed ridgeline	10	0.200	0.632
Secondary Spurline crest	11	0.1818	0.604
Major Watershed ridgeline	10	0.0000	0.000

Watershed ridge/ spurline order	Valid N	Mean	Standard Deviation
1	27	1.186	2.094
2	13	0.308	0.752
3	4	0.000	0.000
4	10	0.200	0.632
5	10	0.000	0.000

Highest drainage line order within 100m	Valid N	Mean	Standard Deviation
1	28	0.214	0.630
2	11	1.454	2.544
3	26	2.154	2.936
4	10	1.000	1.700
5	30	3.000	4.258

Table 6.19 The net areas of landform units with an average areal subsurface artefact incidence of 0.5 a/m2 or greater (excluding mid slopes)

Non-exclusive categories

Landform category or feature	Initial Development (ha)	Longer Term development area (ha)	Whole airport site (ha)
Riparian corridor (100 m either side of drainage line)			
2nd order corridor	266.7	127.6	394.3
3rd order corridor	115	58.5	173.5
4th order corridor	44.3	22.1	66.4
5th order corridor	3.7	73.1	76.8
Ridges and spur crests			
1st order crest	104.7	82.4	187.1
Broad scale landform			
Valley floor	47.8	136.2	184.0
Basal slopes	127.5	86.7	214.2

Exclusive categories

(Note: fluvial corridor and ridge/spurline zones which overlap with valley floor and basal slope units have been excluded)

Landform category or feature	Initial development (ha)	Longer Term development area (ha)	Total within airport site	Proportion of airport site (1845 ha[1])
Riparian corridor (100 m either side of drainage line)				
2nd order corridor	219.3	105.4	324.7	17.6%
3rd order corridor	38.2	6.7	44.9	2.4%
4th order corridor	0	0	0	
5th order corridor	0	0	0	
Ridges and spur crests				
1st order crest	68.7	51.6	120.3	6.5%
Broad scale landform				
Valley floor	47.8	136.2	184.0	10.0%
Basal slopes	127.5	86.7	214.2	11.6%
Total	501.5	386.6	888.1	48.1%

Note 1. The area total includes Australian Government owned lands which are non-contiguous with the airport site

7. Results of stakeholder consultation

7.1 Aboriginal cultural values

This section reports on cultural values which have been communicated by Aboriginal stakeholders, and which are not derived from archaeological interpretation.

All of the stakeholders consulted for this assessment have identified the airport site as a place of Aboriginal cultural significance and continuing cultural connection. The reasons for this are outlined under the following headings:

Material evidence of occupation

The presence of archaeological sites throughout the airport site is a manifest link with their ancestors, with a past way of life, and with a continuing cultural association with the land. Archaeological sites are a tangible component of cultural identity and traditional ownership. In this regard, it is also pointed out that all archaeological sites have cultural significance, regardless of their size, complexity or archaeological interpretation. The relationship between the position of an artefact and its surrounding landscape also has cultural significance. This is often expressed by stakeholders when they specify that after analysis, salvaged artefacts should be returned back to 'their country'.

Cultural landscape values

Although information relating to remembered traditional events in specific places has not been provided, many stakeholders state that the airport site landscape has cultural significance according to traditional lore. A number of landscape features, including prominent ridgelines, and the Badgerys Creek corridor, can be interpreted with reference to traditional knowledge held by various custodians. Many stakeholders expressed the view that there would have been areas and features that would have held special significance, including relationships to stories and law associated with gender roles.

Significant plants, animals and resources

The continuing presence of native animals and plants, and the habitat they require, is considered to be an important part of the cultural significance of the airport site. These are important as traditional sources of food, medicine and raw materials, and for the specific stories and lore associated with them. Some stated examples of significant resources were yams, fresh water mussel, possums, tree timber and bark, and the water from Badgerys Creek. Areas of remnant native vegetation and the riparian corridors of the main creek lines were specifically referenced in this regard.

Educational value

Many stakeholders made reference to their need to educate young people about their culture, lore and traditions. The importance of conserving Aboriginal sites so that they can be accessed for teaching and interpretation is considered to be an important part of maintaining cultural identify, practice and continuity. The educational value of the Badgerys Creek sites was recognised in general by many stakeholders, and in particular, the grinding groove site (B120) and the scarred tree (B40). Similarly, the remnant natural vegetation and riparian corridors across the study area were seen as important educational resources.

A disappearing heritage

A repeated concern expressed by stakeholders was the cumulative impact on Aboriginal sites caused by the continuing urban and industrial development of Sydney across the Cumberland Plain. Given the loss of sites, to date, the remaining sites, such as those in the airport site, are now recognised to have cultural value because of:

- their increasing rarity,
- the need to retain artefacts and sites in their original locations and natural landscapes, and
- the relationship with the land and the sense of cultural identity they support.

Table 7.1 presents specific comments and statements about the cultural values of the airport site provided by Aboriginal stakeholders during the current assessment.

Table 7.1 Tabulation of specific comments and statements from Aboriginal stakeholders regarding Aboriginal cultural values of the airport site

Date	Stakeholder Group	Comment
23/4/15 17/4/15	Darug Land Observations and Darug Custodian Aboriginal Corporation	This area is significant to the Darug people due to this evidence of continued occupation Landscapes and landforms are significant to us for the information that they hold and the connection to Darug people. Darug sites are all connected, our country has a complex of sites that hold our heritage and past history, evidence of the Darug lifestyle and occupation are all across our country, due to the rapid development of Sydney, many of our sites have been destroyed, our sites are thousands of years old and within the short period of time that Australia has been developed pre contact our sites have disappeared. The sites that are low density or single materials are as important as the higher density sites as they show us the connection and the movement of people across the country. Women in the groups were the gatherers, much of the diet of the Darug was plants, and the yam was a staple diet and grew along the waterways in floodplain areas. Darug is the word meaning yam. Included in the diet were berries, seeds (ground down to make flour), tubers, small and large reptiles, mammals, birds and water dwelling animals. Trees were used to make canoes, coolamons, shields, digging sticks, spears, spear throwing tools and boomerangs. The roots and saps were used in tool making as glues for axes and spears. Different reed type plants were used for weaving baskets, ropes and fish traps. Sinew from some animals was also used for rope making. Skins from animals were used for protection and clothing in the colder seasons, skins were cleaned, scraped and treated. Darug people had medicines for all ailments the traditional medicines were of today's standards, many native plants and animals were used to produce medicines. Plants were also used as drink sweeteners and chewed on in

Date	Stakeholder Group	Comment
		dry conditions to prevent dehydration. Many different plants were used as dyes for decorative colours and ceremonial purposes
28/1/15	Walbunja Aboriginal Corporation	Mr Tekowhai stated that the Badgerys Creek area included many significant Aboriginal sites which should be salvaged (via phone).
24/4/15	Gundungurra Aboriginal Heritage Association	Ms Halls stated that she was against the airport proposal being built at Badgerys Creek based on Aboriginal cultural grounds (via phone). The sites should not be destroyed. Darug descendants used to live at Badgerys Creek prior to the airport proposal.
22/5/15	Kamilaroi-Yankuntuatjara Working Group Phil Khan	Mr Khan stated that it was possible that burial sites occur on the flood plains of the airport site, good campsites as well.

7.2 Archaeological values

The Aboriginal stakeholders were consistent in acknowledging the importance of information gained from archaeological recording and analysis. Examples given include the evidence of radiocarbon dating, and the ability to identify past patterns of behaviour, occupation, adaptation, and technological and social change. Archaeological information is seen as complementary to remembered tradition and lore, and evidence from historical records.

While the value of the archaeological method, and the information it generates, is recognised as clearly distinct from Aboriginal cultural evaluation, it is also acknowledged by Aboriginal stakeholders that the potential of a site or an archaeological deposit to provide information about the past has high Aboriginal cultural value.

7.3 Suggested mitigation and management strategies

Aboriginal stakeholders have suggested a variety of mitigation and management strategies for consideration in the assessment. These are noted below:

- Conduct of a 100 per cent surface coverage survey and recording of the airport site.
- Conservation of sites *in situ* wherever possible.
- Conservation and rehabilitation of the natural environment wherever possible.
- Conservation of the two rare sites: B40 (scarred tree) and B120 (grinding grooves) *in situ* and within a riparian reserve along Badgerys Creek.
- Recovery of all surface artefacts prior to development impact
- Recovery, through archaeological excavation, of as much of the subsurface archaeological resource as possible. This is required not only to manage archaeological values, but also the cultural values of the artefacts.
- Exploratory archaeological test pitting for potentially occurring deep deposits, below the clay horizon of the modern soil profile.
- Conduct of salvage excavation if and where appropriate.

- Monitoring of all groundworks by appropriately trained Aboriginal community representatives.
- Damage from construction activities to stone artefacts which remain on-site after the completion of salvage programs is a significant issue and needs to be addressed.
- Ensure the long term archival storage of salvaged cultural material.
- Reburial of salvaged archaeological material (following the completion of recording and analysis) within a specially allocated and managed portion of the airport site.
- Management of all or some of the recovered (salvaged) cultural material in a local, above ground facility which would allow archival storage, periodic display and interpretation, and access by traditional owners and researchers.
- Management should be commensurate with the cumulative impact of the development. It is widely held that this measure of equity has not been evident in past Cumberland Plain development projects.
- There should be adequate compensation provided to the traditional owners and Darug community for the physical destruction of Aboriginal sites, and of the cultural landscape of which they are a part.
- The airport should be given a name sourced from the Darug culture and language.
- The Darug culture and the cultural values of the airport site should be commemorated and interpreted through the public space and infrastructure of the airport.
- The airport should include a prominent and featured public interpretive display about Darug culture and the values of the airport site.

7.4 Non-Aboriginal stakeholder views

The following issues were raised during consultation with the NSW Office of Environment and Heritage, and the Liverpool City Council:

Cultural landscape values

It was considered important that the cultural landscape values of the airport site be addressed in the EIS assessment. The recording of oral history is one avenue for managing the loss of social values resident in a place and its landscape.

Recording social history

It was noted that the recording of local oral tradition, especially from former land owners and occupiers of the airport site could be an important management strategy in the event that the airport development proceeded.

Cumulative impacts

The continuing impact of spreading development across the Cumberland Plain was acknowledged and the impact this was having, and would continue to have, on the archaeological resource and Aboriginal cultural values. It was conceded that cumulative impact has not, for the most part, been effectively mitigated or managed in the past. Very few open space areas or conservation parks in developed contexts, have been established with the conservation management of Aboriginal heritage as a primary criterion.

Neither authority could advise of studies which have quantified the current and projected encroachment of urban and industrial development across the Cumberland Plain and its associated cumulative impacts.

Continued development of the Cumberland Plain is certain. In the face of this reality, the management of cumulative impacts must involve: archival recording, salvage programs and curation, recording of oral history, public interpretation, and commemoration through the use of names, public art, sponsorship and other dedicated facilities.

Management of Aboriginal artefacts which remain on-site during development

The lack of consideration given to Aboriginal artefacts which remain on a development site, or in topsoil spoil heaps, after the completion of archaeological salvage programs, is an increasing source of criticism from Aboriginal stakeholders. A means of managing this material in a culturally sensitive way is required.

The need for a keeping place, and cultural interpretation

It was recognised that despite the extent of development already evident across the Cumberland Plain, there remains no dedicated, secure or effective place for the curation and conservation management of salvaged Aboriginal objects, outside of the Australian Museum. The Museum has increasingly limited storage space and is now highly selective regarding the material it will accept. As a consequence there is no repository where salvaged archaeological or other culturally significant material can be stored according to conservation management standards and as a matter of course.

This would be the function of a 'Keeping Place'. Currently this type of facility is limited to locales in reserved open space areas in which salvaged materials are reburied in relative proximity to their find locations. The current absence of a Keeping Place, where archival curation of salvaged material which cannot or should not be reburied, is undermining the value of archaeological salvage as an effective long term management strategy.

Management of cultural heritage values

Potential means by which the cultural significance of the airport site could be commemorated and the subject of continuing local recognition include:

- the local establishment of a Keeping Place
- the use of Darug names for new infrastructure
- the establishment of commemorative public spaces, plantings, art and activities
- the use of interpretive signage
- interpretation which integrates both Aboriginal and European heritage values
- displays of Aboriginal items and artefacts from the site, and
- the inclusion of a retail shop which sells items created for sale, and which relate to Darug tradition and culture.

8. Significance Assessment

8.1 Assessment Criteria

8.1.1 The Burra Charter

The Burra Charter is a foundation document upon which most local, State and Australian Government conservation management policy and action is based (Aust. ICOMOS 1987). The Charter defines basic concepts, aims and objectives, and outlines a framework for the assessment of significance.

The Charter defines cultural significance as 'aesthetic, historical, scientific or social value for past, present and future generations' (Aust. ICOMOS 1987). The criteria used to assess significance vary according to statutory context and relevance to subject, places, movable heritage and intangible values. The Burra Charter outlines five broad categories applicable to the assessment of the significance of Aboriginal sites. These are:

- significance to contemporary aboriginal people;
- scientific or archaeological significance;
- aesthetic value;
- representativeness; and
- value as an educational and/or recreational resource.

Cultural significance is recognised as a relative value based on variable references within social and scientific practice. The cultural significance of a place is therefore not a fixed assessment and may vary with changes in knowledge and social perceptions.

8.1.2 Commonwealth assessment criteria

The status of the airport site as land owned by the Australian Government places the assessment of cultural significance within the ambit of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Concurrent with the Significance of Impact assessment criteria 1.2, the EPBC Act specifies two sets of criteria for the assessment of heritage significance, one for determining significance which would meet a standard for listing on the National Heritage List, and another for listing on the Commonwealth Heritage List.

The National and Commonwealth Heritage Lists employ nine similar assessment criteria but attach different thresholds. The National Heritage criteria specify a threshold of ‘outstanding heritage value to the nation’. None of the cultural values identified from the airport site are considered to fulfill this threshold and further detail regarding the National Heritage List is not presented here.

The Commonwealth Heritage List is a register of natural and cultural heritage places owned or controlled by the Australian Government. Nominations are assessed by the Australian Heritage Council. In accordance with the EPBC Act, a place has a Commonwealth Heritage value if it meets one of the following Commonwealth Heritage criteria (section 341D):

a) The place has significant heritage value because of the place’s importance in the course, or pattern, of Australia’s natural or cultural history.

b) The place has significant heritage value because of the place’s possession of uncommon, rare or endangered aspects of Australia’s natural or cultural history.

c) The place has significant heritage value because of the place’s potential to yield information that will contribute to an understanding of Australia’s natural or cultural history.

d) The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:

   i) A class of Australia's natural or cultural places, or

   ii) A class of Australia's natural or cultural environments.

e) The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

f) The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.

g) The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

h) The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

i) The place has significant heritage value because of the place's importance as part of Indigenous tradition.

Thresholds

As well as assessing a place against criteria for its heritage value, the Australian Heritage Council applies a 'significance threshold' test. This test helps the Council to judge the level of significance of a place's heritage value by asking 'just how important are these values?'. To be entered on the Commonwealth List, a place must have 'significant' heritage value (Department of the Environment, Heritage website, accessed June 2015). In guidlines prepared by the Australian Heritage Council for Commonwealth agencies on the identification of Commonwealth Heritage Values, it is stated that 'the threshold for inclusion on the Commonwealth Heritage List is local heritage significance' (AHC 2010, p.7). This application of a local level threshold underlines the function of the Commonwealth Heritage List as an instrument for managing places with heritage significance. It is not intended to be a list of places with a Commonwealth or National level of significance.

8.2 Individual site assessments

An assessment of each site recording against the Commonwealth Heritage criteria is provided in table form in Table 8.1. The justification for these evaluations is presented below.

8.2.1 Artefact occurrences

Artefact occurrences comprise 97 per cent (72) of the 74 recorded sites in the airport site.

Fifteen of these include confirmed subsurface archaeological deposits, and 48 have assessed moderate or high subsurface archaeological potential.

Thirty-five of these recordings (49% of artefact occurrences) comprise a single artefact, of which four are recorded from archaeological test pits.

Nine recordings include more than ten artefacts, seven of which were recorded from surface contexts (B45, 46, 66, 80, 102, 113 and 115), and two from subsurface test pits (B88 and 121).

The highest recorded number of artefacts is 64 from the 2014 surface reinspection of site B80 by AMC (AMC 2014), followed by 38 from B121, 36 of which were recovered from test pits.

Based on the maximum artefact count across the various inspections and tests at each site, there is a total of 371 stone artefacts from the recorded sites within the airport site.

Criterion c) – Significance because of potential to yield information that will contribute to an understanding of Australia's cultural history

Fifty-one or 71 per cent of the artefact occurrences are assessed as having significance according to this criterion. This assessment has been based on the archaeological potential of each site, where there is confirmed or predicted moderate or high potential for subsurface archaeological material. In one case (B66), a site with low subsurface potential has been included within this criterion, due to the value of the surface artefact assemblage.

Criterion g) - Significance because of a strong or special association with a cultural group for social, cultural or spiritual reasons.

All of the artefact occurrences are considered to have significance according to this criterion. This assessment is based on statements made consistently across all stakeholders that there is a strong association between persons who identify as Darug, or as Darug descendants, and all archaeological sites situated on traditional Darug lands.

This association is expressed both in terms of cultural identify and typically also involving a spiritual dimension. The latter may relate to the memory or 'presence' of Darug ancestors, together with a concern that artefacts 'belong to', and should remain 'in country' where their makers and users left them.

Criterion i) - Significance because of a place's importance as part of indigenous tradition.

All of the recorded artefact occurrences are also considered to have significance according to this criterion. The Macquarie dictionary defines tradition to be 'the handing down of statements, beliefs, legends, customs, etc., from generation to generation, especially by word of mouth or by practice (Butler 1988:1798).

Based on statements by Darug stakeholders, the Aboriginal sites within the airport site are important to a wider regional tradition which remembers and celebrates the Darug relationship with their land for thousands of years. The sites are an integral part of a cultural landscape which acts as the foundation for this remembrance and an inspiration for continued cultural interpretation and traditional practice.

8.2.2 B40 - Possible Aboriginal scarred tree

There is one recording of a scarred tree from the airport site. The likelihood that the scar has an Aboriginal origin is assessed as 'possible'. The condition of the scar is poor, as is that of the tree, which has a hollow trunk and a missing crown. Despite the poor condition of the heartwood and the un-occluded scar, the regrowth around the margin of the scar appears to be intact. This means that the tree retains a tree-ring record of regrowth following the scarring event.

This tree is considered to have significance according to criteria: b), c), g) and i).

Criterion b) - Significance because of uncommon, rare or endangered aspects of Australia's cultural history.

The rarity of scarred trees on the Cumberland Plain can be demonstrated by a search of the AHIMS Aboriginal sites register. Within the core area of the Cumberland Plain, the register includes only 68 modified tree recordings (all but one of which are scarred trees) (search date: 18 June 2015). This portion of the Cumberland plain is defined as the central and majority portion of the Plain, formed from Wianamatta Group bedrocks, and in which exposures of the underlying Hawkesbury sandstone do not occur. This area comprises 1540 km^2 and contains an incidence of one modified tree recording per 22.6 km^2.

As a core area example of this site type, it can be concluded that site B40 is a rare site type and has significance according to this criterion. Given that a 230 year history of European tree clearance and agricultural development has severely limited the population of surviving old-growth trees on the

Plain, the continued and forecast growth of Sydney's urban areas reinforces the status of Aboriginal scarred trees as an endangered component of the Aboriginal cultural record.

Criterion c) – Significance because of potential to yield information that will contribute to an understanding of Australia's cultural history

Despite the poor condition of the tree and scar, and limitations due to the assessed 'possible' nature of an Aboriginal origin, the B40 site still has significance under criterion c). This is due to the potential of its intact record of regrowth across the scar, to provide information about the original age and shape of the scar. A dendrochronological analysis of the tree's regrowth could provide valuable information relevant to a refined interpretation of the scar's origin, and also provide data to a regional dataset to assist in the interpretation of other tree scars with a cultural origin.

Criterion g) - Significance because of a strong or special association with a cultural group for social, cultural or spiritual reasons.

All scarred trees of possible or greater assessed likelihood of an Aboriginal origin are considered to have significance according to this criterion. This assessment is based on statements made consistently across all stakeholders that there is a strong association between persons who identify as Darug, or as Darug descendants, and all archaeological sites situated within the traditional lands of the Darug.

This association is expressed both in terms of cultural identify and typically also involving a spiritual dimension. The latter may relate to the memory or 'presence' of Darug ancestors, together with a concern that artefacts 'belong to', and should remain 'in country' where their makers left them. Scarred trees are particularly valued by the Aboriginal community because they provide a highly visual marker and easily interpreted feature of a place's Aboriginal history and occupation.

Criterion i) - Significance because of a place's importance as part of indigenous tradition.

In concert with criterion g), all scarred trees of possible or greater assessed likelihood of an Aboriginal origin are considered to have significance according to criterion i). Based on statements by Darug stakeholders, Aboriginal sites within the airport site are important to a wider regional tradition which remembers and celebrates the Darug relationship with their land over thousands of years. Scarred trees preserve a past act of harvest, and as such provide inspiration for both modern oral interpretation, and the continued practise of bark removal for the manufacture of traditional material culture.

Scarred trees can be a valuable aid in teaching past and traditional Aboriginal practice. Where accessible, scarred trees are often incorporated into cultural tours and cultural teaching by Aboriginal community teachers and Elders.

8.2.3 B120 – Grinding grooves

This site consists of at least four grinding grooves on a series of small sandstone outcrops on the edge of a hill side bench, 14 m above, and around 100 metres from Badgerys Creek. The site is a rare example of grinding grooves located on Minchinbury sandstone within the Cumberland Plain and has significance across five assessment criteria:

Criterion b) - Significance because of uncommon, rare or endangered aspects of Australia's cultural history.

A search of the AHIMS Aboriginal sites register within the core area of the Cumberland Plain reveals only three other recordings of grinding grooves situated on Minchinbury sandstone (search date: 18 June 2015). One is situated on the flood plain of South Creek, 1.7 km to the north of the study area (AHIMS site no. 45-5-0215), and the other two in the Toongabbie Creek area in the northeastern portion of the Plain. This provides a site incidence of one Minchinbury sandstone grinding groove recording per 385 km^2 of core Cumberland Plain. This is in contrast, to hundreds of grinding groove sites situated on Hawkesbury sandstone across the Sydney basin, and also from the margins of the Cumberland Plain where down cutting of drainage lines has exposed the Hawkesbury sandstone.

Despite the common nature of grinding groove sites elsewhere across the Sydney Basin, the Minchinbury sandstone grooves are significant for their demonstration of Aboriginal use of a limited resource on the shale dominated landforms of the Cumberland Plain.

Criterion c) – Significance because of potential to yield information that will contribute to an understanding of Australia's cultural history

The B120 site has considerable potential to yield information on the Aboriginal use of Minchinbury sandstone on the Cumberland Plain.

This potential is a result of the following attributes

- The site has the potential to contribute data on a very limited population of similar sites and is thus of great value for future archaeological research, and in providing robust results from statistical analyses.

- The site is one of only two known from the South Creek catchment. Both of these sites are likely to complement each other in presenting opportunities for future research.

- Although no artefacts were detected in three archaeological test pits conducted within 10 metres of the groove outcrops on the adjacent bench, there remains untested potential for subsurface archaeological material to be present in close proximity to, and downslope of the grooved outcrops.

Criterion d) – Significance because of importance in demonstrating the principal characteristics of class of Australia's cultural places

This site appears to demonstrate a number of charcteristics which could be expected of its class. These include:

- the creation of grooves on Minchinbury sandstone;

- the exploitation of sandstone outcrops is most likely when situated in relative proximity to a water source; and

- the use of the Minchinbury sandstone at B120, despite the less-than-ideal quality of the matrix and surfaces for grinding. This suggests that the incidence of sandstone in relative proximity to water, in core areas of the Cumberland Plain, was rare and that available exposures would be used despite their limitations.

It is recognised that, to the knowledge of NOHC staff, no scientific characterisation or comparative analysis of Minchinbury sandstone groove sites has been conducted. Further research is required to validate if this site type can be differentiated from Hawkesbury sandstone sites, based on traits other than bedrock type.

Criterion g) - Significance because of a strong or special association with a cultural group for social, cultural or spiritual reasons.

Based on statements made consistently across all stakeholders, this site type has a strong association with persons who identify as Darug, or as Darug descendants. This association is expressed both in terms of cultural identify and typically also involving a spiritual dimension. The latter may relate to the memory or 'presence' of Darug ancestors, together with a respect for the permanent placement of these sites as significant foci within a cultural landscape. Grinding grooves are particularly valued by the Aboriginal community because they provide easily interpreted visual marker of a place's Aboriginal history and occupation. The grooves are evocative of past expertise, social interaction, and repeated visitation.

Criterion i) - Significance because of a place's importance as part of indigenous tradition.

In parallel with criterion g) values, the B120 site is considered to have significance according to this criterion. Based on statements by Darug stakeholders, high value Aboriginal sites such as B120 are important to a wider regional tradition which remembers and celebrates the Darug relationship with their land over thousands of years. Grinding grooves mark a place of tool manufacture and the application of expert skills and knowledge. As such they provide inspiration for both modern oral interpretation and the continued practise of traditional tool manufacture.

Grinding grooves can be a valuable aid in teaching past and traditional Aboriginal practice. Where accessible, grinding grooves can be incorporated into cultural tours and cultural teaching by Aboriginal community teachers and Elders.

Table 8.1 Individual site significance assessments

Site ID	Site type	No. of recorded artefacts	Archaeological subsurface potential	Significance Criteria								
				a	b	c	d	e	f	g	h	i
B3	sao	1	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B4	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B5	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B7	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B15	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B24	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B25	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B31	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B32	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B39	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B40	mt(st)	1	-	bst	fulfils criterion	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B41	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B42	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B43	sao	5	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B44	sao	3	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B45	sao	12	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B46	sao	13	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B54	sao	2	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B55	sao	2	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B59	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion

Site ID	Site type	No. of recorded artefacts	Archaeological subsurface potential	Significance Criteria								
				a	b	c	d	e	f	g	h	i
B66	sao	16	low	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B67	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B68	sao	1	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B69	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B70	sao	5	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B71	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B74	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B75	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B76	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B77	sao	9	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B78	sao	1	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B79	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B80	sao	64	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B81	sao	1	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B82	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B84	sao	7	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B86	sao	5	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B87	sao	5	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B88	sao +ssao	2 + 16	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B90	sao	2	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B91	sao	2	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B92	sao	4	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion

Site ID	Site type	No. of recorded artefacts	Archaeological subsurface potential	Significance Criteria								
				a	b	c	d	e	f	g	h	i
B93	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B94	sao	1	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B95	sao	8	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B101	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B102	sao	19	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B103	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B104	sao	1	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B112	sao	3	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B113	sao	20	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B114	sao	10	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B115	sao	20	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B116	sao	2	low	bst	bst	bst	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B117	sao	3	high	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B118	sao	2	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B119	sao	2	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B120	gg	4, poss.6	low (refer TL23)	bst	fulfils criterion	fulfils criterion	fulfils criterion	bst	bst	fulfils criterion	bst	fulfils criterion
B121	sao +ssao	2 + 36	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B122	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B123	ssao	7	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B124	ssao	3	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B125	ssao	2	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B126	ssao	2	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion

Site ID	Site type	No. of recorded artefacts	Archaeological subsurface potential	Significance Criteria								
				a	b	c	d	e	f	g	h	i
B127	ssao	1	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B128	ssao	6	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B129	ssao	2	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B130	ssao	1	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B131	ssao	1	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B132	ssao	2	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B133	ssao	5	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B134	ssao	6	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B135	ssao	1	confirmed	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion
B136	sao	1	moderate	bst	bst	fulfils criterion	bst	bst	bst	fulfils criterion	bst	fulfils criterion

bst - below significance threshold for this criteria
mt – modified tree
st – scarred tree

sao – surface artefact occurrence
ssao – subsurface artefact occurrence

8.3 The archaeologically sensitive landscape

The results of the test excavation program, in combination with the surface survey results, have confirmed an interrelated distribution of archaeological sensitivity which is graded and distributed according to key landform variables. Key factors in combination are: proximity to water, the order of the water source (here used as an approximation of size and degree of permanence), locally elevated ground and first order spurlines within valley floor and basal slope contexts, low gradients and aggrading depositional contexts.

Landforms and zones in which relatively higher subsurface artefact incidences have been detected (1.0 or more artefacts per m^2), comprise just under half (48%) of the airport site. The highest average subsurface artefact incidence was 3.1 artefacts per square metre, from select topographic contexts on the valley floor. The valley floor accounts for 10 per cent of the airport site.

Highest potential artefact occurrences on the valley floor are predicted to occur within the 100 metres of third, fourth and fifth order streamlines. These fluvial corridors account for 17 per cent of the airport site (316 ha), and occur roughly equally across the valley floor and basal slope landform categories. The latter two categories also contain the greatest potential for subsurface archaeological deposits, and for potentially rare and higher value archaeological deposits.

Two hundred and eighty stone artefacts have to date been recorded from the surface of the airport site. The corpus of the predicted assemblage of subsurface artefacts within the landforms with relatively high artefact incidence would far exceed this number. The predicted archaeological resource resident within the identified sensitive archaeological landscape must therefore be a foundation component of any assessment of the cultural heritage values resident within the airport site.

8.3.1 Assessment against all criteria

The predicted Aboriginal archaeological resource of the airport site is assessed as having significance according to criteria: b), c), g) and i).

Criterion a) - Significant because of importance in the course, or pattern, of Australia's cultural history

The archaeological resource within the airport site is not assessed as having significance under this criterion. It does not display evidence of, or the potential for evidence of Aboriginal occupation, adaptation or innovation which can be related to persons, events or developments which were important in the course or pattern of Australia's cultural history.

Criterion b) - Significance because of uncommon, rare or endangered aspects of Australia's cultural history.

The predicted and collective subsurface archaeological resource present across the airport site is not considered to be outstanding in terms of artefact incidence or the technological diversity of the sampled assemblages. The content and variability of the analysed artefact assemblage remains consistent with the predictive model for the Cumberland Plain. This resource can be regarded as characteristic of archaeological material from upper catchment and watershed regions of the Cumberland Plain, (with the exception of such areas which occur in proximity to substantial sources of silcrete).

The planned and continuing urban development of the Cumberland Plain will further impact upper catchment landscapes of which the airport site is part. As the proportion of undeveloped land decreases, this cumulative impact is expected to confer an increasing degree of rarity to the remaining archaeological record. Based on this outline, the predicted archaeological resource of the airport site is assessed as an endangered aspect of Aboriginal cultural history, and significant according to this criterion.

Criterion c) – Significance because of potential to yield information that will contribute to an understanding of Australia's cultural history

The predicted archaeological resource within the airport site has considerable potential to yield information that will contribute to an understanding of the Aboriginal cultural history of the Sydney Basin. Based on the evidence of the sampled archaeological deposits, the airport site provides a substantial opportunity to conduct systematic archaeological research on a representative sample of sites within an upper catchment landscape. This resource, and the opportunity to investigate it as a whole, will become increasingly limited in the future. Such research would complement previously conducted large area archaeological investigations which have typically occurred in lower catchment landscapes, and in association with higher order drainage lines.

The distribution of aggrading landforms across the valley floor and basal slopes, and at a lesser and finer scale across the remainder of the airport site, provides potential for encountering rarer sites, such as cultural deposits associated with buried former land surfaces. Although this potential is considered to be highly limited and difficult to quantify using stage one test excavation methodologies, a review of geotechnical borehole data indicates scope for addressing this potential in future studies.

Criterion d) – Significance because of importance in demonstrating the principal characteristics of class of Australia's cultural places

The substantial degree of European land use impact evident across the airport site has reduced the value of the associated archaeological resource to a level below the significance threshold for this criterion. There are no examples of land surfaces, landforms or broader landscapes which display a necessary degree of intactness or integrity to demonstrate the principal characteristics of Aboriginal occupation within such a landscape. The high degree of land surface modification is particularly evident along drainage lines and the valley floor where erosion, the creation of dams and agricultural cropping has transformed much of the landscape.

Criterion e) - Significant because of importance in exhibiting particular aesthetic characteristics valued by a community or cultural group

The predicted archaeological resource of the airport site is not considered to have significance according to this criterion. Some individual artefacts may be considered to display aesthetic characteristics however it is not a value which can considered applicable to the corpus of the predicted artefact assemblage.

Criterion f) - The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period

The predicted archaeological resource of the airport site is not considered to have a sufficient value which reaches the necessary threshold for this criterion. A range of technical skills and techniques are demonstrated in the sampled stone artefact assemblage but are not considered to display a high degree of creative or technical achievement relative to the period or in comparison to more technologically complex sites from other Cumberland contexts.

Criterion g) - Significance because of a strong or special association with a cultural group for social, cultural or spiritual reasons

Based on statements made consistently across all stakeholders, the remaining Aboriginal archaeological record across the airport site has a strong association with persons who identify as Darug, or as Darug descendants. This association is expressed both in terms of cultural identify and a spiritual dimension. The latter may relate to the memory or 'presence' of Darug ancestors, and a belief that artefacts 'belong to', and should remain 'in country' where their makers and users left them. The presence of artefacts within the soil matrix, and as a part of the landscape itself, is often referenced as evidence of traditional ownership and a cultural relationship with country. Aboriginal stakeholders frequently state that all archaeological sites, ranging from single artefacts to large assemblages are considered to have cultural significance in this way.

Criterion h) - The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history

The predicted archaeological resource of the airport site is not considered to have significance according to this criterion. A number of Darug family groupings are historically associated with the central and western districts of the Cumberland Plain, and the eighteenth century Darug warrior Pemulwuy is thought to have recruited followers from the same region. These associations do not however reach a sufficient threshold for recognition according to this criterion.

Criterion i) - Significance because of a place's importance as part of indigenous tradition.

Based on statements by Darug stakeholders, all Aboriginal sites within the airport site, including those not yet detected (the predicted archaeological resource) are important to a wider regional tradition which remembers and celebrates the Darug relationship with their land. This is a relationship which is described both in terms of a long time depth (thousands of years), and as a continuing living tradition. The Macquarie dictionary defines tradition to be 'the handing down of statements, beliefs, legends, customs, etc., from generation to generation, especially by word of mouth or by practice (Butler 1988:1798). The Aboriginal sites on the airport site are an integral part of a cultural landscape which acts as the foundation for this remembrance and an inspiration for continued cultural interpretation and traditional practice.

8.4 Potential for nomination of places to the Commonwealth Heritage List

This assessment has identified places within the airport site with cultural heritage values that are significant as measured against the Commonwealth Heritage List significance criteria. These findings provide a basis for the consideration of nominating one or more places for listing on the Commonwealth Heritage List. Consideration should also be given to any consequential obligations defined by the EPBC Act for Australian Government agencies, and the DIRD Heritage Strategy (DTRS 2005, Godden Mackay Logan 2011).

The Commonwealth would need to consider the Commonwealth heritage provisions of the EPBC Act in developing its strategy for managing heritage as part of the development of the proposed airport.

In the event that consideration is given to nominating places for listing on the Commonwealth Heritage List, the following issues should be addressed:

- the long term role of the Australian Government in the tenure and control of the subject place;
- the potential impact of the airport development and the potential for long term conservation of the place; and
- the need to prepare management plans for all listed places which are consistent with Commonwealth heritage management principles.

9. Assessment of Impacts

9.1 Impact Categories

9.1.1 Construction

Construction impacts are defined as those which are a result of the construction of the airport. A majority of the airport construction impacts would be direct impacts where material items, sites and landforms are substantially modified, removed, or destroyed.

The potential to avoid these impacts is largely negated by the broad-scale and transformative nature of the development. A limited number of indirect impacts could also be anticipated such as impact to the visual and landscape context of sites. These include noise and impact to surrounding landscape features.

For the purposes of this assessment, construction impacts are considered separately according to an initial airport development and a subsequent longer term development stage. The former is considered in detail and according to the specifications of the development as currently known. The latter stage is considered in general terms only.

9.1.2 Operational

Operational impacts are defined as those which result from the day-to-day operation of the airport. These relate to indirect impacts, such as impact to the visual, aural and landscape contexts of adjacent sites.

As for construction impacts, operational impacts are considered separately in this assessment according to an initial airport development and a subsequent longer term development stage. The former is considered in detail and according to the specifications of the development as currently known. The latter stage is considered in general terms only.

9.1.3 Cumulative

Cumulative impacts are defined as the incremental, collective or aggregate effect of a development upon a region or area with respect to the existing or surviving regional Aboriginal archaeological resource and cultural heritage values (Buckley 1994).

Cumulative impact analysis necessarily takes into consideration past and current impacts and may also refer to the anticipated future consequences of a development. The assessment of cumulative impact aims to consider the potentially deleterious effect of the development from a broad regional perspective, rather than as a localised impact within a development boundary. An assessment requirement is therefore a characterisation of the relevant archaeological region within which the development is located. The impact of the development with respect to the regional resource may then be estimated.

For the purposes of this analysis the archaeological region relevant to the airport is defined as the core portion or the 'Shale Slopes' of the Cumberland Plain. This is the landscape in which only landforms derived from the shale dominated Wianamatta Group of rocks are evident. It is exclusive of the river plain and dissected plateau divisions of the Cumberland Plain (refer to Section 3.1.2). The airport site comprises around 1.2 per cent of the Shale Slopes landscape.

The cumulative impact of the airport development can be divided into two components:

- impact relative to the aggregate of previous similarly impactive development; and
- future impacts which are a likely consequence of airport operation.

An important premise for the assessment of cumulative impact is that similar landforms, in similar contexts, will be associated with a similar archaeological resource. This is supported by the predictive model, but with the important rider that the associated resource may be variably degraded according to the degree of land surface disturbance. This premise allows for comparative analyses by using area measurements of similar landforms and disturbance levels.

9.2 Initial airport development

9.2.1 Construction

The proposed initial airport development area includes 39 Aboriginal sites within areas of land disturbance works. All of these recordings comprise artefact occurrences. Construction and development related works would also occur outside of the initial airport development area in the form of drainage swales, detention ponds, and potentially other works in accordance with the Airport Plan and subject to any requirements under the Airports Act. The planned drainage swales which would link the initial airport development area with detention ponds adjacent to Badgerys Creek have the potential to impact additional sites, as could other as yet unspecified works. Quantification of this impact is dependent on future design. The ID numbers of sites affected by the initial construction impact are shown in Table 9.1.

Table 9.1 Sites which would be directly impacted by Initial development construction works

Development area	Affected surface sites	Total
North and west of proposed boundary fence and earthworks boundary	B24, B25, B32, B39, B43, B44, B69, B70, B71, B77, B78, B79, B80, B81, B82, B84, B86, B87, B88, B91, B92, B94, B95, B112, B113, B114, B115, B116, B119, B122, B127, B128, B129, B131, B134	35
Detention Ponds south and east of the proposed boundary fence and earthworks boundary	B5, B101, B102 and B136	4
Drainage swales between earthworks boundary and detention ponds	Subject to design	
Other potential works in accordance with Airport Plan and subject to Airports Act	Subject to design	
Total		at least 39

With regard to the predicted subsurface archaeological resource, the initial construction works would directly impact 501 hectares of archaeologically sensitive landform. This constitutes 27 per cent of the whole airport site. These landform categories, and their affected proportions, are shown in Table 9.2.

The proposed initial development would directly impact all of the archaeologically sensitive landforms associated with the airport site's three north flowing, third and fourth order tributary drainage lines. A portion of the riparian corridor within the airport site along Badgerys Creek would be protected within an environmental conservation zone. The archaeological resource within this zone would also be protected by this zoning. The extent to which the drainage swales would impact the catchment remains to be outlined and quantified.

In addition, all of the higher relief and prominent topography of the airport site would be transformed into a level and graded platform. This would substantially alter and remove the natural topography which acts as an important medium for Aboriginal people to 'read' and experience the Aboriginal cultural values of the land. The loss of the natural landscape across this area would thus represent an appreciable loss of Aboriginal cultural value.

9.2.2 Operation

The operational impacts of the proposed initial airport development would be limited to indirect impacts on the contextual values of adjacent and nearby sites. All known sites within 500 m of the proposed Stage 1 development consist of artefact occurrences. The heritage values of sites of this type, unless valued for their public interpretation or visitation based on Aboriginal cultural reasons, are unlikely to be vulnerable to indirect impacts such as loss of context. Consequently, it can be concluded that the operational impacts of the proposed initial development would be of a low level.

Table 9.2 The area and proportion of archaeologically sensitive landforms subject to direct construction impact from initial development of the airport

Landform category[1] or feature	Area within Initial development area (ha)	Proportion of airport site	Total of this landform category within whole of airport site (ha)	Proportion of total landform area within airport site (1845 ha[2])
Riparian corridor (100 m either side of drainage line)				
2nd order corridor	219.3	11.9%	324.7	17.6%
3rd order corridor	38.2	2.1%	44.9	2.4%
Ridges and spur crests				
1st order crest	68.7	3.7%	120.3	6.5%
Broad scale landform				
Valley floor	47.8	2.6%	184.0	10.0%
Basal slopes	127.5	6.9%	214.2	11.6%
Total	501.5	27.2%	888.1	48.1%

Notes: 1. The categories in this table are mutually exclusive. The area of fluvial corridors and crests which overlap valley floor or basal slope topography have not been tabulated

2. The area total includes Australian Government owned lands which are non-contiguous with the airport site.

9.2.3 Cumulative

The initial development areas would comprise around 60 per cent of the airport site, and include around 27 per cent of the site's archaeologically sensitive landforms. As such, the degree of cumulative impact, relative to the aggregate of past regional development would be approximately half that of the whole site, and roughly equal with the impact of the longer term development area. Despite this, the initial stage would have a substantially greater impact on future surrounding development because it will establish a focus for further commercial and industrial development in adjoining lands. This effect is anticipated and allowed for in the South West Growth Centre through an intended zoning for industrial development along the eastern side of Badgerys Creek adjacent to the airport site.

Figure 9.1 presents the position of the airport site, relative to a 2005 Landsat image and an outline map of the Cumberland Plain. A visual comparison of the two reveals a preference for past and current urban development to be situated on the plain, especially where associated with a transport corridor to the central city regions. The Landsat image reveals how prominent the size the airport site is in relation to the remaining undeveloped portions of the Cumberland Plain. It also reveals the high proportion of the plain which has been cleared of native vegetation for agriculture – thus supporting the evidence for the rarity of Aboriginal scarring on old-growth trees.

The planned and projected future urban and industrial growth areas in the western Cumberland Plain are shown in Figures 9.2 and 9.3. The combined area of the North West and South West Growth Centres, together with the Broader Western Sydney Employment Area is approximately 38,000 ha. This area of planned urban and industrial development would infill a substantial majority of the remaining non-developed lands across the Cumberland Plain. Both the Broader Western Sydney Employment Area and South West Growth Centre are situated within the Shale Slopes division of the Cumberland Plain. Together these zones cover 28,000 hectares, which is approximately 22 per cent of the Shale Slopes division.

Another regional measure of cumulative impact is the developed area as a proportion of the South Creek catchment (Figure 9.3). This catchment comprises 620 square kilometres and dominates the central and northern half of the western Cumberland Plain (Rae 2007:7). In 2000, urban development occupied 12,536 ha of the catchment. The remaining undeveloped catchment lands at this time, amounted to approximately 495 square kilometres, the proposed airport site being 3.4 per cent of that area. Almost all of the combined area of the North West and South West Growth Centres, and the Broader Western Sydney Employment Area are situated within the South Creek catchment. These areas comprise 380 square kilometres, and together with the existing urban development of at least 125 km^2, represent 505 square kilometres or 81 per cent of the catchment. The proposed airport site would then represent 15 per cent of remaining undeveloped lands.

It can be concluded that the cumulative impact of the proposed initial airport development would be substantial. This is a consequence of both its incremental effect on the aggregate of past development across comparable portions of the Cumberland Plain, and especially the aggregate of future planned development. The proposed airport would serve as a key infrastructure component amongst planned growth centres. The generation of secondary commercial enterprises would stimulate development of adjoining areas. It can be predicted that the aggregate future impact of the planned Western Sydney growth centres will be the survival of a very small proportion of the Cumberland Plain natural landscape, especially when measured as a proportion of the South Creek catchment or the low relief rolling terrain of the core areas of the plain.

The observation by the Aboriginal stakeholder community that management of the cumulative impacts of most past developments on the plain has been non-existent or ineffective, lends emphasis to this conclusion. The absence of an Aboriginal Keeping Place for the storage of cultural material salvaged from the Cumberland Plain is raised as evidence of the short-comings of past approaches to cumulative impact.

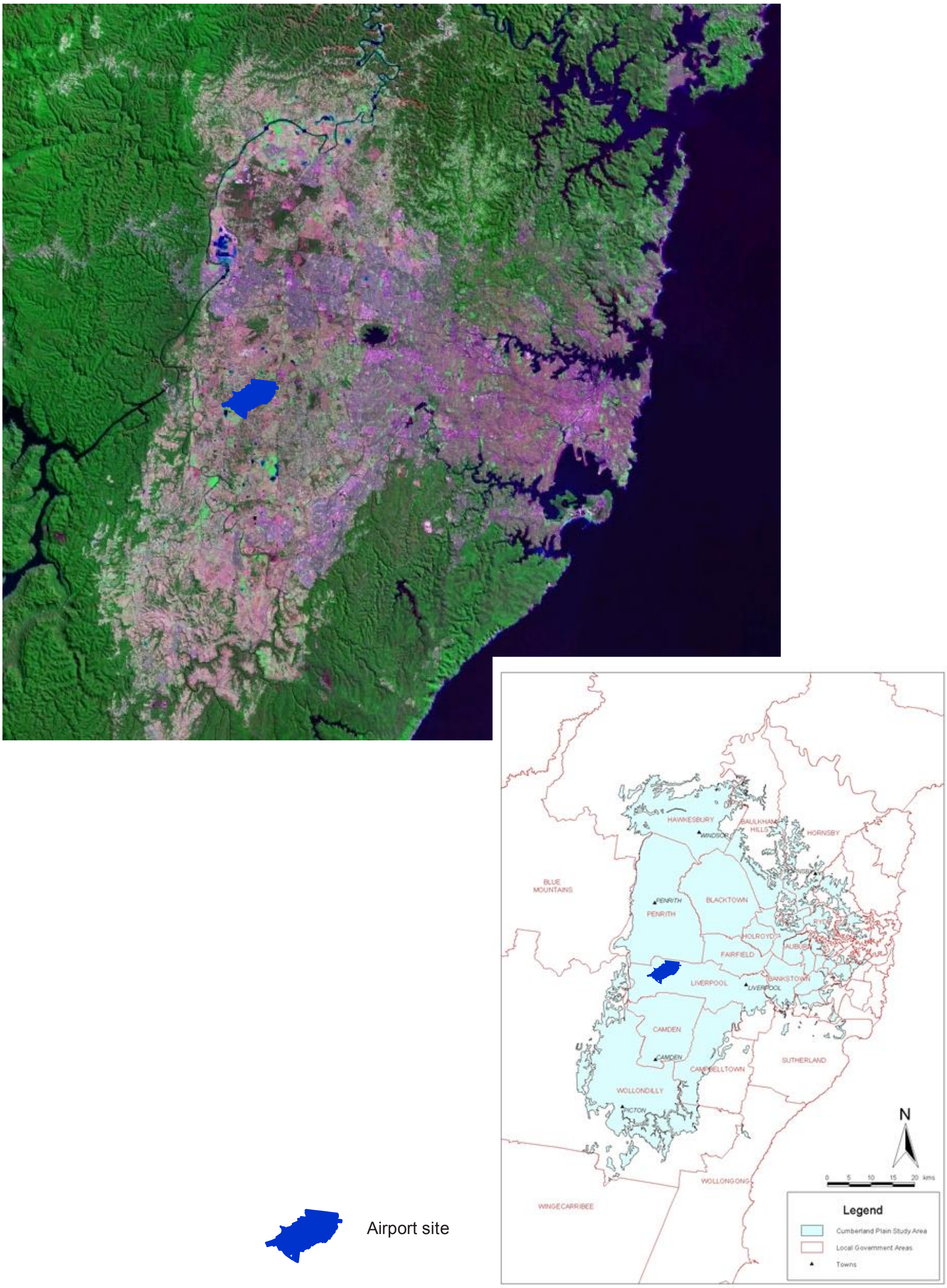


Figure 9.1 Comparison of a 2005 false colour Landsat image of Sydney and the Cumberland Plain, showing built up urban areas as purple, and cleared areas as pink. An outline of the Cumberland shale based landforms is provided for comparison. (Top image: Sydney suburbs geocover". Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Sydney_suburbs_geocover.png#/media/File: Sydney_suburbs_geocover.png. Bottom image: http://www.environment.nsw.gov.au/threatenedspecies/MapOfTheCumberlandPlain.htm)

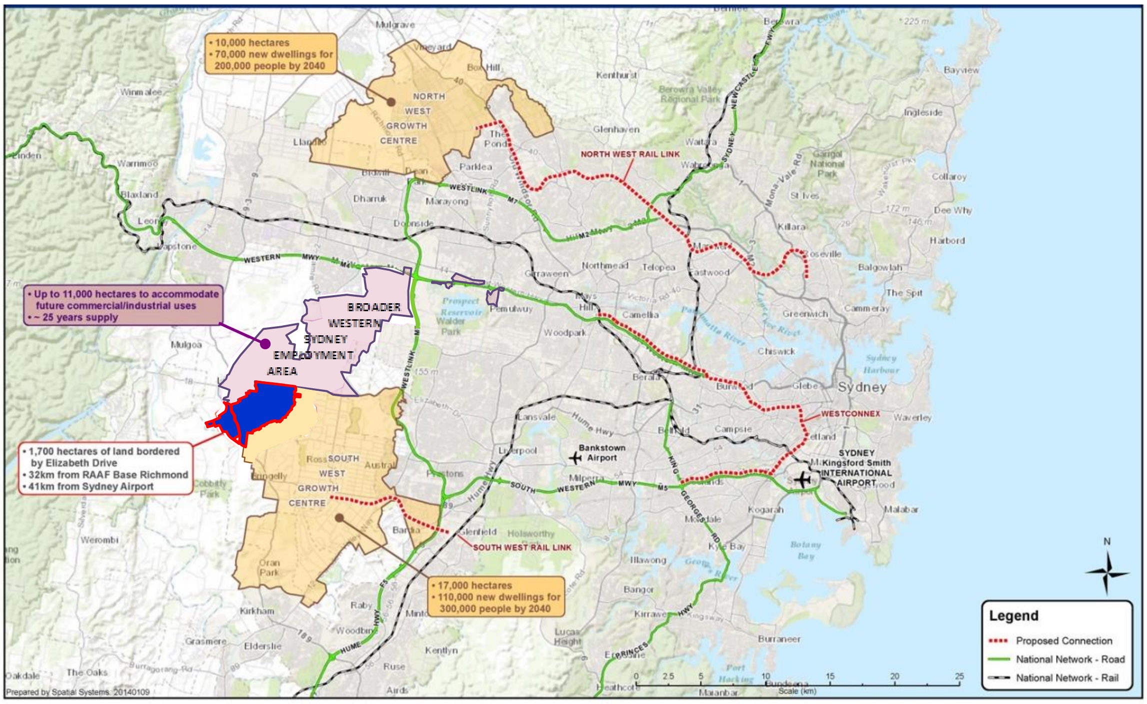


Figure 9.2 The airport site relative to existing urban development (grey) and planned future infrastructure and growth areas on the Cumberland Plan: North West Growth Centre, Broader Western Sydney Employment Area, and the South West Growth Centre (from the Western Sydney Infrastructure Plan, source: http://www.inspiredfinance.com.au/Images/badgerys_creek/Badgerys_Creek_Map.jpg).

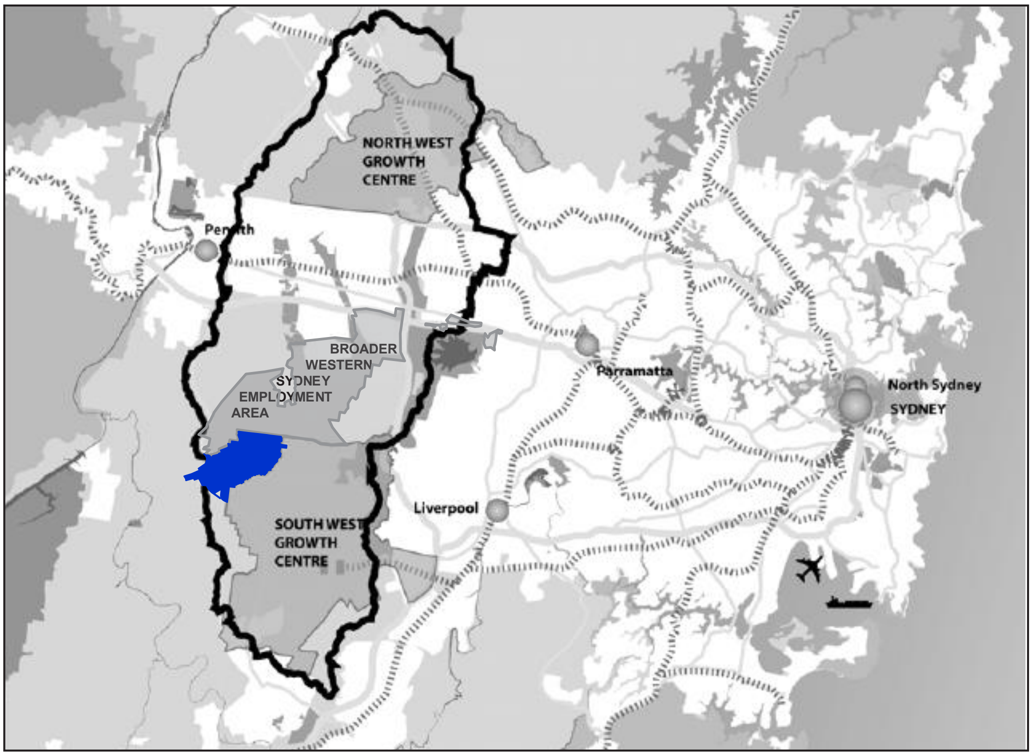


Figure 9.3 The catchment of South Creek (black boundary), relative to the airport site (blue), existing urban development (white) and planned growth centres (darker grey) (base map source: Rae 2006:Figure 6, p.9).

9.3 Longer Term Development

9.3.1 Construction

The proposed longer term development area includes 21 Aboriginal sites within areas of land disturbance works. All of these recordings comprise artefact occurrences. Eleven sites, including grinding groove site (B120), and the possible Aboriginal scarred tree (B40), occur in relative proximity to Badgerys Creek and as they would remain unaffected, present an opportunity to be incorporated into an open space conservation zone between the west bank of the creek and a boundary fence. The ID numbers of sites that would be directly impacted by longer term construction are shown in Table 9.3.

With regard to the predicted subsurface archaeological resource, the longer term construction works would directly impact about 387 hectares of archaeologically sensitive landform. This constitutes 21 per cent of the whole airport site. These landform categories and their affected proportions are shown in Table 9.4.

The proposed longer term development of the airport site would directly impact a major proportion of the remaining Badgerys Creek catchment across the eastern half of the site.

The location of the longer term development area on the eastern fall of the Badgerys Creek catchment means that the levelling of the landscape to create a graded level platform, continuous with the initial development, would substantially alter and remove the natural topography framing Badgerys Creek. The 'lie of the land' acts as an important medium for Aboriginal people to 'read' and experience the Aboriginal cultural values of the land. Its loss on the western side of the creek would represent an appreciable loss of Aboriginal cultural value.

9.3.2 Operation

The operation impacts of proposed development within the longer term development area would be limited to indirect impacts on the contextual values of adjacent and nearby sites. All but two of the known sites within 500 m of the longer term development area consist of artefact occurrences. The heritage values of this site type, unless valued for their pubic interpretation or visitation based on Aboriginal cultural reasons, are unlikely to be vulnerable to indirect impacts such as loss of context.

The two exceptions are the grinding groove site (B120) and possible Aboriginal scarred tree (B40). Both of these sites could potentially be situated in close proximity to the boundary fence. Given the cultural heritage values of these sites and their potential for public interpretation, the indirect impacts of the adjacent development area on their contextual values are likely to be appreciable.

9.3.3 Cumulative

The longer term proposed development area comprises around 40 per cent of the airport site, and includes around 21 per cent of the site's archaeologically sensitive landforms. As such, the degree of cumulative impact, relative to the aggregate of past regional development would be approximately half that of the whole site, and roughly equal with the initial development area. Development of the longer term area would have a considerably smaller impact on future surrounding development because it would simply extend an already established enterprise. The broad scale cumulative impacts of further commercial and industrial development in adjoining lands are likely to have already occurred by the time of its development. The urban and industrial zoning originally planned for, and paired with, the airport development is most likely to have been established by this time. Cumulative impacts from further development in the region are likely to involve infill or redevelopment within these already established zones. As a consequence, and in contrast to Stage 1, the cumulative impact of the longer term development would be considered only to be moderate in scale.

Table 9.3 Sites which would be directly impacted by construction works in the longer term development area

Development area or land use zone	Affected surface sites	Total
North and west of the proposed boundary fence	B3, B15, B31, B42, B46, B59, B66, B67, B68, B75, B76, B95, B104, B117, B118, B121, B123, B124, B125, B126, B132,	21
Potentially situated in environmental conservation zone including Badgerys Creek	B4, B7, B40, B41, B54, B55, B74, B90, B120, B130, B133	11
Total		32

Table 9.4 The area and proportion of archaeologically sensitive landforms subject to direct construction impact from longer term development of the airport site. Note these are mutually exclusive categories. The area of fluvial corridors and crests which overlap valley floor or basal slope topography have not been separately tabulated.

Landform category or feature	Area within longer termdevelopment area (ha)	Proportion of airport site	Total of this landform category within whole of airport site (ha)	Proportion of total landform area within airport site (1845 ha[1])
Riparian corridor (100 m either side of drainage line)				
2nd order corridor	105.4	5.7%	324.7	17.6%
3rd order corridor	6.7	0.4%	44.9	2.4%
4th order corridor	0		0	
5th order corridor	0		0	
Ridges and spur crests				
1st order crest	51.6	2.7%	120.3	6.5%
Broad scale landform				
Valley floor	136.2	7.4%	184.0	10.0%
Basal slopes	86.7	4.7%	214.2	11.6%
Total	386.6	20.9%	888.1	48.1%

Note 1. The area total includes Australian Government owned lands which are non-contiguous with the airport site

9.4 Greater Blue Mountains World Heritage Area

At its closest point, the Greater Blue Mountains World Heritage Area (GBMWHA) is situated approximately seven kilometres to the west of the airport site. The Area was listed on the World Heritage List in 2000 based on its fulfilment of two of the criteria for natural values of outstanding universal value. These involve outstanding examples of ongoing biological processes significant in the evolution of Australia's ecosystems, and significant natural habitats for the *in situ* conservation of biological diversity (NSW NPWS 2009).

The World Heritage listing does not refer to the area's Aboriginal cultural heritage values, however the strategic plan for the GBMWHA notes that protection of the area's other important values, such as Aboriginal cultural heritage, is an integral component of managing the reserves that constitute the GBMWHA, both individually and as a whole (NSW NPWS 2009:11,32).

The Aboriginal cultural heritage values of the Greater Blue Mountains (GBM) Area are derived from a broad spectrum of material evidence, lore and practice. These can be summarised by the following:

- The landscape and its features, especially those which relate to Dreamtime and other cultural and historical stories
- The biota, including animals and plants with special cultural significance as sources of medicine, bush tucker and raw material
- The archaeological and cultural sites present, including a large corpus of rock art and rock shelter sites
- Oral tradition, stories and lore, and
- Continuing traditional practice and interpretation conducted by traditional owners.

There is little potential for the proposed airport to directly impact the Aboriginal cultural heritage values of the Greater Blue Mountains Area.

Fuel dumping is an extremely rare event, and normally conducted at an altitude which makes it very unlikely that any significant quantity of fuel, if any, will reach the ground. Potential impacts on World Heritage values from this source have been considered further in other technical studies undertaken to support the EIS.

Indirect impact to cultural heritage values potentially include those associated with temporary loss of contextual value from the periodic intrusion of aircraft noise or from aircraft arriving at or departing from the proposed airport. This could potentially affect sites, such as rock shelters and open sites, where there is an expectation or requirement for a quiet and natural surrounding environment. Sites within this category could include those developed for public access and interpretation, sites at which traditional Aboriginal activities are performed, and sites within wilderness zones. A limited number of sites have been developed or interpreted for public visitation in the Blue Mountains National Park, these include: Shaws Creek K1, Burralow, Red Hands Cave, Campfire Creek, Kings Tableland, Lyre Bird Dell and Asgard Swamp (NSW NPWS 2001:47; Attenbrow 2010:186).

Wilderness zones form part of the current management zoning in the GBM Area and incorporate objectives such as the conservation of 'pre-European' landscapes with minimal historical and European intrusion, including aircraft noise and vapour trails (NSW NPWS 2001). The potential intrusion of low flying general aviation aircraft undertaking sightseeing flights is currently managed over the Blue Mountains National Park through the implementation of a voluntary code of practice known as a Fly Neighbourly Advice (NSW NPWS 2001:40). This code of practice does not apply to regular public transport aircraft operations.

In conclusion, any potential impacts from an airport development that may affect cultural heritage values of the GBM Area would be indirect in nature and relate to airport noise and visual intrusion from aircraft.

10. Mitigation and Management Strategies

10.1 Terminology

In this section, the term 'mitigation' is defined as actions and strategies which prevent the loss of cultural heritage values. Typically mitigation would involve avoiding direct impact to an item or place. Mitigation mostly occurs prior to the commencement of development-related disturbance, and involves the adoption of policy or specifications which direct planning and design.

The term 'management' is defined as actions and strategies which reduce the loss of cultural heritage values. This may involve partial conservation, discovery and handling protocols, the recovery of information and cultural material through archaeological salvage, and compensatory measures.

10.2 Discussion

This assessment has identified a range of Commonwealth Heritage values, that variously fulfil five of the nine Commonwealth Heritage List significance criteria. These relate to both individual sites and to the corpus of known and predicted archaeological resource as an aggregate. Values include those communicated by Aboriginal stakeholders regarding their cultural tradition and practice, and scientific values relating to rarity and potential to yield information.

The following is an outline of the key considerations regarding the mitigation and management of the anticipated impacts of the proposed airport on the identified Commonwealth Heritage values. It should be noted that Commonwealth Heritage values relate to the significant values of places on land owned or controlled by the Australian government. The effective management of these values, relative to the potential impact of the proposed airport, would vary according to the assessed nature of significance.

Limited scope for mitigation

The scope for mitigation is very limited due to the primary requirement of the proposed development for a broad continuous area of well drained, level ground with unencumbered flight approaches. This has the consequence that for most sites and most of the subsurface archaeological resource, there is no potential for *in situ* conservation.

A limited opportunity for *in situ* conservation management is afforded by the proposed retention of native vegetation and open space along a part of the Badgerys Creek within a proposed Environmental Conservation zone. Aboriginal sites which occur within this area include two high value sites, the grinding groove site (B120) and the possible Aboriginal scarred tree (B40).

The lack of an *in situ* conservation management option across most of the proposed airport site means that construction impacts to Commonwealth Heritage values must be addressed through the conduct of archaeological salvage, and of measures which address impacts to non-archaeological and intangible cultural values. Any program of archaeological salvage must address the broad-area nature of the impact, and ensure that variability within the archaeological record relative to the impacted landscape is adequately sampled.

Staged implementation of the proposed airport

The focus of the mitigation and management strategies in this assessment relates to the anticipated impacts of the initial proposed development of the airport site. Given that the potential longer term development of the site is known only in outline and may be assessed within a different statutory context to the current assessment, the provision of strategies for the longer term are limited to general principles and the continuity of practice from the initial stage.

Strong and current opposition to the airport proposal from many of the Aboriginal stakeholders

There is strong opposition to the airport proposal from many of the Aboriginal stakeholders based on their appreciation of the Aboriginal cultural values which would be impacted, and especially the degree of landscape change and site loss which would result from airport construction.

This emphasises the need to adopt management strategies which would effectively address the loss and/or impacts to Aboriginal cultural values. Principal concerns expressed by Aboriginal stakeholders include:

- The need to minimise, wherever feasible, direct impact to Aboriginal sites and cultural values.
- The need to offset and address the loss of Aboriginal heritage values that would result from airport development.
- The need for the Aboriginal stakeholder community to be consulted and included in the development and conduct of mitigation and management strategies which effect their heritage.
- The need to address the cumulative impacts of the development, especially with regard to the existing, and planned future development of the Cumberland Plain.
- The need to provide for the culturally appropriate repatriation, and where appropriate, the long term curation, of all salvaged Aboriginal archaeological materials.
- The inclusion of commemorative elements within the airport development which celebrate and interpret the Aboriginal cultural heritage of the site.
- The need to adopt protocols and on-site training during the construction phase. These would reduce impact to cultural values, and allow for better management of Aboriginal archaeological material that may remain on site during construction activities.

Curation of cultural materials

Two modes for the potential future management of salvaged Aboriginal archaeological material have been described as culturally appropriate by Aboriginal stakeholders. The first is reburial within a specifically reserved and managed area, within the local area of the airport site. This mode maintains cultural identity and values by replacing artefacts within the general region of their original find-locations, and to the ‘country’ they belong to.

The second is long term storage and curation within a ‘Keeping Place’ which maintains future access to the collection for cultural, educational and research purposes. The first mode is now an established strategy for many large developments across the Sydney Basin and elsewhere. The second however, remains an unfulfilled objective for the Cumberland Plain due to the lack of a physical locality, facility or supporting administrative structure. The need for such a facility is now pressing due to 2012 changes in the deposition policy of the Australian Museum, Sydney, which formerly acted as a repository for salvaged materials (Australian Museum 2012).

Addressing cumulative impacts

There is a range of means by which cumulative impacts can be managed. The most effective are those which establish long term compensatory actions, and as such, offset the loss of values which (in the absence of developmental impact) would otherwise have remained resident within the landscape, ‘country’ and place.

The following strategies involve long term compensatory actions which would be appropriate for addressing cumulative impacts:

- Establishment of offset conservation reserves which include a representative sample of the archaeological resource subject to direct impact;
- Establishment of long term, on-site, elements which commemorate, promote and interpret Aboriginal cultural values to the general public;
- Establishment of facilities for the long term curation, access, management and interpretation of cultural materials salvaged as a part of impact management programs. The ongoing nature and continuity of such facilities provides a valuable contribution to managing the long term losses inherent in cumulative impacts.

The first of these strategies, the establishment of offset reserves, is not a feasible option for the proposed airport, due to the nature of the airport site, the archaeological resource subject to impact, and constraints inherent in the surviving resource of the Cumberland Plain. The latter two strategies remain feasible options and each are addressed as integral components of the impact management proposals defined in sections 10.3.2 and 10.4.2.

It is recognised that protocols and facilities are required for the long term curation of Aboriginal cultural material that would be salvaged as a result of the proposed airport development. Based on the views of Aboriginal stakeholders, options for curation include:

- a “keeping place” for the conservation management of that portion of salvaged Aboriginal cultural material, which according Aboriginal stakeholders should be stored above-ground in a secure facility, and for which future access for cultural purposes, interpretation, education or research should be maintained; and

- repositioning or reburial of material at one or more appropriate locations within the local landscape, that would be determined in consultation with Aboriginal stakeholders.

It is acknowledged that the effective establishment of an above-ground ‘keeping place’ facility would require the participation of many levels of government and stakeholder representation, and include a long term view of the facility’s function and application. The potential use of such a facility for the curation of other salvage collections from Western Sydney developments would be an important consideration in planning and conception. From this basis, a commitment is made to consult with other levels of government and relevant Aboriginal community representatives with the objective of developing protocols for the long term archival storage and conservation management of Aboriginal cultural material.

10.3 Initial airport development

10.3.1 Mitigation

The following mitigation actions address the opportunity for conservation in those portions of the airport site not directly impacted by the proposed airport.

S1 The Aboriginal grinding groove site (B120) should be conserved *in situ* within open space along the western bank of Badgerys Creek, and outside of any future airport site boundary fence. A low barrier fence, which does not obstruct pedestrian traffic, should be erected around specific heritage sites as is necessary to demarcate the area as a no go area for vehicles. The barrier should be situated so that it does not intrude upon the immediate visual and landscape quality of the heritage site surrounds.

S2 The possible Aboriginal scarred tree (B40) should be conserved *in situ* within open space along the west bank of Badgerys Creek, and outside of any airport site boundary fence. A low barrier fence, which does not obstruct pedestrian traffic, should be erected around as much of the site as is necessary to demarcate the area as a no go area for vehicles. The barrier should be situated so that it does not intrude upon the immediate visual and landscape quality of the heritage site surrounds.

S3 Any environmental conservation zones established as part of the airport development should be managed with the conservation of known and predicted Aboriginal sites as one of the principal objectives. This strategy relates in particular to the planned conservation zone along Badgerys Creek and to the west of Willowdene Avenue.

S4 A conservation management plan (CMP) should be developed that defines the future care and management of sites B40 and B120 and all Aboriginal sites situated within the environmental conservation zone(s) identified in the Airport Plan. The management plan should consider future public interpretation and access to sites, as appropriate and subject to meeting safety and security requirements.

10.3.2 Management Strategies

The following management strategies are drafted with specific reference to the initial development area of the airport site. They do, however, include actions which relate to the whole airport site, where it is necessary to address impacts from the construction and operation of the initial development.

Continued consultation with Aboriginal stakeholders

S5 An Aboriginal stakeholder consultation plan should be developed and adopted which specifies the nature and frequency of consultation to be conducted throughout the design and construction phase of the proposed development. The aims of the consultation program would be:

- to inform on, and provide an opportunity for feedback, regarding all matters relating to the mitigation and management of Aboriginal cultural heritage values across the airport site;
- to provide a forum for organising future stakeholder participation in mitigation and management works; and
- to provide opportunities to comment on all policy and documentation drafted in regard to the mitigation and management of Aboriginal cultural values.

S6 Opportunity should be provided to Aboriginal stakeholders to participate in field actions involving the mitigation and management of Aboriginal cultural values. This participation would be arranged according to a fair and equitable scheme.

Recording and salvage

S7 A targeted archaeological surface survey of the initial construction area *not previously subject to surface survey* (and excluding highly disturbed areas) should be conducted prior to the conduct of development-related ground surface disturbance. The aim of this survey would be to ensure that all visible surface Aboriginal sites have been recorded and can be managed prior to development impact.

S8 A salvage program of surface artefact recovery should be conducted across known Aboriginal artefact occurrences in the construction disturbance area with the aim of avoiding damage from construction related activities. This action addresses strongly held concerns by Aboriginal stakeholders concerning the protection of artefacts from construction impact. The collection program would be conducted using an archaeological methodology and the resulting collection could be integrated into the archaeological analysis of salvaged material, where appropriate.

S9 A comprehensive archaeological inspection of surface sandstone outcrops across the whole airport site should be conducted prior to, and as required during construction-related activities. This action has the aim of ensuring that any stone surface with evidence of Aboriginal marking is appropriately recorded and salvaged.

S10 An archival recording of the Aboriginal grinding groove site (B120) and the possible Aboriginal scarred tree (B40) should be conducted prior to the conduct of any development-related ground disturbance works within the area of these heritage sites. This has the objective of providing a baseline record and information upon which to develop a CMP.

S11 A program of oral history recording should be conducted with the aim of recording memories and stories from Aboriginal people which relate to the airport site and its district. It is intended that this record would serve as an archive and a resource for future interpretation of the Aboriginal heritage values of the site.

S12 A selective archaeological salvage program should be conducted prior to, and as necessary during, construction works across the initial development area subject to construction impact. The objective of the program would be to manage impacts to archaeological or scientific values. The aim of the program would be to recover and analyse a representative sample of surface and subsurface archaeological material from the areas subject to construction impact. The program would aim to:

- Recover archaeological material from all landform types based on a systematic and representative sampling matrix;
- Recover additional archaeological material from areas with assessed relatively higher archaeological value, with the objective of providing a large enough artefact population for statistical analysis and from which robust results can be derived; and
- Apply archaeological excavation methodologies which are appropriate to the expected archaeological resource and the objectives of the salvage.

As a part of designing the salvage program, the results of a review of relevant and existing geotechnical data (refer Appendix 6), should be integrated into the process of determining the location and scope of the salvage program.

Protocols

S13 Protocols for the unanticipated discovery of Aboriginal objects (artefacts), and for the discovery of any suspected human remains should be developed and implemented for all development related works involving ground disturbance. These protocols would define legal obligations to be complied with, and management strategies to be followed in the event that suspected human remains are encountered, and/or Aboriginal archaeological material is encountered which is outside of the expected or predicted nature of the archaeological resource (and thus not managed by the conduct of the strategies listed here). It is recommended that the protocols presented in Appendix 8 be adopted, or alternatively be used as a first draft in the development of such protocols.

S14 An investigation should be conducted into the feasibility of a protocol for the management of top soil or other soil matrix material which is assessed as likely to contain a relatively high density of Aboriginal stone artefacts. The aim of this protocol would be to ensure that the excavation, storage and placement of this material is managed in a culturally appropriate manner and the potential for damage to the artefacts is minimised. The protocol would be developed in consultation with Aboriginal stakeholders. The protocol would address the following issues:

- the appropriate identification and tracking of spoil containing artefacts;
- the minimisation of physical damage to the artefacts during mechanical processing and movement; and
- end-use of the spoil in contexts which minimise potential future impact to the artefacts, and where possible, are culturally appropriate.

Induction training

S15 Training in the identification of Aboriginal artefacts and the management of Aboriginal heritage values should be included, at appropriate levels, in compulsory induction courses for site workers. The content of this component would vary according to the stage of construction. After the completion of major cut and fill actions, training may focus on the management of spoil where there is a risk of impacting artefacts, and on no-go areas where relevant.

Conservation Management Plan

S16 A conservation management plan (CMP) should be prepared which defines and integrates all strategies for mitigating and managing Aboriginal heritage values across the airport site. This plan should be developed in consultation with Aboriginal stakeholders and relevant government agencies. The plan should include both short and long term strategies, and address actions required prior to, during and after construction.

Commemoration of Aboriginal heritage

S17 The Aboriginal cultural heritage values of the airport site should be commemorated and interpreted as part of the airport development and its infrastructure. Consideration could be given to a range of options for realising this strategy. These include:

a. The use of Darug words and language in the naming of places and infrastructure.

b. The dedication of various spaces and places for the placement of art and interpretive elements, storage and display of cultural items, and/or the conduct of cultural activities.

c. The provision of public access and interpretive facilities at Aboriginal sites conserved *in situ* within the airport site (such as for sites B40 and B120), subject to safety and security requirements.

Curation and repatriation

S18 Following the completion of archaeological description and analysis, Aboriginal cultural material salvaged from the airport site should, in the first instance, be stored at an appropriate place to be determined in consultation with Aboriginal stakeholders and relevant government agencies. The longer term storage of this material, and potentially material salvaged from other developments in Western Sydney, should be managed in accordance with protocols to be developed through further consultation with Aboriginal stakeholders and relevant state, federal and local government agencies. Longer term storage options could include:

a) a ‘keeping place’, if feasible, that would provide secure, above ground storage enabling future access for cultural purposes, interpretation, education or research; and

b) re-positioning or reburial at an appropriate time, at one or more locations within the local landscape to be determined in consultation with Aboriginal stakeholders.

Greater Blue Mountains World Heritage Area

S19 The potential noise and visual impact from aircraft flying over wilderness areas of the Greater Blue Mountains Area, and Aboriginal sites promoted for public visitation should be considered in the development and refinement of flight paths to and from the airport, subject to requirements for safe and efficient aircraft operations.

10.4 Longer term development

10.4.1 Mitigation

S20 The Aboriginal grinding groove site (B120) should remain as an *in situ* conserved site within an open space area along the west bank of Badgerys Creek and outside of the airport boundary fence. The airport boundary fence should be located in such a way that the distance between the grinding grooves and the fence (and any required adjacent vehicle track or service easements) is maximised.

S21 The possible Aboriginal scarred tree (B40) should remain as an *in situ* conserved site within the reserved area along the west bank of Badgerys Creek and outside of the airport boundary fence. The airport boundary fence should be located in such a way that the distance between the scarred tree and the fence (and any required adjacent vehicle track or service easements) is maximised.

S22 All environmental conservation areas established or maintained as part of the further development of the airport should be managed with the conservation of known and predicted Aboriginal sites as one of the principal objectives.

S23 The conservation management plan (CMP) for all Aboriginal sites situated within environmental conservation areas should be maintained and revised, as necessary, to define the care and management of all Aboriginal sites which continue to be included in such lands.

10.4.2 Management Strategies

Continued consultation with Aboriginal stakeholders

S24 Regular consultation should be conducted with the invited participation of relevant Aboriginal stakeholders throughout the design and construction phase of any further development of the airport site. The aims of this program would be the same as for Strategy 5.

S25 Opportunity should be provided to Aboriginal stakeholders to participate in all field actions involving the mitigation and management of Aboriginal cultural values. This participation should be arranged according to a fair and equitable scheme.

Recording and salvage

S26 An archaeological surface survey of the development areas *not previously subject to surface survey* (and excluding highly disturbed areas) should be conducted prior to the conduct of development related ground surface disturbance. The aim of this survey is to ensure that all surface Aboriginal sites have been recorded and can be managed prior to development impact.

S27 A salvage program of surface artefact recovery should be conducted across all known Aboriginal artefact occurrences within the development areas, with the aim of avoiding damage from construction related activities. The collection program should be conducted using an archaeological methodology and the resulting assemblage can be integrated into the archaeological analysis of salvaged material, where appropriate.

S28 A comprehensive archaeological salvage program should be conducted prior to, and as necessary during, construction works across the further development areas. The aims, scope and methodology of this program would be the subject of a further assessment which justifies any required management actions in the context of current knowledge and research.

Protocols

S29 The protocols for the unanticipated discovery of Aboriginal objects, and for the discovery of suspected human remains would be reviewed and revised as necessary, and enacted for all development related works involving ground disturbance.

S30 A protocol should be enacted for the management of top soil or other soil matrix material which is assessed as likely to contain a relatively high density of Aboriginal stone artefacts. The aim of this protocol is to ensure that the excavation, storage and placement of this material is managed in a culturally appropriate manner and the potential for damage to the artefacts is minimised. The protocol may be based on the protocol developed for the initial development of the airport and should be developed in consultation with Aboriginal stakeholders.

Induction training

S31 Training in the identification of Aboriginal artefacts, and the conduct of airport site strategies for the management of Aboriginal heritage values should be included, at appropriate levels, in the compulsory induction courses for site workers.

Conservation Management Plan

S32 The conservation management plan (CMP) prepared at the time of the initial construction works would be reviewed and revised as necessary. The CMP would define and integrate all strategies for mitigating and managing Aboriginal heritage values across the airport site. This revised plan would be developed in consultation with Aboriginal stakeholders, and relevant statutory authorities and construction proponents.

Commemoration of Aboriginal heritage

S33 The Aboriginal cultural heritage values of the airport site would continue to be commemorated and interpreted as part of the airport development and its infrastructure.

Curation and repatriation

S34 All salvaged Aboriginal cultural material would be curated and managed in consultation with Aboriginal stakeholders, as appropriate and according to available facilities and contemporary protocols.

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Appendix 1

Aboriginal Consultation Documentation

A1.1 Public Notice inviting registration by Aboriginal stakeholders

PROPOSED WESTERN SYDNEY AIRPORT
CULTURAL HERITAGE ASSESSMENT
ABORIGINAL STAKEHOLDER REGISTRATION

The Australian Government is developing a proposal for the construction and operation of an airport, to be located at Badgerys Creek, approximately 3km east of Luddenham, and situated within the Liverpool Local Government Area.

A robust and rigorous environmental assessment is being conducted for the proposed airport. Navin Officer Heritage Consultants Pty Ltd (NOHC) has been commissioned to conduct an Aboriginal cultural heritage assessment of the project.

NOHC are implementing a programme of Aboriginal stakeholder consultation as an integral part of this assessment. This programme will be guided by Commonwealth government standards and guidelines and the Office of Environment and Heritage *Aboriginal cultural heritage consultation requirements for proponents 2010*. It will assist NOHC in the preparation of an application for an Aboriginal Heritage Impact Permit, should one be required.

We invite Aboriginal people and organisations who wish to participate in the programme, and who hold cultural knowledge relevant to determining the cultural significance of objects and places in the project area, to register an interest in the project.

Please forward expressions of interest to:

The Secretary
Navin Officer Heritage Consultants Pty Ltd
4/71 Leichhardt Street
Kingston ACT 2604

The closing date for registration is 10th March 2015

For further information about the proposed Western Sydney airport, visit www.infrastructure.gov.au/westernsydneyairport

Publication record:

- Blacktown Advocate Wednesday 18 February 2015
- Liverpool Leader Wednesday 18 February 2015
- Fairfield City Champion Wednesday 18 February 2015
- Camden Advertiser Wednesday18 February 2015
- Penrith Press Friday 20 February 2015
- Macarthur Chronicle Tuesday 24 February 2015

A1.2 List of registered Aboriginal stakeholders and representatives

Registered stakeholder entities

- Badu
- Bilinga CHTS
- Butucarbin Aboriginal Corporation
- Cubbitch Barta Native Title Claimants Aboriginal Corporation
- Darug Aboriginal Cultural Heritage Assessments
- Darug Aboriginal LandCare
- Darug Custodian Aboriginal Corporation
- Darug Land Observations
- Darug Tribal Aboriginal Corporation
- Deerubbin Local Aboriginal Land Council
- Dhinawan-Dhigaraa Culture and Heritage Pty Ltd
- EORA
- Gandangara Local Aboriginal Land Council
- Gangangarra
- Goobah
- Gundungurra Aboriginal Heritage Association Inc.
- Gunyuu
- Kamilaroi-Yankuntuatjara Working Group
- Kawul Cultural Services
- Mungunya (sic) CHTS
- Murrumbul
- Ngunawal
- Ngunawal Heritage Aboriginal Corporation
- Nundagurri
- Tharawal Local Aboriginal Land Council
- Tocomwall Pty Ltd
- Walbunja
- Wandandian
- Warragil Cultural Services
- Wingikarah CHTS
- Wullung
- Wurrumay
- Yerramurra

Seventeen registrations have been received following the completion of the fieldwork program:

- Bidawal
- Bulling Gang Elders
- Curwur Murre Elders
- Dharug
- Djiringanj
- Elouera
- Gadung Elders
- Golangaya Elders
- Gulla Gunar Elders
- Kuringgai
- Murrin
- Ngarigo
- Peter Falk Consultancy
- Tharawal
- Thauaira
- Walbunja Elders
- Walgalu

Stakeholder representatives who participated in the field program

Registered Stakeholder Entity	Representatives
Badu	Andrew Bond
Bilinga CHTS	Robert Parsons Chris Brierley Chris Payne (observer)
Butucarbin Aboriginal Corporation	Jack Gibson Johnathan Whitton
Cubbitch Barta Native Title Claimants Aboriginal Corporation	Glenda Chalker
Darug Aboriginal Cultural Heritage Assessments	Gordon Morton
Darug Aboriginal Land Care	Shaun Lynch
Darug Custodian Aboriginal Corporation	Elizabeth Coplin Tylah Blunden Lana Wedgwood
Darug Land Observations	Jamie Workman Jamie Eastwood
Darug Tribal Aboriginal Corporation	John Reilly
Deerubbin LALC	Steve Knight Steve Randall Wayne Boney
Dhinawan-Dhigaraa Culture and Heritage Pty Ltd	Donald Nixon Jamarl Leroy
EORA	Wayne Brierley
Gandangara Local Aboriginal Land Council	Brad Maybury
Gangangarra	Richard Andy
Goobah	Michael Williams
Gundungurra Aboriginal Heritage Association Inc.	Kieren McNally
Gunyuu	Sam Juparulla Wickman
Kamilaroi-Yankuntuatjara Working Group	Marbuck Khan Philip Khan
Kawul Cultural Services	Greg Slater
Munyunga [Mungunya] CHTS	Shaun Wellington Peter Foster (Observer)
Murrumbul	Trae Andy
Ngunawal	Edward Stewart Chris Brierley
Ngunawal Heritage Aboriginal Corporation	Graeme Dobson
Nundagurri	Thomas Tighe
Tharawal Local Aboriginal Land Council	Abbi Whillock
Tocomwall Pty Ltd	John Phillips
Walbunja	Leonard ‘Jacko’ Nye
Wandandian	Sam Juparulla Wickman
Warragil Cultural Services	Aaron Slater
Wingikarah CHTS	Michael Williams
Wullung	Leeroy Boota
Wurrumay	Bo Field
Yerramurra	Edward Stewart Peter Foster

A1.3 Native Title Search

National Native Title Tribunal

Sydney Office, Operations East
Level 16
Law Courts Building
Queens Square
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2001
Telephone (02) 9227 4000
Facsimile (02) 9227 4030

19 February 2015

Nicola Hayes
Principal Archaeologist
Navin Officer Heritage Consultants
4/71 Leichhardt Street
Kingston ACT 2604

Our Reference: 0419/15MO
Your Reference: WSA

Dear Ms Hayes

Native Title Search Results for Badgerys Creek within Liverpool Local Government Area

Thank you for your search request received on 13 February 2015 in relation to the above area.

Search Results
The results provided are based on the information you supplied and are derived from a search of the following Tribunal databases:

Register Type	NNTT Reference Numbers
Schedule of Applications (unregistered claimant applications)	Nil.
Register of Native Title Claims	Nil.
National Native Title Register	Nil.
Register of Indigenous Land Use Agreements	Nil.
Notified Indigenous Land Use Agreements	Nil.

At the time this search was carried out, there were **no relevant entries** in the above databases.

Please note: There may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed with the Federal Court may not appear on the Tribunal's databases.

Tribunal accepts no liability for reliance placed on enclosed information
The enclosed information has been provided in good faith. Use of this information is at your sole risk. The National Native Title Tribunal makes no representation, either express or implied, as to

Facilitating timely and effective outcomes.

Freecall 1800 640 501
www.nntt.gov.au

the accuracy or suitability of the information enclosed for any particular purpose and accepts no liability for use of the information or reliance placed on it.

If you have any further queries, please do not hesitate to contact me on the numbers listed below.

Yours sincerely

MOMalley

Melissa O'Malley | RECEPTIONIST/CLIENT SERVICES OFFICER
National Native Title Tribunal | Sydney Office
Level 16, Federal Law Courts Building, Queens Square, Sydney, New South Wales 2000
Telephone (02) 9227 4000 | Facsimile (02) 9227 4030 | Email melissa.o'malley@nntt.gov.au
Freecall 1800 640 501 | www.nntt.gov.au
Shared country, shared future.

Searching the NNTT Registers in New South Wales

Search service
On request the National Native Title Tribunal may search its public registers for you. A search may assist you in finding out whether any native title applications (claims), determinations or agreements exist over a particular area of land or water.

In New South Wales native title cannot exist on privately owned land including family homes or farms.

What information can a search provide?
A search can confirm whether any applications, agreements or determinations are registered in a local government area. Relevant information, including register extracts and application summaries, will be provided.

In NSW because we cannot search the registers in relation to individual parcels of land we search by local government area.

Most native title applications do not identify each parcel of land claimed. They have an external boundary and then identify the areas not claimed within the boundary by reference to types of land tenure e.g., freehold, agricultural leasehold, public works.

What if the search shows no current applications?
If there is no application covering the local government area this only indicates that at the time of the search either the Federal Court had not received any claims in relation to the local government area or the Tribunal had not yet been notified of any new native title claims.

It does not mean that native title does not exist in the area.

Native title may exist over an area of land or waters whether or not a claim for native title has been made.

Where the information is found
The information you are seeking is held in three registers and on an applications database.

National Native Title Register
The National Native Title Register contains determinations of native title by the High Court, Federal Court and other courts.

Register of Native Title Claims
The Register of Native Title Claims contains applications for native title that have passed a registration test.

Registered claims attract rights, including the right to negotiate about some types of proposed developments.

Register of Indigenous Land Use Agreements
The Register of Indigenous Land Use Agreements contains agreements made with people who hold or assert native title in an area.

The register identifies development activities that have been agreed by the parties.

Schedule of Native Title Claims
The Schedule of Native Title Claims contains a description of the location, content and status of a native title claim.

This information may be different to the information on the Register of Native Title Claims, e.g., because an amendment has not yet been tested.

How do I request a native title search?
Download the Search Request Form from the Tribunal's website at - http://www.nntt.gov.au/assistance/Pages/Searches-and-providing-Register-information.aspx

Email to: NSWEnquiries@nntt.gov.au
Post to: GPO Box 9973 Sydney NSW 2001
For additional enquiries: 02 9227 4000

A1.4 Presentations

A1.4.1 Background paper and draft methodology

Background Paper and Proposed Methodology

for Aboriginal Stakeholder review and comment

Western Sydney airport project

2015 Environmental Impact Statement - Aboriginal Cultural Heritage Assessment

Navin Officer Heritage Consultants *25 March 2015*

What is the purpose of this document?

The purpose of this document is to provide all Registered Aboriginal Parties (RAPs) an opportunity to review and comment on the proposed methodology for the conduct of an archaeological survey and subsurface testing program and cultural heritage assessment for the Western Sydney airport Environmental Impact Statement (EIS).

Navin Officer Heritage Consultants (NOHC) has developed this methodology in accordance with the *Code of Practice for Archaeological Investigations of Aboriginal Objects in New South Wales (DECCW 2010a)*.

All comments received will be documented in the final version of this document and in the report for the project. All comments will be addressed and amendments made to the methodology where appropriate.

What is the Western Sydney airport proposal?

The Australian Government has commenced a new environmental assessment for the proposed Western Sydney airport. The airport site has been identified as approximately 1700 hectares of Commonwealth-owned land at Badgerys Creek, New South Wales. (Figure 1).

The proposed airport would be developed in accordance with an airport plan that identifies concept designs for the airport and a more detailed proposal for an initial development stage. Development of the proposed airport would be staged in response to demand, with an initial stage including one runway and an ultimate layout potentially comprising two parallel runways of up to 4,000 metres in length.

To maximise the potential of the site and its commercial viability, the proposed airport would operate on a 24-hour basis.

Construction of the airport could commence in 2016 with airport operations commencing in the mid-2020s.

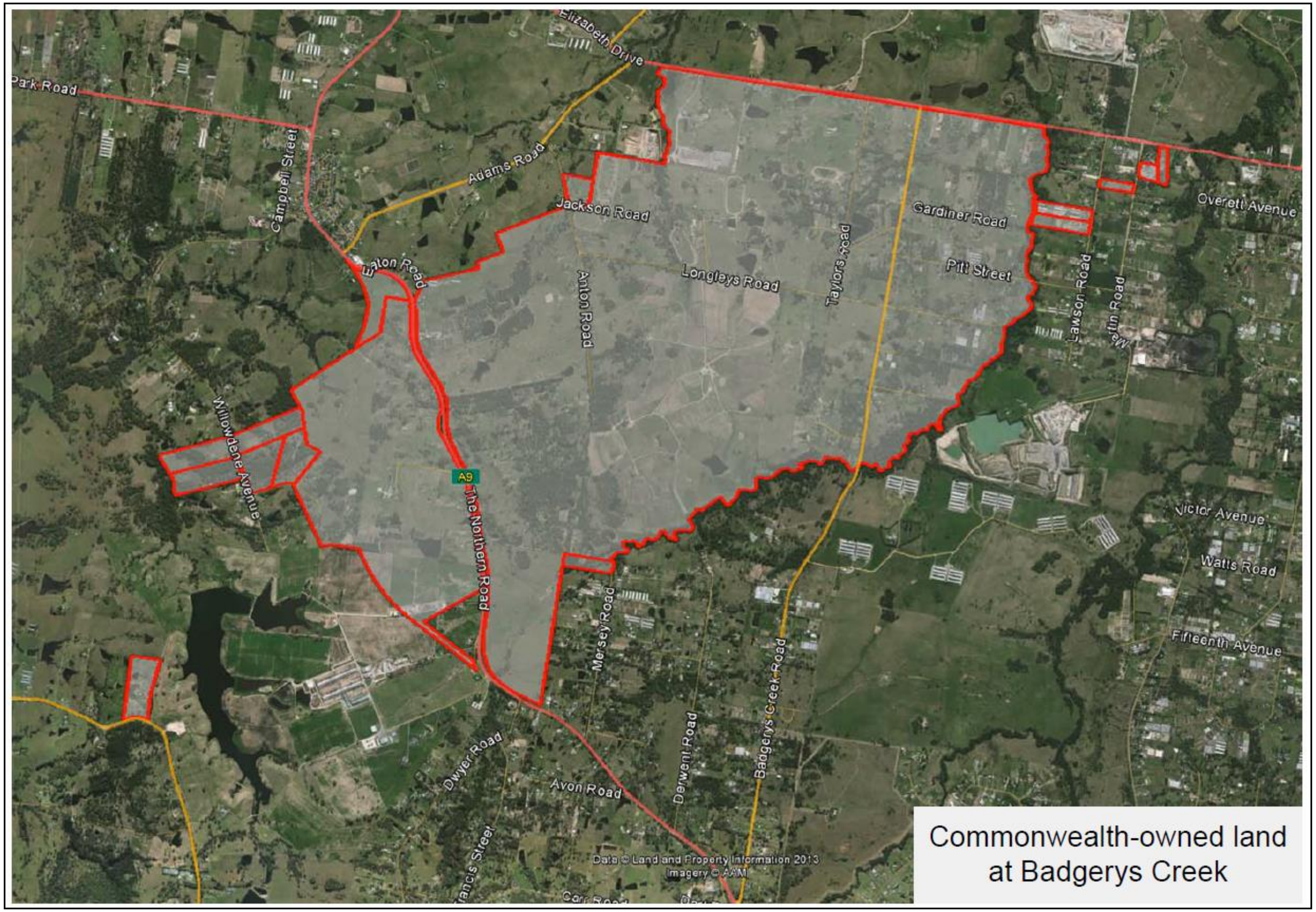


Figure 1 Indicative Project Area

About the Assessment Process

This EIS is being conducted in accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). Note that this is not a NSW or State legislative process.

The proposal was referred under the EPBC Act by the Western Sydney Unit of the Australian Government Department of Infrastructure and Regional Development (WSU) to the Minister for the Environment on 4 December 2014. A delegate of the Minister determined on 23 December 2014 that approval is required as the proposal has the potential to have a significant impact on the following matters of national environmental significance (NES) and other matters that are protected under Part 3 of the EPBC Act:

- Listed threatened species and ecological communities;
- The heritage values of a National Heritage place;
- The world heritage values of a declared World Heritage property; and
- The environment because the proposal is a Commonwealth action.

While the Commonwealth also has guidelines addressing heritage investigations, for example *Identifying Commonwealth Heritage Values and Establishing a Heritage Register; a Guideline for Commonwealth agencies* (Australian Heritage Council 2010), the WSU has chosen to adopt the NSW Office of Environment and Heritage (OEH) Aboriginal stakeholder consultation protocols and the *Code of Practice for Archaeological Investigations of Aboriginal Objects in New South Wales* for consistency and to address stakeholder expectations.

How can I provide a comment on this methodology?

Registered Aboriginal parties are invited to provide comments and suggestions back to NOHC by 23 April 2015.

NOHC contact information is as follows:

The Secretary
Navin Officer Heritage Consultants Pty Ltd
4/71 Leichhardt Street
Kingston ACT 2604

email: navinofficer@nohc.com.au

phone: 02 62829415
fax: 02 62829416

Additionally, a meeting will be held in the Badgerys Creek area to discuss the project and this methodology during the week of the 6th April. Further details of this meeting will be forwarded to you at least 1 week prior.

Project Assessment Background

A number of previous EIS studies have been conducted at the proposed airport site over several decades; including:

1985 - Second Sydney Airport: Site Selection Program (Department of Aviation)

1997-1999 – Second Sydney Airport Proposal (Department of Transport and Regional Development)

The most recent and comprehensive EIS of the Badgerys Creek study area was conducted in 1997-1999 where three possible airport layout options were investigated. A total of 110 recordings were made resulting from sample surveys of the Badgerys Creek study area. Surveys were undertaken for all airport options, as well as some areas which subsequently fell outside of the finalised option boundaries. No test excavations were conducted.

Option A of the 1997-1999 EIS relates to the current proposal. A total of 60 known sites or isolated finds were located within the area of Option A. These comprised 25 open artefact scatters, five scarred trees, and 30 isolated finds. Five of these recordings are associated with recorded potential archaeological deposits. The valley floors and fringing basal slopes associated with major creek lines were identified as having moderate or higher subsurface archaeological potential. Aboriginal cultural values were identified not only in association with the archaeological sites, but also with surviving native plants and animals.

A targeted re-inspection of 21 Aboriginal heritage sites identified within areas of moderate and high archaeological potential by the 1997-1999 EIS study, was undertaken by Australian Museum Consulting archaeologists on 22 –23 September2014. Surface artefacts were found to be visible at only seven of the 21 sites. The seven sites consisted of two possible scarred tree sites and five stone artefact sites. This indicates that conducting further surface survey is unlikely to reveal much more information about the project area. The best option to advance our understanding of the archaeology of the project area is to now conduct a program of test excavation.

Based on the existing information and the previous assessments conducted, the priorities for this current investigation are considered to be:

- The conduct of an archaeological test excavation program, across a sample of landforms, to investigate the presence and significance of Aboriginal sites and deposits below-the-ground surface;
- Assessment of Aboriginal cultural values and intangible values held by contemporary Aboriginal stakeholders; and
- An assessment of the impacts of the current project in the context of other past, present and future projects on the Aboriginal cultural heritage of the project area and the wider region.

Proposed Methodology

The EIS assessment of the impacts of the proposal on Aboriginal cultural heritage values will involve:

- Review of existing and background information, and assessment requirements
- Liaison with statutory authorities
- Conduct of Aboriginal stakeholder consultation program
- Aboriginal stakeholder inspections
- A focused archaeological test excavation program to determine the nature and significance of the Aboriginal subsurface archaeological resource
- Analysis and compilation of all data and findings, significance assessment
- Impact assessment and development of impact mitigation strategies
- Preparation of draft cultural heritage impact assessment technical report(s)
- Input to Draft EIS
- Exhibition of Draft EIS including review of interim heritage report and Draft EIS by Aboriginal stakeholders
- Responses to public submissions including comments from Aboriginal stakeholders on the findings and recommendations of the interim heritage report
- Final EIS

Field Program

The field program will commence on 27 April 2015 and conclude on 17 May 2015.

Stakeholder inspections

The first week of field program, 27 April – 1 May 2015 will involve inspection of the project area with RAPs, to identify cultural values, concerns, issues and to provide firsthand experience of the project area and likely scope of development impact. All potential test excavation locations will be subject to field inspection during this time. Potential land acquisition areas will be reviewed; however site access to these areas is expected to be restricted and targeted survey is unlikely to be possible.

Archaeological test excavation program

To be conducted in the second and third weeks of the field program:

- Thirty-eight potential locations for archaeological test locations have been identified after a review of landform types, access conditions and ground disturbance.
- Between 10 and 20 locations will be subject to test excavation, the final number will depend on how resources are expended based on an assessment of field results.
- Test excavation will be conducted at up to twenty selected locations between the dates 1 May – 17 May 2015. Around 10 pits will be conducted at each test location, arranged in a grid pattern and/or along straight line transects, with pits spaced at regularly intervals.
- Excavations at each test location will last approximately one or two days.
- Excavation will be conducted according to OEH 'Code of Conduct' protocols. All excavation will be conducted by hand, and excavated material will be dry sieved on site and then used to back fill the pits.

RAP participation in the field program

A roster will be developed for the participation of all RAPs in the fieldwork program. Each RAP will be given equal time to participate in the field including in the test excavation and inspection days.

We ask that each group nominate a representative or representatives to participate in the program. Each representative must have the appropriate levels of insurance including Workers Compensation and Public Liability, certificates of currency must be supplied.

Analysis

All artefacts recovered will be examined in detail by stone artefact specialist Dr Oliver McGregor (or other suitably qualified lithic specialist, depending on availability). Descriptions of each artefact will be entered into a database and digital photographs may be taken of selected artefacts, where appropriate. Information for each artefact recorded in the analysis will be provided in an appendix in the heritage report.

Recovered material will be analysed in the NOHC lab in Canberra.

The only destructive analysis will be the use of recovered charcoal, or shell or bone material for radiocarbon dating.

Report Drafting

Information gained in the course of the test excavation program and information provided by the Aboriginal community will be documented in a heritage report (except where information has been identified as culturally sensitive and therefore restricted). The report will detail the methodology, results and assessment of significance of identified sites. An impact assessment will be completed and recommendations will be provided for the management of sites.

Stakeholder review of the report

All registered stakeholders will be provided with a copy of the Draft EIS report and supporting Aboriginal heritage specialist report with an invitation to provide comments and responses.

Unlike the NSW EIS process, exhibition of a Draft EIS is required by the Commonwealth EIS process and all community and stakeholder comments on the Draft EIS received and responded to as part of a Final EIS. The Final EIS will not be exhibited in the same way as the Draft EIS.

For this project, the review of the Draft EIS and interim heritage report by registered stakeholders will coincide with the public review of the Draft EIS. The comments and responses of registered stakeholders will subsequently be included and addressed in the Final EIS report.

Return of cultural material

Disposition and storage of collected stone artefact assemblages during the test excavation will be dealt with in accordance with the Code of Practice under Requirement 26.

After analysis, all recovered artefacts would be stored individually in standard resealable plastic bags or bagged in appropriate and identifiable units. The bags would be labelled using a permanent black pen with the item's unique identification number (where generated and appropriate), and/or details of its provenance within the excavation (as appropriate).

Following completion of the analysis of the recovered artefacts, it is proposed that all Aboriginal objects be repositioned back into the landscape ('returned to country') in accordance with Requirement 26 of the Code of Practice.

All locations of repositioned artefacts would be recorded on appropriate OEH forms and lodged with the AHIMS, administered by OEH.

What will happen if human remains are encountered?

In the event that suspected human remains are encountered during any of the proposed test or salvage excavations, protocols for the unanticipated discovery of archaeological material and suspected human remains (presented in Attachment 1) would be adopted.

Attachment 1: Protocol to be followed in the event that suspected human remains are encountered

1. All ground surface disturbance in the area of the finds should cease immediately after the finds are uncovered.

   a. The discoverer of the find(s) will notify all field workers and machinery operators in the immediate vicinity of the find(s) so that work can be halted; and

   b. The excavation director, site supervisor and representatives of the proponent will be informed of the find(s).

2. If there is substantial doubt regarding a human origin for the remains, then consider if it is possible to gain a qualified opinion within a short period of time. If feasible, gain a qualified opinion (this can circumvent proceeding further along the protocol for remains which turn out to be non-human). If conducted, this opinion must be gained without further disturbance to any remaining skeletal material and its context (Be aware that the site may be considered a crime scene containing forensic). If a quick opinion cannot be gained, or the identification is positive, then proceed to the next step.

3. Immediately notify the following people of the discovery:

   a) The local Police (this is required by law);

   b) The Western Sydney Unit of the Australian Government Department of Infrastructure and Regional Development;

   c) The Australian Government Department of the Environment

   c) An archaeologist or Aboriginal Heritage Officer (as appropriate) from the Office of the Environment and Heritage (OEH) (Environment hotline: 131 555);

   e) Representative(s) from the registered Aboriginal parties (as appropriate); and

   f) The project archaeologist (if not already present).

4. Facilitate the evaluation of the find(s) by the statutory authorities and comply with any stated requirements. Depending on the evaluation of the find(s), the management of the find(s) and their location may become a matter for the Police and/or Coroner.

5. Excavation works in the area of the find(s) may not resume until the proponent receives written approval from the relevant statutory authority: from the Police or Coroner in the event of an investigation, or from OEH in the case of Aboriginal or Non-Aboriginal remains outside of the jurisdiction of the Police or Coroner.

In the event that the proponent continues an active role in the evaluation and/or management of the find(s), via a direction or advice from the Police, Coroner and/or the OEH or Heritage Council, then all or some of the following steps *may* be conducted:

6. Facilitate, in co-operation with the appropriate authorities, the definitive identification of the skeletal material by a specialist (if not already completed). This must be done with as little further disturbance to any remaining skeletal material and its context as possible.

7. If the specialist identifies the remains as non-human then, where appropriate, the protocol for the discovery of Non-Aboriginal or Aboriginal artefacts should be followed.

8. If the specialist determines that the remains are human, then the proceeding course of action may be of three types:

a. The remains are of an Aboriginal or non-Aboriginal person who died less than 100 years ago. All further decisions and responsibilities regarding the remains and find location rest with the Police and/or the State Coroner.

b. The remains are of a non-Aboriginal person who died more than 100 years ago. In this case, and where the Police have indicated that they have no interest in the find(s), the following steps may be followed:

   i. Ascertain the requirements of the Heritage Branch (OEH), the proponent, the project archaeologist, and the views of any relevant community stakeholders;

   ii. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

      1. Avoiding further disturbance to the find and conserving the remains in situ (this option may require relocating the development and this may not be possible in some contexts);
      2. Conducting (or continuing) archaeological salvage of the finds following receipt of any required statutory approvals;
      3. Scientific description (including excavation where necessary), and possibly also analysis of the remains prior to reburial;
      4. Recovering samples for dating and other analyses; and/or
      5. Subsequent reburial at another place and in an appropriate manner determined by the Heritage Council and in consultation with other relevant stakeholders.

c. The remains are of an Aboriginal person who died more than 100 years ago. In this case the following steps may be followed:

   i. Ascertain the requirements of the relevant registered Aboriginal parties, the OEH, the proponent, and the project archaeologist;

   ii. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

      1. Avoiding further disturbance to the find and conserving the remains in situ, (this option may require relocating the development and this may not be possible in some contexts);
      2. Conducting (or continuing) archaeological salvage of the finds following receipt of any required statutory approvals;
      3. Scientific description (including excavation where necessary), and possibly also analysis of the remains prior to reburial;
      4. Recovering samples for dating and other analyses; and/or
      5. Subsequent reburial at another place and in an appropriate manner determined by the registered Aboriginal parties and the OEH.

Reference/Sources:

Donlan, D., McIntyre-Tamwoy, S. and A. Thorne 2002 Aboriginal Skeletal Remains Manual. NSW National Parks and Wildlife Service, Hurstville.

Heritage Office, NSW 1998 *Skeletal Remains Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977*.

A1.4.2 Presentation at Stakeholder Meeting 8 April 2015

Proposed Methodology

Aboriginal cultural heritage assessment

Proposed Western Sydney airport

Aboriginal stakeholder meeting
St Mary's Memorial Hall, St Mary.

Navin Officer Heritage Consultants
8 April 2015

What are the aims of this meeting?

- To present information about the Western Sydney airport project
- To provide some background information about the project area
- To provide registered Aboriginal stakeholders an opportunity to review and discuss the proposed methodology prior to submitting written comments
- An opportunity to identify issues and significant cultural values

Code of Conduct

- Principles we agree on
- To allow all participants to be heard and respected
- Everybody's opinion is important
- Criticism is welcome and part of the process
- Criticise ideas or concepts but not people or personalities
- It is everybody's responsibility to maintain a civil work environment and a healthy place in which debate can happen

The Western Sydney Airport proposal

- The Australian Government has commenced a new environmental assessment for the proposed Western Sydney airport
- Assessment is being directed by the Western Sydney Unit of the Dept of Infrastructure and Regional Development
- Project area consists of all the Commonwealth owned land at Badgerys Creek
- Approximately 1700 hectares

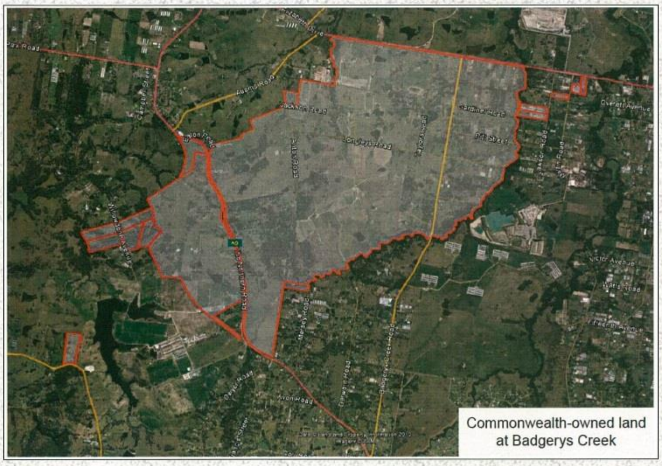
The Western Sydney Airport proposal

- Little or no opportunity to conserve Aboriginal sites *insitu* within the airport development
- Airport development will be staged in response to demand
- Airport to operate on a 24 hour basis
- Construction to start in 2016 and airport operations to start in mid 2020s

A previous airport proposal

1997 EIS Option A airport layout

The project area



The Assessment Process

- An EIS conducted in accordance with Commonwealth legislation
- *Environment Protection and Biodiversity Conservation Act 1999*
- Not an assessment under State legislation or the National Parks and Wildlife Act
- The OEH consultation protocols used as a guide for the consultation program
- The OEH Code of Practice for Archaeological Investigations also being used as a guide for the fieldwork program

The Assessment Process

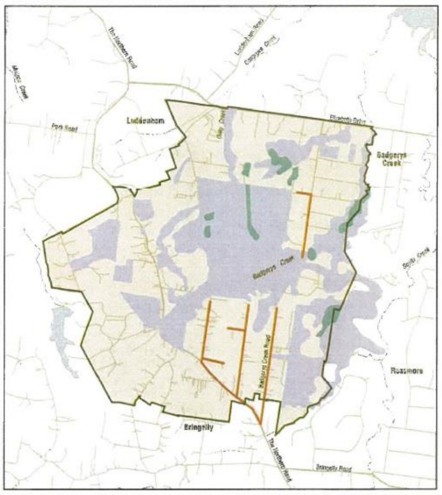
- Opportunity for Aboriginal stakeholder comment and review of the draft EIS will be conducted in parallel with the period for public comment on the draft.
- All Aboriginal stakeholder comments will be included and addressed in the final EIS

Previous Assessments

- 1985 Site Selection Program
- Second Sydney Airport EIS in 1997 – evaluated two possible sites: Holsworthy and Badgerys Creek
- Various reviews and audits of the 1997 EIS, to 1999
- Australian Museum Consulting Archaeologists re-inspected a sample of the 1997 EIS recordings in 2014

1997 EIS

- Option A project area, 16970 hectares, roughly equivalent to current project area (some additions)
- 50% of Option A area subject to comprehensive survey
- 60 Aboriginal archaeological sites recorded:
  - 25 open artefact scatters
  - 5 scarred trees
  - 30 isolated finds
- Valley floors and fringing basal slopes along major creeklines have moderate or higher subsurface archaeological potential
- Aboriginal cultural values were identified in association with both the archaeological sites, and with surviving native plants and animals



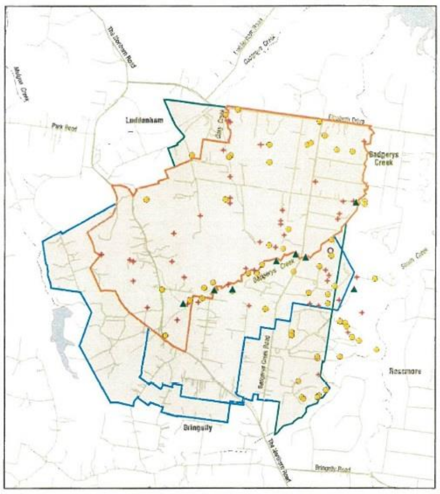
1997 EIS

Survey coverage

Combination of Options A, B and C airport boundaries
Field survey coverage
Previous survey coverage (Kinhill Stearns, 1985)
Road corridors surveyed

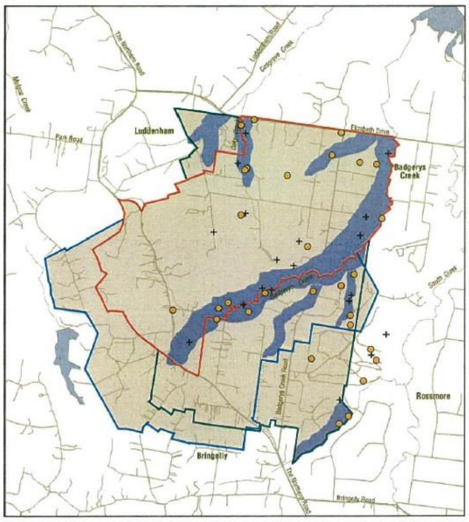
1997 EIS

All recorded sites



1997 EIS

Recordings of moderate or greater archaeological significance



Criticisms of 1997 EIS

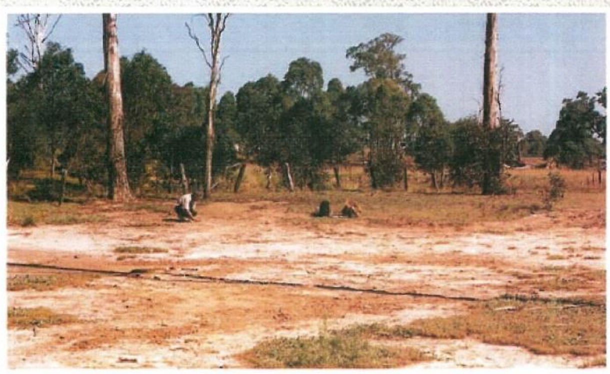
- Too reliant on surface survey results
- No subsurface testing conducted
- Aboriginal cultural values
- Intangible values
- Cumulative impacts

2014 re-inspection

- Conducted by Australian Museum Consulting Archaeologists
- 21 sites in areas of moderate or higher predicted archaeological subsurface potential revisited
- Only seven had artefacts (5) or tree scars (2) visible
- This result due to poor visibility and greater vegetation cover
- Indicates that doing further surface survey is unlikely to provide a great deal of new information

Priorities for current assessment

- Build upon (but not repeat) the results of the previous studies
- Emphasis on test excavation program
- Test a representative range of landform types
- Aboriginal cultural and intangible values
- Cumulative impacts



Typical ground surface exposure revealing stone artefacts, recorded in 1997 EIS field program. This type of exposure is now rarer in the project area

Proposed Methodology

- Review of existing information
- Predictive model
- Liaison with statutory authorities
- Aboriginal stakeholder consultation program
- Aboriginal stakeholder inspections
- Archaeological test excavation program
- Analysis and significance assessment
- Impact assessment and develop impact mitigation strategies
- Preparation of draft report
- Exhibition of Draft EIS including review of Draft by Aboriginal stakeholders
- Responses and comments from Aboriginal stakeholders included and addressed in Final EIS

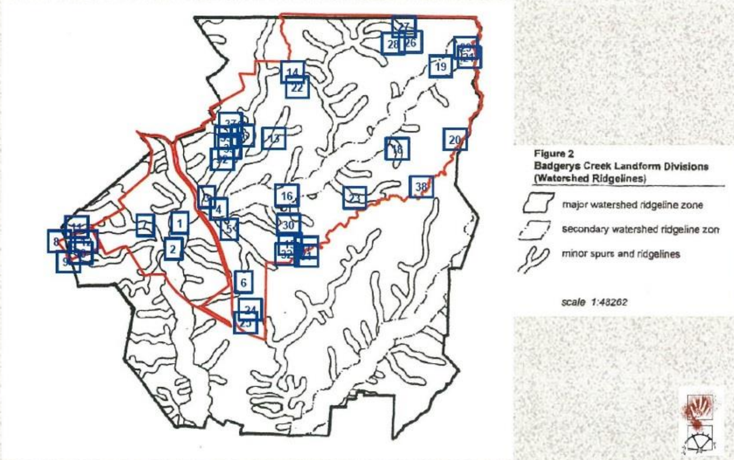
Field Program

- 27 April to 17 May (excluding weekends)
- First week to identify cultural values, concerns, issues and to provide first-hand experience of the project area and likely scope of development impact
- First week to include general inspection of project area, review and refinement of test excavation locations
- Test excavation program to be conducted in the remaining two weeks

Test Excavation

- After review of landform types, access conditions and ground disturbance, 38 possible test locations identified
- Between 10 and 20 locations will be selected for test excavation, depending on resources and assessment of field results
- Around 10 regularly spaced pits will be conducted at each test location, arranged in a grid pattern and/or along straight line transects
- Excavations at each test location will last approximately one or two days.

Possible test locations



Test Excavation & Analysis

- Excavation will be according to OEH 'Code of Conduct' protocols.
- All excavation will be conducted by hand
- Excavated material will be dry sieved on site and then used to back fill pits
- All recovered artefacts to be temporarily stored at NOHC Canberra lab and examined in detail by stone artefact specialist
- The only destructive analysis would be the use of recovered charcoal, or shell or bone material for radiocarbon dating

Stakeholder participation in field program

- Each registered stakeholder invited to nominate a representative (or representatives) to participate in the field program
- A roster will be developed for the participation of all nominated representatives in the fieldwork program. Each stakeholder will be given equal time to participate in the field, including the test excavation and inspection days
- Only one representative per registered stakeholder per day

Stakeholder participation in field program

- Each representative must show proof of Workers Compensation and Public Liability insurance and provide own personal protection equipment (PPE)
- Field participation will be paid by the Department of Infrastructure and Regional Development at a standard hourly rate, (rate to be confirmed)
- Nominations and evidence of insurance to be presented please by the 10th April (this Friday)
- Nominations forms available today

Return of all cultural material

- After analysis, all recovered artefacts would be stored and identified using standard resealable plastic bags
- It is proposed that all Aboriginal objects be repositioned back into the landscape ('returned to country') in accordance with Requirement 26 of the OEH Code of Practice
- Subject to Aboriginal stakeholder consensus
- All locations of repositioned artefacts would be recorded on appropriate OEH forms and lodged with OEH.

What will happen if human remains are encountered?

- The actions defined in the *Protocol to be followed in the event that suspected human remains are encountered* would be conducted
- Copy of protocol in Attachment 1 of the proposed methodology
- In summary:
  - Stop work in area of find
  - Confirm human origin
  - Advise authorities
  - Consult with stakeholders
  - Comply with legal requirements and follow agreed strategies or direction by authorities

How to provide comment on the methodology

- In writing please
- Submit by the 23 April 2015
- By post:

  The Secretary
  Navin Officer Heritage Consultants Pty Ltd
  4/71 Leichhardt Street
  Kingston ACT 2604

- By email: navinofficer@nohc.com.au
- By fax: 02 62829416

Agenda

Western Sydney airport project

Proposed methodology discussion and information meeting

Date: 8th April 2015

Time: 2:00pm – 4:00pm

Location: St Marys Memorial Hall, corner of the Great Western Highway and Mamre Road, St Marys Sydney

Facilitator: Kelvin Officer, Navin Officer Heritage Consultants

Agenda

1. Welcome and introduction
2. Presentation of the project background and methodology
3. Discussion and Questions

Minutes, discussion notes and issues

Meeting of Registered Stakeholders to discuss draft cultural heritage assessment methodology

Western Sydney airport EIS

Navin Officer Heritage Consultants *13 April 2015 v.1*

Date: 8th April 2015

Time: 2:00pm – 4:15pm

Location: St Marys Memorial Hall, corner of the Great Western Highway and Mamre Road, St Marys, Sydney

Facilitator: Kelvin Officer (KO), Director, Navin Officer Heritage Consultants (NOHC)

Other EIS team members present: Nicola Hayes (Principal Archaeologist NOHC)
Nick Johnson (Senior Manager, Environment, RPS Australia)

Aboriginal Stakeholders who signed attendance sheet:

Name	Organisation
Tim Wells	Darug Aboriginal Cultural Heritage Assessments
Gordon Morton	Darug Aboriginal Cultural Heritage Assessments
Jamie Workman	Darug Land Observations
Uncle Gordon Workman	Darug Land Observations
John Reilly	Darug Tribal Aboriginal Corporation
Justine Coplin	Darug Custodian Aboriginal Corporation
Glenda Chalker	Cubbitch Barta Native Title Claimants Aboriginal Corporation
Ricky Fields	Dhinawan-Dhigaraa Culture and Heritage Pty Ltd
Shane Fields	Dhinawan-Dhigaraa Culture and Heritage Pty Ltd
Aaron Slater	Kawul Cultural Services / Wurrumay
Matthew Hall	Warragil Cultural Services
Peter Foster	Murrin Nation
Chris Payne	Murrin Nation
David Bell	Murrin Nation
Pemilway Johnson	Murrin Nation
Leeroy Boota	Wullung
Michael Williams	Goobah – Murrin Nation
Basil Smith	Goobah – Murrin Nation
Robert Wester	Tocomwall Pty Ltd
Steven Randall	Deerubbin Local Aboriginal Land Council
Philip Khan	Kamilaroi-Yankuntuatjara Working Group
Hika Tekowhai	Walbunja
Kahu Brennan	Eora
Karia Bond	Bodu
Nick Glover	Yerramurra
Richard Campbell	Wandandian
Aaron Broad	Nundagurri
Kim Carriage	Gandangarra

Meeting Agenda

1. Introduction to project and meeting (KO)

2. Welcome to Country - Gordon Morton

3. PowerPoint presentation (KO)

Please refer separate files a) Background document and draft methodology; and
b) Powerpoint presentation

- Draft methodology and process
- Identification of issues and significant cultural values
- Code of conduct
- Proposal and EIS conducted by the Western Sydney Unit (WSU) or the Department of Infrastructure and Regional Development (DIRD)
- Potential for conserving sites, total impact project

- Project timeframes
- Project layout and area
- Act under which the assessment is being undertaken
- Process of reporting and comments will be sought during the public exhibition phase
- Overview of assessment to date
- 1997 EIS, Option A, 50% surveyed, summary of results including intangible values
    - Emphasised that input and direction into cultural values comes from the RAPs
- Criticisms of 1997 EIS including cumulative impacts not adequately assessed
- Up to RAPs and archaeologists to present a case for long term management and impact mitigation measures
- Reinspection in 2014
- Sites and test excavation overview
    - Emphasised the assessment based on cultural landscapes rather than just on sites
- Current assessment:
    - All effort to be put into test excavation
    - All landforms will be tested
    - Constrained by timing
    - Will extrapolate results over the whole project area, make predications to a good enough degree to build recommendations
    - Intangible values equally important to the assessment
    - Information on cumulative impacts can also come from RAPs as they have knowledge about the local area
- Methodology summary
    - The first week of fieldwork will be site visits and defining test areas
    - 10 pits per test area
- Stakeholder participation
    - Have to provide an opportunity for all to participate
- Return to country
- Human remains protocol
- Ways to provide comment

Issues raised and discussion points

Native Title over commonwealth land?

- Does Native Title exist on the project area lands?
- (KO) This is a question which should be answered by a qualified legal professional. Stakeholders were urged to seek qualified legal opinion on this question. My limited understanding is that the majority of the project area consisted of land grants and that the consequential status of the land as freehold title extinguished native title.

Cumulative development impacts

- It was noted that the Cumberland Plain has been the subject of increasingly intensive urban and industrial development and that the cumulative impact of this has resulted in an ever diminishing number of Aboriginal sites.
- Cumulative impacts within the Cumberland plain, have not been adequately taken into account in many other projects. The cumulative loss of Aboriginal sites from multiple project areas is unacceptable to stakeholders and there is little to show or compensate

for this loss, such as keeping places or salvage collections managed by Aboriginal people.

- It is a responsibility of this and future projects to adequately manage and conserve the remaining cultural heritage values.
- (KO) The assessment of cumulative impacts will be an important component of the EIS assessment.

A poor past record

- Nothing in Western Sydney has come back to stakeholders from development.
- There have been archaeological salvage programs over a small proportion of the (number and area) of sites found, and the rest have been bulldozed.
- There needs to be a better standard of management and conservation of cultural heritage values, especially with regard to the proportion of artefacts salvaged, their conservation on site, and facilities for storage and management ('Keeping places').

Not all sites encountered during archaeological surveys conducted in the 1990s and before were recorded. Were all sites in the 1997 EIS field program recorded?

- (KO) All sites encountered in the 1997 archaeological surveys were recorded, however not all surface artefacts at each site were described in detail.

Access to the Project Area

- Will there be access to all of the project area?
- (KO) Most of the project area has been, or remains the subject of leasehold agreements to private individuals or companies. The Commonwealth government is currently in the process of ending these leases. The lease agreements specify strict time periods for giving notice for entry and inspections. Given that there are long lead-times for giving notice to leaseholders, NOHC have already nominated a range of properties where it is anticipated that field work should be conducted. For these reasons, and due to this process, access will not be possible across the whole project area.
- Some stakeholders expressed that view that all of the project area should be made accessible to the assessment, and stakeholders should be able to nominate areas for field assessment, outside of those already selected by NOHC.

The Scope of the proposed field program

- All stakeholder comments on this subject were of the view that the proposed 3 week field program was inadequate and the proposed 2 weeks of test excavation could not provide a reliable sample of the archaeological material present within the project area.
- All stakeholder comments were of the opinion that:
    - more field time was required so that more of the possible test locations could be tested;
    - more stakeholder representatives should participate per day
    - more test pits should be conducted per test locations (the draft methodology suggests ten per location)
- Some stakeholders held the strong view that the whole of the project area should be the subject of a further comprehensive surface archaeological survey, and test excavation program.
- (KO) In response KO outlined how the draft methodology sought to build upon the results of the previous 1997 EIS, which were derived from an approximately 50% comprehensive archaeological survey of the project area, when ground surface visibility

was much greater than today. The focus of the current assessment is proposed to be test excavation across a representative sample of landforms, rather than the conduct of surface survey (the reasons for this were presented in the PowerPoint presentation). The scope of the proposed test excavation is limited by the overall timetable for the EIS assessment which is outside of the control of the archaeologists and the EIS team. The three week program, which includes one week of surface inspections and on-site consultation, and two weeks of test excavation, will provide a minimal sample of the archaeological deposit. Despite this, the results of the two week test excavation program would be considered to provide a reliable basis for estimating the nature and extent of the archaeological resource across the whole project area. It is conceded that a larger sample could provide greater reliability in the data generated and the findings of the analysis.

- The test excavation programs for other larger Western Sydney development areas, such as the ADI site have extended into months. The Western Sydney airport project area is similarly large and should have a comparable test excavation program.
- Imposed timelines for EIS projects have typically been too short to allow a proper level of cultural heritage assessment. This has been part of the cumulative impact of developments in Western Sydney. Timelines for EIS projects should be doing the right thing by Aboriginal people – the field program should be more like three months in duration.
- Some stakeholders stated that the Western Sydney airport project should ensure that every aspect of Aboriginal cultural heritage is salvaged and returned.

Is there a mean depth for the discovery of subsurface artefacts?

- (KO) The depth of subsurface artefacts tends to depend on the type of landform and soil deposit, however, typically in Western Sydney, artefacts occur in the top 30 centimetres. In valley floor deposits this can be much deeper. Also, where there is a distinct clay layer, artefacts will tend to move down the soil profile and lie just above the clay layer.

Management of artefacts which remain on site after the completion of archaeological salvage

- The fact that archaeological testing and salvage only recovers a small proportion of the total number of artefacts present within a project area was mentioned as a source of frustration for stakeholders, especially when subsequent development may damage those artefacts, which still have strong Aboriginal cultural values.
- (KO) Yes, this is an issue which some statutory authorities have been slow to address, such as by requiring appropriate management of stripped and stock-piled top soil where it is known to contain high proportion of stone artefacts. It is important for stakeholders to provide suggested strategies for the management of the artefacts which remain in the project area after all archaeological work is completed.
- (KO) Archaeological methodology does not normally seek to recover as many artefacts as possible. Its aim is to recover information from a representative sample of archaeological material. Even archaeological salvage programs cannot aim to recover all artefacts. New strategies are required to effectively manage the cultural values which reside in stone artefacts that remain on a development site (often in great numbers) and which may be impacted by development activities.

A ‘Keeping place’ and commemorative feature within the airport

- Some stakeholders indicated that there are very few opportunities provided in the normal processes of environmental impact assessment, to establish Keeping Places [a dedicated place for the storage and management of archaeological materials], for recovered Aboriginal artefacts, in close association with the country they came from.
- Some stakeholders would like to see a formal keeping place for Aboriginal artefacts provided within a possible future Western Sydney airport, and for the Aboriginal heritage

of the project area to be commemorated in a public and meaningful form within the development.

Participation of stakeholder representatives in the proposed field program

- All stakeholder comments were critical of the proposed level of stakeholder participation (5 representatives (varied daily according to a roster) and four NOHC staff per day [= 1 team]). All responses sought a higher degree of representation.
- Some stakeholders thought that all registered stakeholders should be represented on each field day, to be fair and to ensure information and artefacts are not missed.
- Others thought that only stakeholders who were descendants of the local Aboriginal people (the Darug or Daruk) should be represented in field work, or at least always be represented each day.
- Some stakeholders suggested that there should be more than one representative allowed per stakeholder per day.
- Representatives of the Darug groups considered that only Darug descendants should be able to identify cultural values in the project area.
- It was noted that representatives should have experience to know what they are looking at, and that only Darug descendants could effectively ‘witness’ the recovery and identification of the artefacts.
- Some stakeholders suggested that there should be a ratio of 5 stakeholder representatives to one NOHC staff member.
- Others felt that the proposed number of representatives per day should at least be doubled.
- A number of stakeholders suggested that field participation should be limited to those groups who were represented at this meeting.
- Some stakeholders indicated that the purpose of field representatives is to see (‘witness’) what is coming out of country, and not to do all the manual work.
- The number of registered stakeholders, especially those not directly representing Western Sydney traditional groups, is a concern, ‘too many are putting up their hand to be involved, this needs to be sorted out now’.
- The value of getting young people involved in the field program was noted by a number of stakeholders, and reference was made to allowing for ‘trainee’ status field participants.

Wet Sieving

- All stakeholders were of the opinion that the proposed test excavation methodology of dry sieving should be replaced with a wet sieving methodology. It was felt that this would make sieving faster and the test program more efficient.
- (KO) Dry sieving was proposed so that the test methodology would be consisted with the OEH Code of Practice for test programs conducted without an Aboriginal Heritage Impact Permit (AHIP). However, following the recent provision of legal advice from the Australian Government Solicitor, it is now known that the permit provisions of the National Parks and Wildlife Act 1974 do not apply to the Western Sydney Airport EIS assessment. This means that it would possible to conduct the test excavation program using wet sieving techniques. It was agreed that wet sieving could speed up the test program and may allow the conduct of more test pits per test location.
- (KO) Like all of the points and suggested revisions raised at this meeting, this suggested revision will be presented to the WSU for their consideration.

Distribution of list of registered stakeholders

- It was asked if the list of registered Aboriginal stakeholders was going to be provided to Office of Environment and Heritage (OEH) and the Gandangara Local Aboriginal Land Council (GLALC)?
- (KO) There are currently 32 registered Aboriginal stakeholders for this assessment project. Five stakeholders have indicated that they do not wish to have their details provided to OEH or the GLALC.
- (KO) The provision of the list of registered Aboriginal stakeholders to the OEH and the LALC is a requirement of the OEH Aboriginal consultation protocol which is being used as a guide for this assessment. Given that compliance with this protocol is not a legal requirement for this EIS assessment, advice has recently been sought from the WSU as to whether this step in the protocol should be followed.
- Many stakeholders requested that they be provided with a copy of the list of registered stakeholders.
- Some stakeholders expressed surprise at the number of registrations and expressed frustration that some of these registrations may not be from people who are descended from local tribes. The large number of registrations means that less time may be afforded via a roster system to each field representative. This is stated to be unfair to traditional owner groups.
- (KO) Advice will be sought from the WSU as to whether the list of registered Aboriginal stakeholders should be:
    - Provided to OEH and/or the GLALC, as per the OEH protocol; and
    - Distributed to all registered stakeholders.
- (KO) It was noted that the list would eventually be included in the EIS report as a background document to the Aboriginal consultation process, however contact numbers and addresses would probably be withheld to protect the privacy of the organisations and individuals concerned.
- Many stakeholders felt that disclosure of the registered Aboriginal stakeholder list was an important test of the fairness and 'transparency' of the consultation process.
- (KO) Noted that NOHC, the EIS team and the WSU may have legal obligations to protect registered stakeholder contact information and that advice would be sought from the WSU regarding the request to distribute the stakeholder list.

Full disclosure and fairness for all aspects of the project

- A number of stakeholders indicated that they wanted to see full disclosure, transparency and fairness in all aspects of the project

Payment and fee scales for field representatives

- (KO) It was noted that a standard hourly pay rate, applicable across all registered stakeholder groups, is proposed, and that this rate was yet to be determined by the WSU (Department of Infrastructure and Regional Development).
- A wide range of opinions were expressed and debated:
    - How much is cultural knowledge worth?
    - In the past, standard pay rates, determined by the WSU, have been too low and considered to be insulting.
    - It is wrong for the Department to set a pay rate. Pay rates should conform to the standard consultation rates determined by each stakeholder group.
    - Participation and pay rates should be determined according to a tender process.

  - In order to be fair and to treat all stakeholders equally, there should be a standard rate, paid equally.
  - Fees should be based on Commonwealth public service rates and fees.
  - Pay rates should be based on demonstrable levels of experience, such as 3) Senior Sites Officer, 2) Sites Officer, and 1) Trainee. These categories are used by the NSW Roads and Maritime Service.
  - If pay rates are based on experience and the services that can be provided, how would that experienced be determined or proven?
  - Should payment be made to stakeholder individuals or organisations? There was a degree of consensus that payment should go to stakeholder organisations, who would then in turn pay their representatives.

A stakeholder meeting with the 'proponent' (WSU) is requested

- A number of stakeholders requested that a meeting be held with the participation of registered Aboriginal stakeholders and the 'proponent'.
- It was felt that only the 'proponent' could effectively describe objectives and have the responsibility to provide answers to stakeholder questions and make commitments regarding project resourcing and the management of Aboriginal cultural values.
- (KO) All points of view and suggestions arising from this meeting will be passed on to the WSU for their consideration. A major objective of this meeting was the review and discussion of the draft methodology, and this was best done in a forum with the stakeholders and the EIS heritage specialist (NOHC).
- The overall EIS team is represented at this meeting by Nick Johnson (RPS) who will assist in conveying information from the meeting to the rest of the EIS team and the WSU.

A personal point of contact for the 'proponent'?

- Some stakeholders requested that a personal name and contact information for the 'proponent' (WSU) be provided to all registered Aboriginal stakeholders.
- It was noted that the OEH Aboriginal stakeholder consultation protocols require that the name and contact details of the proponent must be provided to registered Aboriginal stakeholders.

Extension of time provided for the provision of nominations by stakeholders of field representatives

- (KO) Notice for the submission of field representative nominations by the 10 April 2015 was provided in covering letters with the background document and draft Methodology.
- (KO) In order to provide a little more time for submissions following this meeting, the date for submission of nominations has been extended to the 17 April 2015.

A1.4.4 Supplementary Stakeholder Meeting

Agenda

Western Sydney airport project

Supplementary Meeting on proposed methodology
Discussion with Mr Peter Robertson, WSU.

Date: 23rd April 2015

Time: 10:00pm – 11:30pm

Location: St Marys Memorial Hall building, Multi Use Room 1, corner of the Great Western Highway and Mamre Road, St Marys Sydney

Facilitator: Kelvin Officer, Navin Officer Heritage Consultants

WSU Representative: Peter Robertson, General Manager of Environment, Legal and Communication, Western Sydney Unit (WSU),
Commonwealth Department of Infrastructure and Regional Development.

Agenda

1. Welcome to country
2. Introduction and purpose of this meeting
3. Presentation by Peter
4. Discussion of Issues:
    a. The scope of the proposed archaeological field program
    b. Representation of Aboriginal stakeholders in the field program
    c. Field program pay rates
    d. Wet sieving
    e. Distribution of list of registered participants to all registered stakeholders
    f. Native title
    g. Management of recovered cultural material
5. Fieldwork next week
6. Any other Items

A1.4.5 Aboriginal stakeholder submissions on proposed assessment methodology

Date	Type of Contact (email, phone etc)	Group/Individual	Comment
23/4/15	post	Darug Land Observations	Concerns and Comments relating to two main issues: Archaeological investigation - Limited archaeological survey and excavation has been undertaken in this locality. Given the size and nature of the study area, an extensive program of investigation should be undertaken to provide information about past Aboriginal occupation of the area - The proposed sample size, consisting of 10-20 areas within a 1700 hectare site, is not large enough to provide reliable results. - The proposed three week timeframe is not enough to complete the limited survey and test excavation program proposed. - Dry sieving is not an option in this timeframe and is not as accurate as wet sieving. - The results of the limited fieldwork program proposed would not be adequate to assess the archaeological resource and heritage significance of the study area. The resulting impact assessment and management recommendations would therefore also be unreliable. Aboriginal community consultation - A large number of Aboriginal parties have registered an interest in the project. To our knowledge these include a number of sole trader/self-profit Registered Aboriginal Parties (Raps), and Raps that are based outside the local area. - The increasing involvement of such parties in cultural heritage management means that genuine local Aboriginal community groups such as ours are unable to properly care for our heritage and support our community like we have in the past. - We recommend structuring the consultation process to ensure the best outcomes for the project and the community. In particular, representatives of all traditional stakeholder groups should be on site every day for the whole of the fieldwork. Raps that are individuals only, do not represent a community and/or are based outside the local area should be provided with project information and invited to comment, but should not be engaged in the fieldwork.
8/4/15	post	Cubbitch Barta Native Title Claimants Aboriginal	It I difficult to make any informed comments on the areas being proposed for test excavation for two reason: 1. The report that was formed from the surveys carried out in 1997 are not included in this

Date	Type of Contact (email, phone etc)	Group/Individual	Comment
		Corporation	document, and to make an informed recommendation it should have been. I am therefore requesting a copy of the document as soon as possible, as in before the proposed field work, late April. 2. Again comments are being asked for before the proposed field survey takes place. As to the places for test excavations, there is not enough information, once again referring back to the report for 1997 and the field survey not yet taking place. If there are 38 potential locations for test excavation why are only 20 being proposed in the methodology. Dry sieving is not appropriate, much more information can be gained through wet sieving. All artefact are to be returned to Country when appropriate, in the appropriate place.
24/4/15	phone	Cubbitch Barta Native Title Claimants Aboriginal Corporation	Expressed that it was not appropriate that groups from other areas of the country participate in the project
22/4/15	post	Tocomwall Pty Ltd	The proposed methodology and approach is not supported by Tocomwall because of: 1. Inadequate consultation with the RAP; 2. Inadequate consideration of RAP views and perspectives; 3. A lack of transparency; 4. Insufficient data being made available for the RAP to make informed decisions; 5. An insufficient testing program that has not been fully disclosed; 6. The absence of a stratigraphic approached to the proposed testing program; and 7. That fact the unique nature of the Cumberland Plains Cultural and scientific resource is rapidly being destroyed with little or no strategic planning for the long-term or consideration of intergenerational equity.
17/4/15	email	Darug Custodian Aboriginal Corporation	Concerns and Comments relating to two main issues: Archaeological investigation - Limited archaeological survey and excavation has been undertaken in this locality. Given the size and nature of the study area, an extensive program of investigation should be undertaken to provide information about past Aboriginal occupation of the area

Date	Type of Contact (email, phone etc)	Group/Individual	Comment
			- The proposed sample size, consisting of 10-20 areas within a 1700 hectare site, is not large enough to provide reliable results. - The proposed three week timeframe is not enough to complete the limited survey and test excavation program proposed. - Dry sieving is not an option in this timeframe and is not as accurate as wet sieving. - The results of the limited fieldwork program proposed would not be adequate to assess the archaeological resource and heritage significance of the study area. The resulting impact assessment and management recommendations would therefore also be unreliable. Aboriginal community consultation - A large number of Aboriginal parties have registered an interest in the project. To our knowledge these include a number of sole trader/self-profit Registered Aboriginal Parties (Raps), and Raps that are based outside the local area. - The increasing involvement of such parties in cultural heritage management means that genuine local Aboriginal community groups such as ours are unable to properly care for our heritage and support our community like we have in the past. We recommend structuring the consultation process to ensure the best outcomes for the project and the community. In particular, representatives of all traditional stakeholder groups should be on site every day for the whole of the fieldwork. Raps that are individuals only, do not represent a community and/or are based outside the local area should be provided with project information and invited to comment, but should not be engaged in the fieldwork.
23/4/15	email	Warragil Cultural Services	No sites visits were conducted before commencing the methodology
10/4/15	email	Darug Aboriginal LandCare	Have no objections to the planned development
10/3/15	phone	Gunyuu	Repatriation of artefacts and skeletal and concerned that people off country should not have a say in repatriation procedures, concerned that precedence should be given to people from country
27/4/15	phone	Darug Land Observations	too many groups have registered an interest in the project, and that many of the groups registered do not have legitimacy to speak for the country, in the context of this project’s area
8/4/15	Stakeholder	Various	Cumulative development impacts

Date	Type of Contact (email, phone etc)	Group/Individual	Comment
	Meeting		• Cumulative impacts within the Cumberland plain, have not been adequately taken into account in many other projects. The cumulative loss of Aboriginal sites from multiple project areas is unacceptable to stakeholders and there is little to show or compensate for this loss, such as keeping places or salvage collections managed by Aboriginal people. A poor past record • Nothing in Western Sydney has come back to stakeholders from development. • There needs to be a better standard of management and conservation of cultural heritage values, especially with regard to the proportion of artefacts salvaged, their conservation on site, and facilities for storage and management ('Keeping places'). Access to the Project Area • Some stakeholders expressed that view that all of the project area should be made accessible to the assessment, and stakeholders should be able to nominate areas for field assessment, outside of those already selected by NOHC. The Scope of the proposed field program • All stakeholder comments on this subject were of the view that the proposed 3 week field program was inadequate and the proposed 2 weeks of test excavation could not provide a reliable sample of the archaeological material present within the project area. • All stakeholder comments were of the opinion that: ○ more field time was required so that more of the possible test locations could be tested; ○ more stakeholder representatives should participate per day ○ more test pits should be conducted per test locations (the draft methodology suggests ten per location) • Some stakeholders held the strong view that the whole of the project area should be the subject of a further comprehensive surface archaeological survey, and test excavation program. • Imposed timelines for EIS projects have typically been too short to allow a proper level of cultural heritage assessment. This has been part of the cumulative impact of developments in Western Sydney. Timelines for EIS projects should be doing the right thing by Aboriginal

Date	Type of Contact (email, phone etc)	Group/Individual	Comment
			people – the field program should be more like three months in duration. • Some stakeholders stated that the Western Sydney airport project should ensure that every aspect of Aboriginal cultural heritage is salvaged and returned. Management of artefacts which remain on site after the completion of archaeological salvage • The fact that archaeological testing and salvage only recovers a small proportion of the total number of artefacts present within a project area was mentioned as a source of frustration for stakeholders, especially when subsequent development may damage those artefacts, which still have strong Aboriginal cultural values. A ‘Keeping place’ and commemorative feature within the airport • Some stakeholders indicated that there are very few opportunities provided in the normal processes of environmental impact assessment, to establish Keeping Places [a dedicated place for the storage and management of archaeological materials], for recovered Aboriginal artefacts, in close association with the country they came from. • Some stakeholders would like to see a formal keeping place for Aboriginal artefacts provided within a possible future Western Sydney airport, and for the Aboriginal heritage of the project area to be commemorated in a public and meaningful form within the development. Participation of stakeholder representatives in the proposed field program • All stakeholder comments were critical of the proposed level of stakeholder participation (5 representatives (varied daily according to a roster) and four NOHC staff per day [= 1 team]). All responses sought a higher degree of representation. • Some stakeholders thought that all registered stakeholders should be represented on each field day, to be fair and to ensure information and artefacts are not missed. • Others thought that only stakeholders who were descendants of the local Aboriginal people (the Darug or Daruk) should be represented in field work, or at least always be represented each day. • Some stakeholders suggested that there should be more than one representative allowed per stakeholder per day. • Representatives of the Darug groups considered that only Darug descendants should be able to identify cultural values in the project area.

Date	Type of Contact (email, phone etc)	Group/Individual	Comment
			• It was noted that representatives should have experience to know what they are looking at, and that only Darug descendants could effectively ‘witness’ the recovery and identification of the artefacts. • Some stakeholders suggested that there should be a ratio of 5 stakeholder representatives to one NOHC staff member. • Others felt that the proposed number of representatives per day should at least be doubled. • A number of stakeholders suggested that field participation should be limited to those groups who were represented at this meeting. • Some stakeholders indicated that the purpose of field representatives is to see (‘witness’) what is coming out of country, and not to do all the manual work. • The number of registered stakeholders, especially those not directly representing Western Sydney traditional groups, is a concern, ‘too many are putting up their hand to be involved, this needs to be sorted out now’. • The value of getting young people involved in the field program was noted by a number of stakeholders, and reference was made to allowing for ‘trainee’ status field participants. Wet Sieving • All stakeholders were of the opinion that the proposed test excavation methodology of dry sieving should be replaced with a wet sieving methodology. It was felt that this would make sieving faster and the test program more efficient.

A1.4.6 Example of Invitation to participate in the field program

Navin Officer heritage consultants pty ltd
abn: 28 092 901 605

1 May 2015

Ms Jennifer Beale
Address obscured to maintain privacy

Dear Jennifer,

Re: Western Sydney Airport EIS Aboriginal cultural heritage assessment
Invitation to participate in field program

Thank you for your organisation's acceptance of the GHD offer of employment for the participation of your nominated site offers in the WSA Aboriginal cultural heritage field program.

On behalf of GHD, NOHC are happy to formally invite the participation of one representative (Site Officer) from your organisation in the field program, per rostered day as identified in the attached fieldwork roster.

Each registered Aboriginal party has been allocated 5 days field participation spread over the 3 week period. Only the name of each group is listed on the roster therefore you are able to provide whichever nominated fieldworker is available for that day.

On the first rostered day for each representative, an ID card will be created for their use during the field program. The card will display their name, organisation and role, based on the names and information you have already provided to us. For this reason, the representative provided for each rostered day must be one of those listed on your organisation's nomination form. A portrait photo is also required for the ID card. A photo for this purpose will be taken at the time of the card issue.

In the first week for the program we will be undertaking an overall view of the project area and also visiting the nominated sites for subsurface testing with the aim of identifying the preferred sites, which will be done in consultation with you. We will also be discussing the cultural values of the project area.

We will be undertaking the subsurface testing program in weeks two and three of the field program. This will include wet sieving and hand excavation of pits.

For each field day (Monday to Friday) we will be meeting at 8am at the Badgerys Creek site office located at 2160 Elizabeth Drive Badgerys Creek (see attached map). This property is on the south side of Elizabeth Drive (on the left if you are travelling away from Sydney), 200m before you reach the intersection of Elizabeth Drive and Badgerys Creek Road.

The day will include 15 minutes for morning tea and a 30 minute lunch break and will finish at 4:45pm.

For week 1 your representative should bring their own lunch, and their own personal safety equipment and supplies:

Number 4, Kingston Warehouse
71 Leichhardt St, Kingston ACT 2604
ph 02 6282 9415 fax 02 6282 9416
navinofficer@navinofficer.com.au

- sturdy walking boots (that are also suitable for boggy ground, it is going to be wet underfoot);
- long sleeves and pants;
- high vis vest or shirt;
- sun hat;
- sunburn cream;
- wet weather gear; and
- personal water bottle (with water)

For weeks 2 and 3 your representative should bring their own lunch, and their own personal safety equipment and supplies:

- steel capped boots;
- long sleeves and pants;
- high-vis vest or shirt;
- sun hat;
- sunburn cream;
- wet weather gear; and
- personal water bottle (with water).

If you have any queries, please do not hesitate to contact me.

We look forward to continuing working with you through out this important assessment program.

Yours Sincerely

N. Hayes

Nicola Hayes

Number 4, Kingston Warehouse
71 Leichhardt St, Kingston ACT 2604
ph 02 6282 9415 fax 02 6282 9416
navinofficer@navinofficer.com.au

Appendix 2

Inventory of Aboriginal heritage sites within the airport site

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	No. surface stone artefacts (2015)	No. of subsurface stone artefacts recorded (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Dimensions of ground surface exposure (2015)	Arch'l subsurface potential (NOHC1997 and this assessment)	GDA Easting *removed from this report version*	GDA Northing *removed from this report version*
B3	45-5-2586	sao	1					Stock track		0.3m wide		high		
B4	45-5-2638	sao	1	nil				Erosion gully platform		2.6 x 3.9		low		
B5	45-5-2637	sao	1	1				Creek ford		20 x 7		low		
B7	45-5-2635	sao	1	nil				Stock track and creek bank		1 x 1		moderate		
B15	45-5-2705	sao	1					Suburban road verge		4 x 4		low		
B24	45-5-2642	sao	1					Track from dam wall				not recorded		
B25	45-5-2643	sao	1					Grassed ploughed area (vineyard)				low		
B31	45-5-2617	sao	1					Dirt track		3 x 3		low		
B32	45-5-2618	sao	1							10 x 2		not recorded		
B39	45-5-2629	sao	1					Ploughed zone between vines		100 x 2		low		
B40	45-5-2630	modified tree										-		
B41	45-5-2768	sao	1	nil				BMX bike jump		2.5 x 2.5		moderate		
B42	45-5-2631	sao	1					Building (construction) site		6 x 2		low		
B43	45-5-2783	sao	5					Salt scald	30 x 30	10 x 5		high		

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	No. surface stone artefacts (2015)	No. of subsurface stone artefacts recorded (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Dimensions of ground surface exposure (2015)	Arch'l subsurface potential (NOHC1997 and this assessment)	GDA Easting *removed from this report version*	GDA Northing *removed from this report version*
B44	45-5-2632	sao	3	nil				Erosion gully and horse track	150 x 25	150 x 25		moderate		
B45	45-5-2633	sao	12	3				Scald at gate and dam bank	120 x 30	18 x 4 7 x 4		moderate		
B46	45-5-2699	sao	13	1				Channel and erosion scour and agricultural dam wall	60 x 50	25 x 5 40 x 5 15 x 20		high		
B54	45-5-2790	sao	2	nil				Eroded gully margin	11 x 1	15 x 3		low		
B55	45-5-2693	sao	2	nil				Gateway and ant nest scald	23 x 2	4 x 3		low		
B59	45-5-2690	sao	1	nil				Road margin		16 x 15		not recorded		
B66	45-5-2659	sao	16					Scald	12 x 4	25 x 4		low		
B67	45-5-2658	sao	1					Trampled and eroded soil exposure		2 x 6		moderate		
B68	45-5-2623	sao	1					Stock trail		200 x 30		high		
B69	45-5-2771	sao	1					Graded embankment for agricultural dam		10 x 5		not recorded		
B70	45-5-2770	sao	5					Drainage line scald and stock yards	7 x 3	16 x 8		moderate		

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	No. surface stone artefacts (2015)	No. of subsurface stone artefacts recorded (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Dimensions of ground surface exposure (2015)	Arch'l subsurface potential (NOHC1997 and this assessment)	GDA Easting *removed from this report version*	GDA Northing *removed from this report version*
B71	45-5-2687	sao	1					Stock treadage		20 x 3		not recorded		
B74	45-5-2685	sao	1	nil				Recently ploughed field		100 x 200		moderate		
B75	45-5-2682	sao	1					Agricultural dam wall		25 x 6		moderate		
B76	45-5-2683	sao	1	nil				Side of bitumen road		100 x 5		low		
B77	45-5-2681	sao	9					Dry creek bed	10 x 2	11 x 5		high		
B78	45-5-2680	sao	1					Creek bed	10 x 15	10 x 15		high		
B79	45-5-2663	sao	1					Road cutting		50 x 10		low		
B80	45-5-2678	sao	11	64				Erosion scald above agricultural dam and creek bed	100 x 30	20 x 6 4 x 2		moderate		
B81	45-5-2679	sao	1	nil				Creek bed and banks		17 x 30		high		
B82	45-5-2764	sao	1	nil				Agricultural dam wall		40 x 5		low		
B84	45-5-2782	sao	7					Scald around dead tree	1.7 x 1.5	30 x 15		moderate		
B86	45-5-2781	sao	5	nil				Erosion scar	30 x 20	30 x 20		low		
B87	45-5-2763	sao	5					Graded vehicle track	20 x 4	20 x 4		high		
B88	45-5-2665	sao+ssao	2	nil		16		Excavated trench below dam	20 x 5	20 x 5		confirmed		

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	No. surface stone artefacts (2015)	No. of subsurface stone artefacts recorded (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Dimensions of ground surface exposure (2015)	Arch'l subsurface potential (NOHC1997 and this assessment)	GDA Easting *removed from this report version*	GDA Northing *removed from this report version*
B90	45-5-2667	sao	2					Vehicle track	10 x 0.5	2.5m wide		moderate		
B91	45-5-2671	sao	2					Ploughed marked garden	6 x 1	300 x 200		low		
B92	45-5-2670	sao	4					Disused vehicle track	25 x 3	3m wide		high		
B93	45-5-2668	sao	1					Agricultural dam wall		20 x 1.5		low		
B94	45-5-2789	sao	1	nil				Salt scald/clay pan		2 x 1		high		
B95	45-5-2762	sao	8	1				Agricultural dam wall and margin		100 x 7		moderate		
B101	45-5-2673	sao	1					Gate exposure		2.5 x 1.5		low		
B102	45-5-2656	sao	19					Sheet wash areas in old horse training paddock	13.5 x 3.5	19 x 5		high		
B103	45-5-2814	sao	1					Gate exposure		7 x 2		low		
B104	45-5-2813	sao	1					Horse training track and adjacent spoil		100 x 10		low		
B112	45-5-2788	sao	3					Stock scar	10 x 1	20 x 1		moderate		
B113		sao			20			eroded track and dam wall			150 x 30	high		

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	No. surface stone artefacts (2015)	No. of subsurface stone artefacts recorded (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Dimensions of ground surface exposure (2015)	Arch'l subsurface potential (NOHC1997 and this assessment)	GDA Easting *removed from this report version*	GDA Northing *removed from this report version*
B114		sao			10			eroded track, creek edge			110 x 20	high		
B115		sao			20			erosion and disturbance			5 x 5	high		
B116		sao			2			track				low		
B117		sao			2			erosion scald				high		
B118		sao			2			edge of ploughed field				moderate		
B119		sao			2			gate exposure				moderate		
B120		gg						sandstone outcrop				low (refer TL23)		
B121		sao +ssao			2	36	TL9 pits 2-10	track/gate exposure				confirmed		
B122		sao			1			dam wall				moderate		
B123		ssao				7	TL6 pits1-4					confirmed		
B124		ssao				3	TL6 pits 9&10					confirmed		
B125		ssao				2	TL8/10 pits 3&4					confirmed		
B126		ssao				2	TL8/10 pits 7&9					confirmed		
B127		ssao				1	TL13 pit 3					confirmed		
B128		ssao				6	TL14 pits 1&3					confirmed		
B129		ssao				2	TL14 pit 8					confirmed		
B130		ssao				1	TL23 pit 9					confirmed		

Site No.	OEH Site No.	Site type	No. surface stone artefacts (1996)	No. surface stone artefacts (AMC 2014)	No. surface stone artefacts (2015)	No. of subsurface stone artefacts recorded (2015)	Subsurface Site Pit no.	Type of ground surface exposure	Max dimensions of surface artefact distribution (1996) (m)	Dimensions of ground surface exposure(s) (1996) (m)	Dimensions of ground surface exposure (2015)	Arch'l subsurface potential (NOHC1997 and this assessment)	GDA Easting *removed from this report version*	GDA Northing *removed from this report version*
B131		ssao				1	TL26/27 pit 11					confirmed		
B132		ssao				2	TL32 pits 3&4					confirmed		
B133		ssao				5	TL32 pits 9&10					confirmed		
B134		ssao				6	TL37 pits 1,2,4 & 5					confirmed		
B135		ssao				1	TL4 pit 5					confirmed		
B136		sao		1 (initially attributed by AMC as site B5)				Vehicle track		20 x 7		moderate		

Appendix 3

Landform variables recorded for each test pit

Landform variables recorded for each test pit

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
26/27	1	3	4	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	2	3	5	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	3	3	6	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	4	3	7	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	5	3	8	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	6	3	9	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	7	3	10	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	8	3	11	Valley floor	Alluvial flats	-	flat	yes	3	52	1	4	O	Lower
26/27	9	3	12	Basal slopes	slope	-	low	no	3	55	4	4	S	Lower
26/27	10	3	13	Basal slopes	slope	-	low	no	3	56	5	4	S	Lower
26/27	11	3	14	Upper slopes	slope	2	low	no	3	57	6	4	SW	Lower
26/27	12	3	15	Upper slopes	slope	2	low	no	3	57.5	6.5	4	SW	Lower
26/27	13	3	17	Secondary Spurline crest	Saddle	2	flat	no	3	58	7	4	O	Lower
26/27	14	3	16	Secondary Spurline crest	Saddle	2	flat	no	3	58	7	4	SW	Lower
14	1	1	18	Mid slopes	minor spur crest	1	low	yes	2	67.5	1.5	2	NW	Lower
14	2	1	19	Basal slopes	minor spur crest	1	low	yes	2	66.5	1	2	NW	lower

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
14	3	1	20	Basal slopes	minor spur crest	1	low	yes	2	65.5	1	2	NW	lower
14	4	1	21	Basal slopes	minor spur crest	1	low	yes	2	65	1	2	O	lower
14	5	1	22	Basal slopes	minor spur crest	1	flat	yes	2	64.5	0.5	2	O	lower
14	6	1	23	Valley floor	elevated rise	1	flat	yes	2	64.5	0.5	2	O	lower
14	7	1	24	Valley floor	elevated rise	1	flat	yes	4	64	0.5	2	O	lower
14	8	1	25	valley floor	elevated rise	1	flat	yes	4	64	0.5	2	O	lower
14	9	1	26	valley floor	elevated rise	1	flat	yes	4	63.5	1.5	4	O	lower
14	10	1	27	valley floor	elevated rise	1	flat	yes	4	63	1	4	O	lower
13	1	7	29	Secondary Spurline crest	knoll	2	low	no	1	86	5	1	O	middle
13	2	7	28	Secondary Spurline crest	crest	2	flat	no	1	85	5	1	E	middle
13	3	7	30	Secondary Spurline crest	crest	2	low	no	-	83.5	5.5	1	E	middle
13	4	7	31	Secondary Spurline crest	crest	2	low	no	-	82.5	4	1	E	Middle
13	5	7	32	Secondary Spurline crest	shoulder	2	flat	no	-	81.5	4	1	O	Middle
13	6	7	33	Secondary Spurline crest	shoulder	2	flat	no	-	81	5	1	O	Middle
13	7	7	34	Secondary Spurline crest	shoulder	2	flat	no	-	81	5	1	O	Middle

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
13	8	7	35	Secondary Spurline crest	shoulder	2	flat	no	-	80.5	5.5	1	O	Middle
13	9	7	36	Secondary spurline crest	shoulder	2	flat	no	-	80	6	1	O	Middle
13	10	7	37	minor spurline crest	shoulder	1	flat	no	-	79	5.5	1	O	Middle
23	1	14	38	Upper slopes	break-of-slope	3	moderate	no	1	86	27	1	S	middle
23	2	14	39	Upper slopes	slope	3	moderate	no	1	83	24	1	S	middle
23	3	14	40	Upper slopes	slope	3	moderate	yes	5	78	19	1	S	middle
23	4	14	41	Mid slopes	bench	3	low to moderate	yes	5	76	17	1	S	middle
23	5	14	42	Mid slopes	minor spurline crest	1	low to moderate	yes	5	75	16	1	W	lower
23	6	14	43	Mid slopes	minor spurline crest	1	low to moderate	yes	5	73	14	1	W	lower
23	7	14	44	Mid slopes	minor spurline crest	1	moderate	yes	5	71	12	1	W	lower
23	8	14	45	mid slopes	fan	-	low to moderate	yes	5	67	8	5	SW	lower
23	9	14	46	Basal slopes	fan	-	low to moderate	yes	5	63.5	4.5	5	SW	lower
23	10	14	47	Basal slopes	fan	-	low	yes	5	62	3	5	S	lower
37	1	6&7	48	Valley floor	elevated rise/terrace	-	flat	yes	3	70.5	1	3	O	middle

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
37	2	7	49	Valley floor	elevated rise/terrace	-	flat	yes	3	71	1	3	O	middle
37	3	7	50	Valley floor	elevated rise/terrace	-	flat	yes	3	71.5	1.5	3	NW	middle
37	4	6&7	51	Valley floor	elevated rise/terrace	-	flat	yes	3	71.5	1.5	1	NW	middle
37	5	6	52	Valley floor	elevated rise/terrace	-	flat	yes	3	71.5	1.5	1	O	middle
37	6	6	53	Valley floor	elevated rise/terrace	-	flat	yes	3	72	1	1	O	middle
37	7	6	54	Valley floor	elevated rise/terrace	-	flat	yes	3	72.5	1.5	3	O	middle
37	8	6	55	Valley floor	elevated rise/terrace	-	flat	yes	3	73	2	3	O	middle
37	9	6	56	Valley floor	elevated rise/terrace	-	flat	yes	3	73	2	3	O	middle
37	10	6	57	Basal slopes	minor spurline crest	-	low	yes	3	73.5	2.5	3	O	middle
6	1	12	58	mid slopes	minor spurline crest	1	low	no		79.5	5.5	3	S	Lower
6	2	12	59	mid slopes	minor spurline crest	1	low	yes	3	78	4	3	S	Lower
6	3	12	60	basal slopes	slope	-	low	yes	3	76	2	3	SW	Lower
6	4	12	61	basal slopes	slope	-	low	yes	4	75	1	3	SW	Lower
6	5	12	62	Valley floor	alluvial flats	-	flat	yes	4	74	0.5	3	O	Lower

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
6	6	12	63	Valley floor	alluvial flats	-	flat	yes	4	74	0.5	4	O	Lower
6	7	12	64	Valley floor	alluvial flats	-	flat	yes	4	73.5	0.5	4	O	Lower
6	8	12	65	Valley floor	alluvial flats	-	flat	yes	4	73	0.5	4	O	Lower
6	9	12	66	Valley floor	alluvial flats	-	flat	yes	4	72.5	0.5	4	O	Lower
6	10	12	67	Valley floor	alluvial flats	-	flat	yes	5	72	0.5	4	O	Lower
4	1	12	68	2ndy Watershed ridgeline	crest	4	flat	no	1	115	22	1	O	Upper
4	2	12	69	2ndy Watershed ridgeline	crest	4	flat	no	1	115	22	1	O	Upper
4	3	12	70	2ndy Watershed ridgeline	crest	4	flat	no	1	115	22	1	O	upper
4	4	12	71	2ndy Watershed ridgeline	crest	4	flat	no	1	115	22	1	O	upper
4	5	12	72	2ndy Watershed ridgeline	crest	4	flat	no	1	115	22	1	O	upper
4	6	12	73	2ndy Watershed ridgeline	upper slopes	4	moderate	no	1	114	21	1	SW	upper
4	7	12	74	2ndy Watershed ridgeline	crest	4	Low to moderate	no	1	114	21	1	NE	upper

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
4	8	12	75	2ndy Watershed ridgeline	crest	4	Low to moderate	no	1	113	20	1	NE	upper
4	9	12	76	2ndy Watershed ridgeline	crest	4	Low to moderate	no	1	111	18	1	NE	upper
4	10	12	77	2ndy Watershed ridgeline	crest	4	Low to moderate	no	1	109	16	1	NE	upper
1	1	12	78	Major Watershed ridgeline	crest	5	flat	no	1	99.5	8.5	1	O	upper
1	2	12	79	Major Watershed ridgeline	crest	5	flat	no	1	100	9	1	O	upper
1	3	12	80	Major Watershed ridgeline	crest	5	flat	no	1	100	9	1	O	upper
1	4	12	81	Major Watershed ridgeline	crest	5	flat	no	1	100.5	9.5	1	O	upper
1	5	12	82	Major Watershed ridgeline	crest	5	flat	no	1	100.5	9.5	1	O	upper
1	6	12	83	Major Watershed ridgeline	crest	5	flat	no	1	100.5	9.5	1	O	upper

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
1	7	12	84	Major Watershed ridgeline	crest	5	flat	no	1	101	10	1	O	upper
1	8	12	85	Major Watershed ridgeline	crest	5	flat	no	1	101	10	1	O	upper
1	9	12	86	Major Watershed ridgeline	upper slopes	5	low	no	1	101	10	1	SW	upper
1	10	12	87	Major Watershed ridgeline	upper slopes	5	low	no	1	101.5	10.5	1	SW	upper
32	1	13	88	Mid slopes	minor spurline crest	1	low	no	1	75.5	3	1	E	lower
32	2	13	89	Mid slopes	minor spurline crest	1	low	no	1	74	3	1	E	lower
32	3	13	90	Basal slopes	minor spurline crest	1	flat	no	1	73	3	1	SE	lower
32	4	13	91	Basal slopes	minor spurline crest	1	flat	no	1	72	2	1	SE	lower
32	5	13	92	Basal slopes	minor spurline crest	1	low	yes	5	71	5	1	S	lower
32	6	13	93	Valley floor	alluvial flats	-	flat	yes	5	68.5	2.5	1	O	lower
32	7	13	94	Valley floor	alluvial terrace	-	flat	yes	5	68	2	1	O	lower
32	8	13	95	Valley floor	alluvial terrace	-	flat	yes	5	68	2	5	O	lower

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
32	9	13	96	Valley floor	alluvial terrace	-	flat	yes	5	68	2	5	O	lower
32	10	13	97	Valley floor	alluvial terrace	-	flat	yes	5	68	2	5	O	lower
8/10	1	10	98	mid slopes	minor spurline crest	1	flat	yes	2	68.5	9	2	O	middle
8/10	2	10	99	mid slope	minor spurline crest	1	low	yes	2	67	7.5	2	O	middle
8/10	3	10	100	mid slopes	minor spurline crest	1	flat	yes	2	65.5	5	2	NW	lower
8/10	4	10	101	mid slopes	minor spurline crest	1	low	yes	2	64.5	4.5	2	NW	lower
8/10	5	10	102	mid slopes	minor spurline crest	1	low	yes	2	62	3.5	2	NW	lower
8/10	6	10	103	basal slopes	minor spurline crest	1	low	yes	5	58	2.5	2	NW	lower
8/10	7	10	104	valley floor	alluvial flats	-	flat	yes	5	57	1	2	O	lower
8/10	8	10	105	valley floor	alluvial flats	-	flat	yes	5	57	3	5	O	lower
8/10	9	10	106	valley floor	alluvial flats	-	flat	yes	5	57.5	4,5	5	O	lower
8/10	10	10	107	valley floor	elevated rise	-	low	yes	5	58.5	5.5	5	O	lower
9	1	9	108	basal slopes	slope	-	low	yes	5	50.5	4.5	5	O	lower
9	2	9	109	basal slopes	slope	-	low	yes	5	50	4	5	O	lower
9	3	9	110	valley floor	alluvial flats	-	flat	yes	5	49.5	3.5	5	O	lower
9	4	9	111	valley floor	alluvial flats	-	flat	yes	5	49.5	3.5	5	O	lower

Test Locn	Pit no.	Map page	GPS refer. point	Broad scale landform category	Fine scale landform category	Watershed/ spurline order	Slope category	within 100 m of <1st order drainage line	Highest drainage line order within 100m	Elevation (AHD)	Elevation above nearest <1st order drainage line (m)	Order of closest drainage line	Aspect	Overall valley context
9	5	9	112	valley floor	alluvial flats	-	flat	yes	5	49.5	3.5	5	O	lower
9	6	3	113	valley floor	alluvial flats	-	flat	yes	5	48	2	5	O	lower
9	7	3	114	valley floor	alluvial flats	-	flat	yes	5	48	2	5	O	lower
9	8	3	115	valley floor	alluvial flats	-	flat	yes	5	48	2	5	O	lower
9	9	3	116	valley floor	alluvial flats	-	flat	yes	5	48	2	5	O	lower
9	10	3	117	valley floor	alluvial flats	-	flat	yes	5	48	2	5	O	lower

Appendix 4

Glossary of technical terms

Term	Definition
Aboriginal site	A place or location which relates to past or contemporary Aboriginal occupation. Sites can be divided into those identified from archaeological evidence (archaeological sites), and those related to intangible cultural values, such as revealed by oral tradition and lore, or from the historical record. An Aboriginal site may have both archaeological and intangible values.
aggradation	(i) The building up of the Earth's surface by deposition; specifically the upbuilding performed by a stream in order to establish or maintain uniformity of grade or slope. (ii) A synonym of accretion, as in the development of a beach.
alluvial	pertaining to alluvium and fluvial processes.
alluvium	unconsolidated deposit of gravel, sand, mud etc., formed by water flowing in identifiable channels. Commonly well-sorted and stratified.
archaeological deposit	a ground deposit with the confirmed presence of archaeological evidence of Aboriginal occupation, where the context of that evidence can be reliably related to the Aboriginal actions which produced the evidence.
Archaeological sensitivity	A term used to describe an area or zone within which sites and/or potential archaeological deposits are known or predicted to occur at a scale or frequency which necessitates careful management action in the future.
archaeological site	a place or location with the confirmed presence of archaeological evidence of Aboriginal occupation, where the context of that evidence can be reliably related to the Aboriginal actions which produced the evidence.
archaeologically sensitive landform (asl)	an area within which sites and/or potential archaeological deposits are known or reliably predicted to occur at a scale or frequency which necessitates careful management action in the future.
artefact	an object, normally portable, made or modified by human hand (see 'stone artefact').
artefact occurrence	a term usually applied to site recordings comprising stone artefacts and which refers to one or more stone artefacts situated within a specified surface area or subsurface deposit. Various measures are used for defining the boundaries of such recordings. Refer also to 'surface' and 'subsurface artefact occurrence'.
artefact scatter	a formerly used open site-type classification defined as two or more stone artefacts situated no more than a specified distance (such as 60m) away from any other included artefact. Typically this category did not include isolated finds. The use of the term *scatter* was intended only to be descriptive and did not infer the original human behaviour which formed the site. The term *open camp site* has been used extensively in the past to describe open artefact scatters.
assemblage	see lithic assemblage.
background discard or scatter	There is no single concept for background discard or 'scatter', and therefore no agreed definition. The definitions in current use are based on the postulated nature of prehistoric activity, and often they are phrased in general terms and do not include quantitative criteria. Commonly agreed is that background discard occurs in the absence of 'focused' activity involving the production or discard of stone artefacts in a particular location. An example of unfocussed activity is occasional isolated discard of artefacts during travel along a route or pathway. Examples of 'focussed activity' are camping, knapping and heat-treating stone, cooking in a hearth, and processing food with stone tools. In practical terms, over a period of thousands of years an accumulation of 'unfocussed' discard may result in an archaeological concentration that may be identified as a 'site'. Definitions of background discard comprising only qualitative criteria do not specify the numbers (numerical flux) or 'density' of artefacts required to discriminate site areas from background discard.
background lithic material	natural stone (in the form of pebbles and/or fragments) of types used by Aborigines to make artefacts (such as quartz, tuff, silcrete, chalcedony and quartzite) and occurring in or near a prehistoric archaeological site.
background scatter	can be generally defined as manuport and artefactual material which is *insufficient either in number or in association* with other material to suggest focused activity in a particular location or context.

Term	Definition
backing (retouch)	abruptly angled flaking (retouch) which has shaped a thick back part to an implement such as an elouera or microlith. The process of flaking varies from bipolar impact (on some eloueras) to delicate application of pressure with a small stone ('chimbling' used to make microliths).
bending initiation	the commencement of a fracture by the application of a bending load or force, as in breaking a bar of chocolate, where the load is applied away from the point at which the object breaks. Bending initiation is common in the fracture of a tool's cutting edge during its use, and is commonly caused by human treadage at a site. It normally occurs on thin edges (see also 'snap fractures or flakes').
bioturbation	the process of mixing soil materials or sediments by living organisms.
bipolar core	A core (nucleus) that is supported on a stone anvil surface and struck repeatedly with a hammerstone from above. Diagnostic attributes of bipolar fracture damage are point or sinuous ridge type initiation platforms, crushing, cracks, and concentrated overlapping step fractures emanating from areas of hammer impact.
bipolar flake	(and broken bipolar flake) -a flake retaining evidence of bipolar fracture damage on at least one end. Some of these are 'compression flakes' formed by substantial compressive force. A broken bipolar flake has a transversely oriented breakage.
bipolar flaking	a method of making flakes or retouched flake tools by smashing a piece of stone, often a quartz pebble, rested on a stone surface and repeatedly striking the core from above with a stone hammer.
BP	Before present, a convention adopted in the publication of radiometric age determinations whereby the present is deemed to be 1950 AD.
broken bipolar flake	Transversely broken flake from a bipolar core.
broken flake	A flake with two or more breakages but retaining its area of flake initiation.
Cenozoic	is the current and most recent of the three Phanerozoic geological eras, following the Mesozoic Era and covering the period from 65 million years ago to present day.
chalcedony	a compact variety of silica, formed of quartz crystallites, often fibrous in form and with sub-microscopic pores which contain water (about 1% of weight). Coloured varieties include carnelian (yellow brown), sard (brown), agate (varicoloured) and jasper (red). Chalcedony can form veins or can occur as pseudomorphs, resulting from silica-charged solution infiltrating voids or cavities in rock, sometimes by gradually replacing decaying organic matter. Chalcedony, like fine quality chert, was a valued stone tool material. Mohs hardness always registers within half a point of 7. Chalcedony appears very fine-grained to the naked eye and can be translucent, banded and include a wide variety of colours. This rock type breaks by the process of conchoidal (shell-like) fracture and provides flakes that have sharp durable edges.
chert	a highly siliceous rock type formed biogenically from the compaction and precipitation of the silica skeletons of diatoms. Normally there is a high percentage of cryptocrystalline quartz. This rock type breaks by the process of conchoidal (shell-like) fracture and provides flakes that have sharp durable edges.
chronosequence	a sequence of soils developed under similar soil-forming conditions, but at different times
clast	a grain or crystal with a finer grained matrix (usual in silcrete).
cobble	waterworn stones of diameter greater than 64 mm (about the size of a tennis ball) and less than 256 mm (about the size of a basketball). Archaeologists often refer to cobbles as pebbles (see also 'pebble').
colluvium	an unconsolidated deposit of gravel, sand, mud etc., formed by water flowing across a hillslope surface (slope wash, sheetwash, rain wash) and/or by mass movement. Commonly poorly sorted and stratified.
conchoidal flake	a flake created by Hertzian initiation (a cone crack). This is the most common type of flake produced by tool making, but occasionally also occurs in nature. It is distinguished by a partial or complete cone crack and a bulb of force; other fracture surface features are éraillure scar, lances and undulations (see these other glossary entries, and Cotterell and Kamminga 1987, 1992). The inside fracture surface of a well-formed conchoidal flake is similar to that of a bivalve shell, hence the term 'conchoidal'. 'Conchoidal fracture' refers to the process of this flake formation.

Term	Definition
conchoidal fracture	describes the way that brittle materials break or fracture when they do not follow any natural planes of separation. Materials that break in this way include quartz, flint, quartzite, and other fine-grained or amorphous materials with a composition of pure silica, such as obsidian and window glass.
concretion and nodules	a mineral forming in isolated aggregates, sometimes as spherical or ellipsoidal forms. Concretions display a concentric zonation of matrix components, whereas nodules display an undifferentiated internal fabric.
cone crack initiation	a Hertzian cone initiation which leads to the formation of a conchoidal flake. A Hertzian cone is similar in shape to the neck of a milk bottle with the top of this cone being the initiation of the circular fracture. On a flake surface the cone is not fully formed and is represented by one side, because the fracture-initiating force was applied from above at an angle of about forty-five degrees, not ninety degrees. Other terms in current usage are 'focussed initiation' and 'split cone'.
conjoin analysis	piecing together or 'conjoining' artefacts helps in reconstructing prehistoric 'events' (such as tool manufacture, tool use activities and cutting-edge rejuvenation), determining chronology and assessing site integrity.
contact	A relative chronological term used loosely to refer to the initial period of contact between Aboriginal and European peoples. This period occurred at different times within the eighteenth and nineteenth centuries, depending on the nature and timing of European exploration and settlement.
Core (synonymous with nucleus)	a piece of stone, often a pebble or cobble but also quarried stone, from which flakes have been struck for the purpose of making stone tools. (see also 'tabular nucleus'). The core (or core fragment) is generally amorphous in shape. Flakes removed from a core are called 'primary flakes' and may be further shaped by finer flaking, called 'retouch'. The term 'nucleus' refers to cores and flakes or cores that have been retouched.
core rotation	rotation of a core so that another surface is presented from which to initiate fractures that create flakes or blades. Usually this occurs when the previously flaked part of the core because unsuitable for further flake removals. Core rotation may be in any direction. The process may be opportunistic or planned, and is aimed at maximising the number of suitable flakes detached from the core.
cortex	cortex is the weathered exterior of rocks formed by long periods of exposure to chemical and physical weathering. The percentage of cortex remaining on either the dorsal (if limited to the dorsal), the platform (if limited to the platform) or both dorsal and platform (if occurring on both) is recorded in 10% increments. On flaked pieces, cortex is recorded as an estimation of the total surface area covered
cortex type	cortex type varies according to the environment in which it formed and the subsequent processes by which it came to be transported to its current position. Three types of cortex are recorded for all artefacts preserving a cortical remnant. These are angular, rounded and irregular.
Cretaceous	is defined as the period between 145.5 and 65.5 million years ago,* the last period of the Mesozoic Era, following the Jurassic
cutan	a skin, generally thin, on the natural surfaces in soil, that is, on the walls of the voids, the surfaces of skeleton grains and aggregates (e.g., pisoliths) or associated structures (e.g., glaebules), or the boundaries of other associated structures. Cutans have a composition and/or fabric different from the objects they coat. Cutans may be, e.g., argillans (clay), ferrans (iron oxide hydroxide), mangans (manganese oxide/hydroxide), calcans (or calcitans) (calcite).
debitage	commonly used French word for the stone refuse from flaking activity. Usually there is a large quantity of flaking debitage for every finished stone implement.
discard	when referring to lithic scatters the term discard means the incidental, intended and unintended scatter of artefacts on the ground surface or directly into a sediment.
distal portion or end	the end of a flake or microblade (the opposite end to that of the point of fracture origin on the ventral (or inside) surface. Tabular cortex is the weathered surface of a tabular shaped nucleus (core).

Term	Definition
dorsal face/facet	the outside surface(s) of a flake, the inside surface of the flake being one side of the fracture created during the formation of the flake. The speed at which these fracture formed ranges from about 200 m to over one kilometres a second (see also 'ventral face').
edge-ground axe	Implement shaped on at least one margin by grinding against another surface. Such implements are often shaped by flaking, pecking, flaking and pecking or grinding and/or burnishing around much of their exterior.
end scraper	A flake with a flat ventral surface and steeply retouched distal end.
Éraillure flake	a secondary flake, always very thin in cross-section that usually remains attached by a fine bridge of stone to the bulbar surface of a conchoidal negative flake scar. The fine attachment is easily removed by applying a very small force. A negative éraillure scar is left on one side of the bulb of force, which is in the upper part of the ventral surface of the primary flake from which it was detached, and is often referred to as 'bulbar scar'. This flake type has no initiation platform, is round or ovoid in plan view, and is always very thin. This flake type is not significant for the purposes of analysis other than to indicate conchoidal flaking.
facies	a body of rock with specified characteristics. Ideally, a facies is a distinctive rock unit that forms under certain conditions of sedimentation, reflecting a particular process or environment.
ferricrete	an indurated material formed by the in-situ cementation of regolith by iron oxyhydroxides, mainly goethite and/or hematite. The fabric, mineralogy and composition of the cemented materials may reflect those of the parent (regolith) material. Some authors restrict the term to the ferruginous horizon of lateritic regolith (and therefore synonymous with cuirasse, lateritic duricrust) but the more general definition is preferred. [Anand1] Original definition: A conglomerate of surficial sands and gravels cemented by Fe “salts”.
flake	(General) a piece of stone detached from a nucleus such as a core. A complete or substantially complete flake of lithic material usually with evidence of hard indenter initiation, or occasionally bending initiation. A general category for substantially complete conchoidal flakes, and rarely bending-initiated flakes. The most common type of flake is called 'conchoidal flake'. In certain circumstances flakes (especially conchoidal flakes) may be the result of natural fracture of stone. The flake's primary fracture surface (the ventral or inside surface) exhibits features such as fracture initiation, bulb of force, and undulations and lances that indicate the direction of the fracture front. Very occasionally a conchoidal flake comprises only a bulb of force (see also 'core', 'fracture initiation', 'bulb or force', 'lances' and 'undulations', and specific flake types).
flake fragment	A category comprising flake fragments without areas of fracture initiation but which display sufficient fracture surface attributes (normally conchoidal markings) for identification as a lithic artefact fragment.
flake from bipolar core	A flake retaining evidence of bipolar fracture damage on at least one end. Some of these are 'compression flakes' formed by substantial compressive force.
flake portion	terminated flake'. This variety of flake sustains a breakage at its distal end either because it was detached from the nucleus by a bending force that created a second, transverse break or was broken transversely by a bending force after it was detached (such as when it struck the ground during knapping or subsequently by treadage at the site).
flake portion	a proximal portion retains the area of flake initiation, a distal portion exhibits a flake termination. Longitudinally broken flakes and ones with an oblique break are also recognised.
flake rotation contact damage	the fine flake scars damage on the distal end of a flake (such as a microlith backing flake) a fraction of a second after it has been created and before it separates fully from the nucleus. This fracturing is caused by the continued application of load or force to the flake as its upper part moves outwards and away from the nucleus.
flaked piece	A flaked piece is defined as any piece of rock clearly derived from the process of conchoidal fracture, but for which no attributes exist to identify it as a core, a flake or any other identifiable technological category.

Term	Definition
flat	a landform element which is planar or near horizontal; creek flat -flat adjacent to a creek usually a floodplain.
floodplain	valley floor flat adjacent to a stream which is flooded by the 'annual' flood (often considered to be the flood with a recurrence interval of about 1.6 years).
fluvial	pertaining to a stream or river.
fluvial	of or pertaining to a river or rivers.
fracture or flake initiation	the point or area defining the beginning of a flake-forming fracture (always found at the top of the top of the flake scar or ventral (inside) surface of the flake (see also 'initiation surface').
fresh breakage or fracture	fracturing of a lithic item during archaeological excavation or sieving. Such fracture, which has no adhering sediment or sediment stain, may be caused by trowel, pick, shovel or earth moving machinery.
hammerstone /anvil	A piece of stone with such evidence of use in the form of diagnostic abrasion and other fracture damage.
heat fracture	fractures cause by heating the stone, either from natural causes, a campfire, or intentional heat treatment. Generally, these are undesirable effects though larger pieces of stone fractured by heat sometimes are used as cores or made into implements because of their convenient shape or size. Attributes indicating heat fracture include colour change, cracking, crazing, potlidding and creation of highly irregular fracture surface topography (often referred to as 'crenation' or 'crenulation'.
heat treatment	the intentional slow heating of stone, such as silcrete, above 300°C to improve its flaking properties.
hinge termination	when the end of the flake or fracture continuously turns at ninety degrees to the surface of the nucleus or outside surface of the flake (see also 'retroflexed hinge termination').
Holocene	is the geological epoch that began at the end of the Pleistocene (at 11,700 calendar years BP) and continues to the present.
implement (of stone)	synonym for a stone tool, usually denoting a tool that has been shaped by flaking (retouch).
Indeterminate retouched piece	an artefact or piece of an artefact with retouch along at least one margin. The purpose of this retouch cannot be determined, though some items are probably fragments of microlithic items, scrapers or utilised flakes listed above
initiation	see 'fracture or flake initiation'.
initiation platform	see 'initiation surface'.
initiation surface	the surface of a stone (sometimes called a platform) that is struck with a hammerstone at low angle for the purpose of detaching a flake. This surface is where a flake-forming crack commences; commonly part of it is retained on the flake. The load applied to this surface may be delivered by a hammerstone or by continuous increasing pressure with a length of dense wood or bone (a pressor or pressure flaking tool).
interfluve	the area between rivers; especially the relatively un-dissected upland or ridge between two adjacent drainage basins.
isolated find	a single stone artefact, not located within a rock shelter, and which occurs without any associated evidence of Aboriginal occupation within a specified radius, such as 60 metres (depending on which archaeological convention is used). Isolated finds may represent single discard events, be constituent components of background scatter, or be indicative of larger obscured, remnant and disturbed sites.
knapping episode	a series of flaking events (see also 'knapping event')
knapping event	a single act of flaking a piece of stone resulting in the *in-situ* deposition of stone flaking debris. Such an event may occur as part of a series of events
knick point	any interruption or break of slope in the longitudinal profile of a stream or of its valley, especially a point of abrupt change or inflection, resulting from rejuvenation, glacial erosion, or the outcropping of a resistant bed.
lamination	a fine layer within the matrix of a lithic material. This layer is less than 2 mm thick.
lateral margin (of a flake)	the edge along the side of a flake, running from the flake's initiation surface to its termination.

Term	Definition
laterite	generally, regolith exhibiting the characters of all, or at least the upper part, of a laterite profile. Laterite, or lateritic regolith, commonly has a hard, more or less prominent, ferruginous surface expression, with some degree of chemical and mineralogical differentiation below, characterized by varying colour reflecting varying iron and silicate distribution. Laterite is the product of weathering.
lateritization	the process of transformation of a (near) surface layer (rock or soil) into lateritic regolith.
lithic	in an archaeological context, items of a hard, usually siliceous, stone of a type selected by Aborigines for tool making. These items are often nondescript fragments but some also finely shaped implements.
lithic assemblage (of stone)	a collection of whole and fragmentary stone artefacts and manuports obtained from an archaeological site, either by collecting items scattered on the present ground surface (see lithic scatter) or by controlled excavation (see also 'stone artefact').
lithic fragment	a nondescript lithic item that does not have sufficient morphological attributes to identify it as a complete artefact or a portion of an artefact. The lithic fragment category comprises items which are identified only to the level of manuport fragments, even though it contains nondescript flaking shatter and fragments of flakes not individually identifiable as such. Some fragments exhibit attributes characteristic of heat stress, such as occurs during bushfire, hearth fire or intentional heat treatment. Evidence of heat fracture on lithic fragments (and identifiable artefacts) has been recorded in the comments for each entry. Depending on the nature of the cultural sediment and non-Aboriginal land-use practices this group may also contain a small number of non-artefactual fragments exhibiting fresh fracture surfaces.
lithic item	a piece of stone exhibiting fracture surfaces and not identified as a natural piece of stone.
lithofacies	a mappable subdivision of a designated stratigraphic unit, distinguished from adjacent subdivisions on the basis of lithology; a facies characterized by particular lithologic features. The rock record of any particular sedimentary environment, including both physical and organic characteristics.
lithology	the lithology of a rock unit is a description of its physical characteristics visible at outcrop, in hand or core samples or with low magnification microscopy, such as colour, texture, grain size, or composition
manuport	an object or fragment of an object (called item in this report) carried by human agency to the locality in which it is found.
margin	the surface immediately adjacent to an edge, the letter being the intersection of two margins.
microdebitage	flaking waste or debris (debitage) up to 10 mm in maximum size. There is no uniform metrical definition of micro-debitage and some archaeologists specify a maximum size of 5 mm.
microlith (synonym 'backed blade')	a variety of small, delicately retouched implements of various shapes such as asymmetric (bondi) point, segment, crescent, triangle, trapeze, rectangle and oblique ended. These implements are commonly thought to have been spear barbs.
microlith preform	a microblade with some degree of initial backing retouch, often along the distal end. Recognised portions are proximal, distal and fragment.
modified tree	an Aboriginal archaeological site type classification which includes all trees considered to have been modified by an Aboriginal action. Most modified tree recordings are of *scarred trees*, which display scarring that resulted from the removal of bark or wood. Rarer types include trees with evidence of carved motifs and designs, foot and hand holds, extraction of animals, or deliberate manipulation of growth form.
mottles (in soil/sediment)	masses or blotches of subdominant colours within a soil mass. Often evidence of poor drainage or extensive bioturbation.
mottles (on stone surface)	masses or blotches of subdominant colours in an area of stone surface.

Term	Definition
Neogene	is a geologic period and system in the International Commission on Stratigraphy (ICS) Geologic Timescale starting 23.03 million years ago and ending 2.58 million years ago. The second period in the Cenozoic Era, it follows the Paleogene Period and is succeeded by the Quaternary Period. The Neogene is subdivided into two epochs, the earlier Miocene and the later Pliocene
nondescript core or core fragment	A core (or core fragment) of generally amorphous shape.
nucleus	see 'core', 'polyhedral core', 'tabular nucleus'.
open camp site	a formerly used site type classification defined as an open context stone artefact occurrence (or artefact scatter), containing two or more artefacts situated no more than a specified arbitrary distance (such as 60 metres) away from any other included artefact. The term *open camp site* was based on ethnographic modelling suggesting that most artefact occurrences resulted from activities at camp sites. However, in order to separate the description from the interpretation of field evidence, both open camp sites and isolated finds are now referred to as *artefact occurrences*.
open site	an Aboriginal site which does not occur within a rock shelter or cave.
outrépasse termination	a flake ending that turns inwards within the nucleus taking off part of its base. This occurs when the fracture front approaches the bottom of a nucleus and must turn in one direction or the other, as the stresses on either side of the fracture front cannot be equal. If the fracture front turns sharply towards in the other direction the flake will terminate in a hinge. A modest to pronounced outrépasse termination is common on microlith backing flakes and occasionally is seen on microblades.
palaeochannel	is a remnant of an inactive river or stream channel that has been either filled or buried by younger sediment.
palaeosol	soil formed under environmental conditions different from those of the present. May be buried.
palaeovalley	re geologically ancient, buried river valleys which no longer function as active surface water systems.
Paleogene	is a geologic period and system that began 66 and ended 23.03 million years ago and comprises the first part of the Cenozoic Era.
pebble	by geological definition, a waterworn stone less than 64 mm in diameter (about the size of a tennis ball). Archaeologists often refer to waterworn stones larger than this as pebbles though technically they are cobbles.
pedogenesis	soil formation. Adjective: pedogenetic, pedogenic.
pH	acidity or alkalinity of soil or water. Expressed in logarithmic units either side of 7 which is neutral, <7 = acid, >7 = alkaline.
pit	a below ground level ('subsurface') testing location, either excavated by hand and sometimes referred to as a *spade pit* or *shovel pit*, or excavated by machine, such as with a backhoe or machine auger and sometimes referred to as a *trench*.
porphyry	An igneous rock rich in phenocrysts. The term 'porphyritic' refers to ones in which relatively large crystals are set in a fine-grained or glassy groundmass.
potential archaeological deposit (pad)	A discrete location or area, defined spatially either by geomorphological, disturbance or administrative criteria, within which there is a predicted likelihood that subsurface archaeological material is present, and that this material would warrant archaeological investigation in order to determine its' scientific, cultural, or statutory value and status.
potential archaeological sensitive landform (pasl)	an area within which sites and/or potential archaeological deposits are predicted to occur at a scale or frequency which necessitates careful management action in the future. The 'potential' prefix of this classification is necessary where there are no locally applicable results or model available to support the predicted occurrence.
potlid	A piece of lithic material that has a generally convex or dome-shaped ventral surface, often with evidence of fracture initiation from a location within the surface and not from the edge.
preform	a flake or blade selected for shaping by retouch into an implement. For inclusion in this category an artefact must have some degree of retouch (see also 'retouch' and 'blank').

Term	Definition
primary fracture surface	One of the two conjoining fracture surfaces created on a nucleus and flake after the flake has detached. The primary fracture surface on the flake is called the ventral surface.
proximal	the top part of a flake beginning with the initiation surface or ridge. It is the same for an implement (or tool). The opposite end of flake is called the distal end.
quarry	a site where stone was obtained by excavation from bedrock with extraction tools of simple design (see also Stone procurement site or place).
quartz	a mineral composed of crystalline silica SiO^2. Quartz is a very stable mineral that does not alter chemically during weathering or metamorphism. It is hard, usually colourless or white ('milky'). In its massive form quartz occurs as geodes or veins, from which pebbles are formed by weathering. Despite the often unpredictable nature of fracture in quartz the flakes often have sharp cutting edges. Quartz is common and abundant, and the Aborigines used it throughout Australia to make convenient light-duty cutting tools.
quartzite	A hard, silica rich stone formed from a sandstone that has been recrystallised by heat (meta-quartzite) or strengthened by slow infilling of silica in the voids between sand grains (orthoquartzite). The essential difference between sandstone and quartzite is that major fracture will propagate around the larger grains in sandstone and through the grains in quartzite.
quartzose	relating to or made of quartz
Quaternary	The most recent geological time period. Divided into the Holocene and the Pleistocene. Began 1.8 million years ago.
Quaternary	the most recent geological time period. Divided into the Holocene and the Pleistocene. Began 1.8 million years ago
reduction process	the process of removing flakes from a core, or of manufacturing an implement by flaking and/or grinding, or progressively rejuvenating a tool's working edge.
reduction strategy	strategy of flaking and/or grinding a piece of stone in predetermined stages to produce an implement.
regolith	all materials stored over bedrock on the earth`s surface
residues on stone tools	residue analysis concerns the identification of tool use activities from preserved organic and inorganic residues of worked materials. These residues may be compacted into small flake scars on the edges of utilised artefacts or adhere strongly to their surfaces. Routine examination of residues is aided by low-magnification microscopy.
retouch or retouching	an area of flake scars on an artefact resulting from intentional shaping, resharpening, or rejuvenation after wear or breakage. In resharpening a cutting edge the retouch is invariably found only on one side (see also 'indeterminate retouched piece', retouch flake' etc).
rockhead	the surface of the bedrock beneath soil cover, uppermost occurrence of unweather bedrock
sandstone	a cemented or compacted rock consisting of detrital grains which range in size from 2 mm. Because of its chemical stability quartz often comprises the majority of the grains. The nature of the cement is denoted by terms such as argillaceous (clayey), calcareous, ferruginous and tuffaceous sandstone.
saprock	compact, slightly weathered rock with low porosity; defined as having less than 20% of weatherable minerals altered but generally requiring a hammer blow to break.
saprolite	weathered bedrock in which the fabric of the parent rock, originally expressed by the arrangement of the primary mineral constituents of the rock (e.g., crystal, grains), is retained. Compared to saprock, saprolite has more than 20% of weatherable minerals altered, and generally collapses under a light blow.
scarred tree	A tree with a scar or scars of assessed Aboriginal origin. Most such scars are the result of the removal of bark or wood. The identification of a scar as Aboriginal in origin is dependent on a set of inter-related interpretive criteria, and is often associated with varying degrees of recorder confidence or surety. For this reason classifications are often prefixed as possible, probable or most likely. The credibility of alternative causal explanations such as natural traumas and other types of human scarring must be tested for each scar. Scarred trees are now included in the more inclusive site type classification of *modified tree*.

Term	Definition
siderite	is a mineral composed of iron(II) carbonate (FeCO3).
sieve damage	fracture damage on lithic items caused by abrasive contact with the sieve mesh during the process of sieving. This occurs more commonly with wet sieving of clayey sediment.
silcrete	(also known as 'porcellanite' and 'grey billy') A hard, fine grained siliceous stone flaking properties similar to quartzite and chert. It is formed by the cementation and/or replacement of bedrock, weathering deposits, unconsolidated sediments, soil or other material by a low temperature physico-chemical process. Silcrete is essentially composed of quartz grains cemented by microcrystalline silica (SiO^2). Mineral composition is highly variable, but it comprises more than 85% silica, and includes aluminium, iron and titanium in small but significant amounts. The bonding matrix is often composed of microcrystalline quartz or chalcedony. Clasts are most often quartz grains but may also include chert or chalcedony or some other hard mineral particle. Mechanical properties and texture are equivalent to the range exhibited by chert at the fine-grained end of the scale to silcrete at the coarse-grained end. Silcrete has been used by Aborigines for stone tool manufacture throughout most of Australia.
site	refer *Aboriginal site*
site integrity	the degree of post-depositional disturbance to a site.
spit	an arbitrary interval of excavated depth in an archaeological excavation, such as in: spit 2 was the layer of deposit excavated between 10 and 20 cm below ground level.
stone artefact	a piece or fragment of stone showing evidence of intentional human creation or modification.
stone layer	a sheet or layer of gravel sized materials found within a body of soil material. Commonly formed at the lower limit of bioturbation and often contains a concentration of artefacts.
stone material	(synonymous with 'lithic material', 'stone type' and 'raw material' which is a less specific but commonly used term).
stone procurement place (or site)	a place where stone is obtained for making into artefacts. As a prehistoric site type in Australia, stone procurement places range on a continuum, from pebble beds in watercourses (where there may be little or no archaeological evidence of human activity) to extensively quarried outcrops of bedrock where there is clear evidence of procurement activity, such as quarry pits, discarded hammerstones and large consolidated cultural deposits of primary flaking debris. (See also quarry)
stone tool	a piece of flaked or ground stone used in an activity or fashioned for use as a tool. A synonym of stone tool is implement, which is more often used by archaeologists to describe a flake tool fashioned by more delicate flaking (retouch).
subsurface artefact occurrence	One or more stone artefacts which occur within a specified deposit, and which have been revealed as a result of natural or human excavation. The boundaries of a recording may be strictly tied to known artefacts (such as test pits or erosion scarps) or consist of an interpretation base on topographic or disturbance variables. Subsurface artefact occurrences can also be described as archaeological deposits
superficial	at the surface, especially the surface of the Earth
surface artefact occurrence	One or more stone artefacts which occur within a specified surface area, and which are distinguished from other recordings by defined criteria, such as the boundary of ground surface exposures, landform type, or an arbitrary separation distance
technological attributes analysis	methods of reconstructing reduction sequences in stone technology (see reduction sequence). Discrete and metrical attributes of artefacts are identified, recorded and examined mathematically.
termination (of a flake)	the distal end
tuff	a stone type consisting of consolidated volcanic ash. Fine grained and highly siliceous forms of tuff were often exploited by Aboriginal people for the manufacture of flaked stone tools.
unconformable	consisting of a series of younger strata that do not succeed the underlying older rocks in age or in parallel position, as a result of a long period of erosion or non-deposition.
use fractures	breakages on the edges of stone tools resulting from tool use (see also 'use-wear').

Term	Definition
use-wear	microscopic and macroscopic damage to the surfaces of stone implements resulting from its use. Routine examination for use-wear is aided by low-magnification microscopy. Major use-wear forms are edge fractures, use-polish and smoothing, abrasion, and edge rounding and bevelling.
ventral face	the inside surface of a flake created during the flake's formation. The speed of the fracture ranges from about 200 metres to over one kilometres per second (see also 'dorsal face').
volcanic stone	rock types formed by volcanic activity display a wide range of mechanical and flaking properties. Freshly fractured volcanic stone tends not to have fine, durable edges suitable for cutting. Only a few types are utilised for making stone tools, often ones that are shaped by grinding.
working edge	the edge of a tool in contact with the worked substance or material during its usage.

Appendix 5

Mapping of landforms and test locations

A5.1 Landform mapping

Key to landform mapping

Drainage lines

First order — *not delineated*

Second order

Third order

Fourth order

Fifth order

Crests

(5) Major watershed (Nepean R – South Creek)

(4) Secondary watershed (Cosgroves Creek – Badgerys Creek)

(3) Tributary watershed (eg Oaky Creek)

(2) Secondary spurline

(1) Minor spurline or locally elevated ground

Valley Context

Valley Floor Flats/infill sediments

Basal valley slopes

Upper and mid valley slopes

Riparian zone

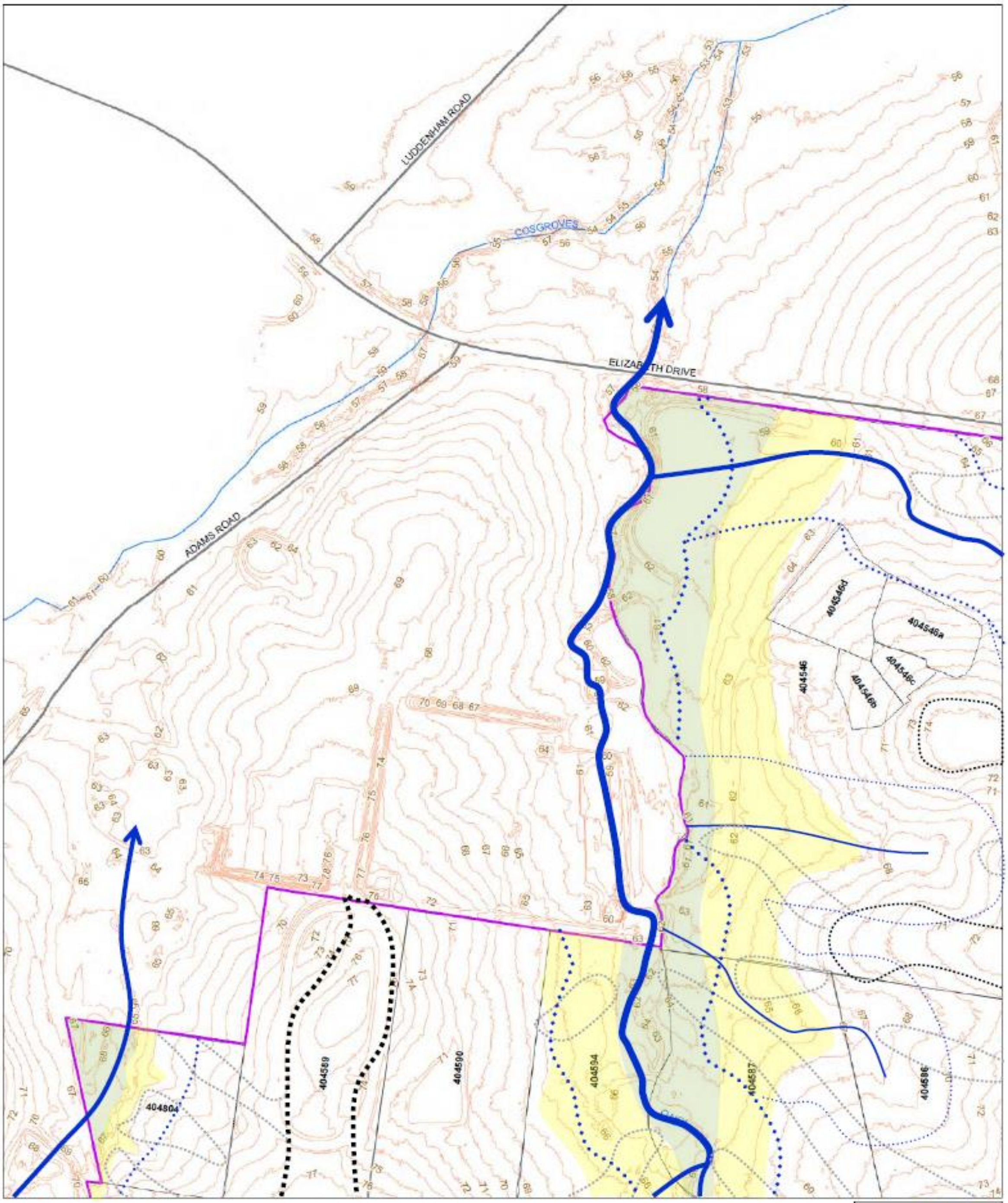
100 m radius around:

Second order drainage line

Third order drainage line

Fourth order drainage line

Fifth order drainage line



LEGEND

Property boundaries	Roads
Badgerys Creek Site Boundary	Contours (1m from Lidar DEM)
Watercourses	

Paper Size A3
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek

Job Number 21-24265
Revision A
Date 26 Feb 2015

Site layout

Page: 1

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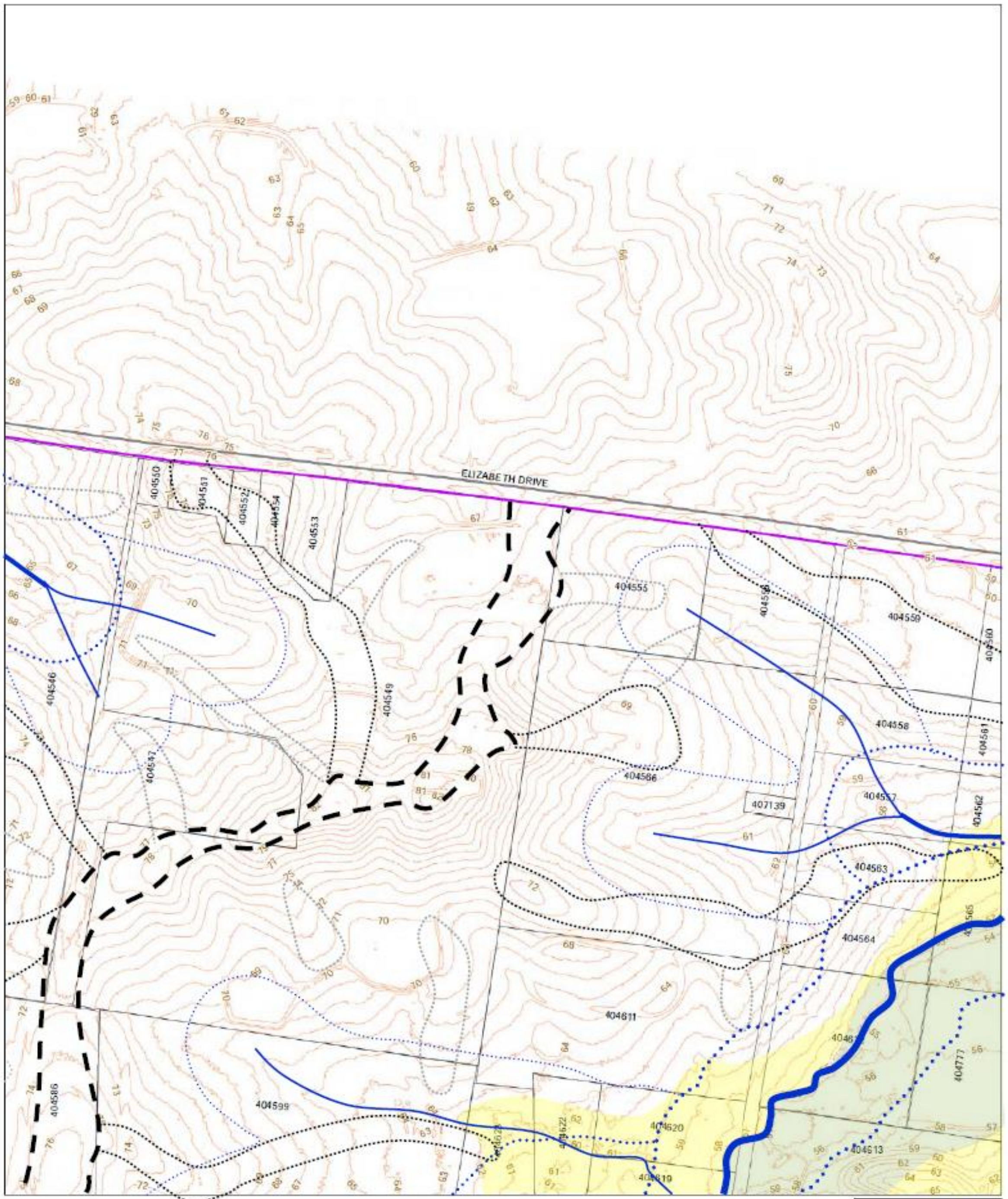

LEGEND

- Property boundaries
- Badgerys Creek Site Boundary
- Watercourses
- Roads
- Contours (1m from Lidar DEM)

			1	2	3	4			
	5	6	7	8	9				
10	11	12	13	14	15				
16		17							

Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Western Sydney Unit, Department of Infrastructure and Regional Development

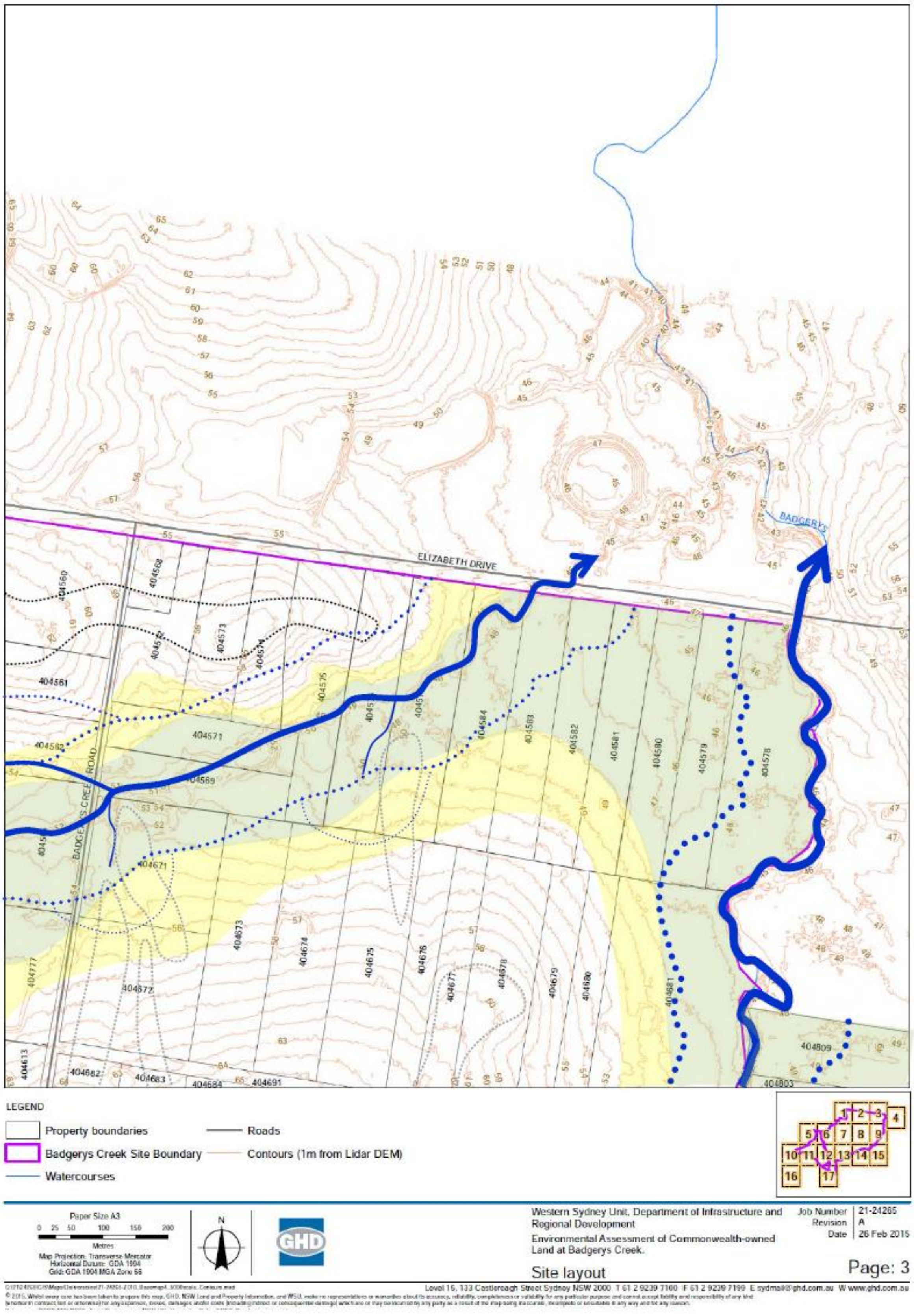
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.

Job Number 21-24265
Revision A
Date 26 Feb 2015

Site layout

Page: 2

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au



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BADGERYS
LEGEND
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Badgerys Creek Site Boundary
Watercourses
Roads
Contours (1m from Lidar DEM)
Paper Size A3
Metres
Map Projection: Transverse Mercator
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Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 3
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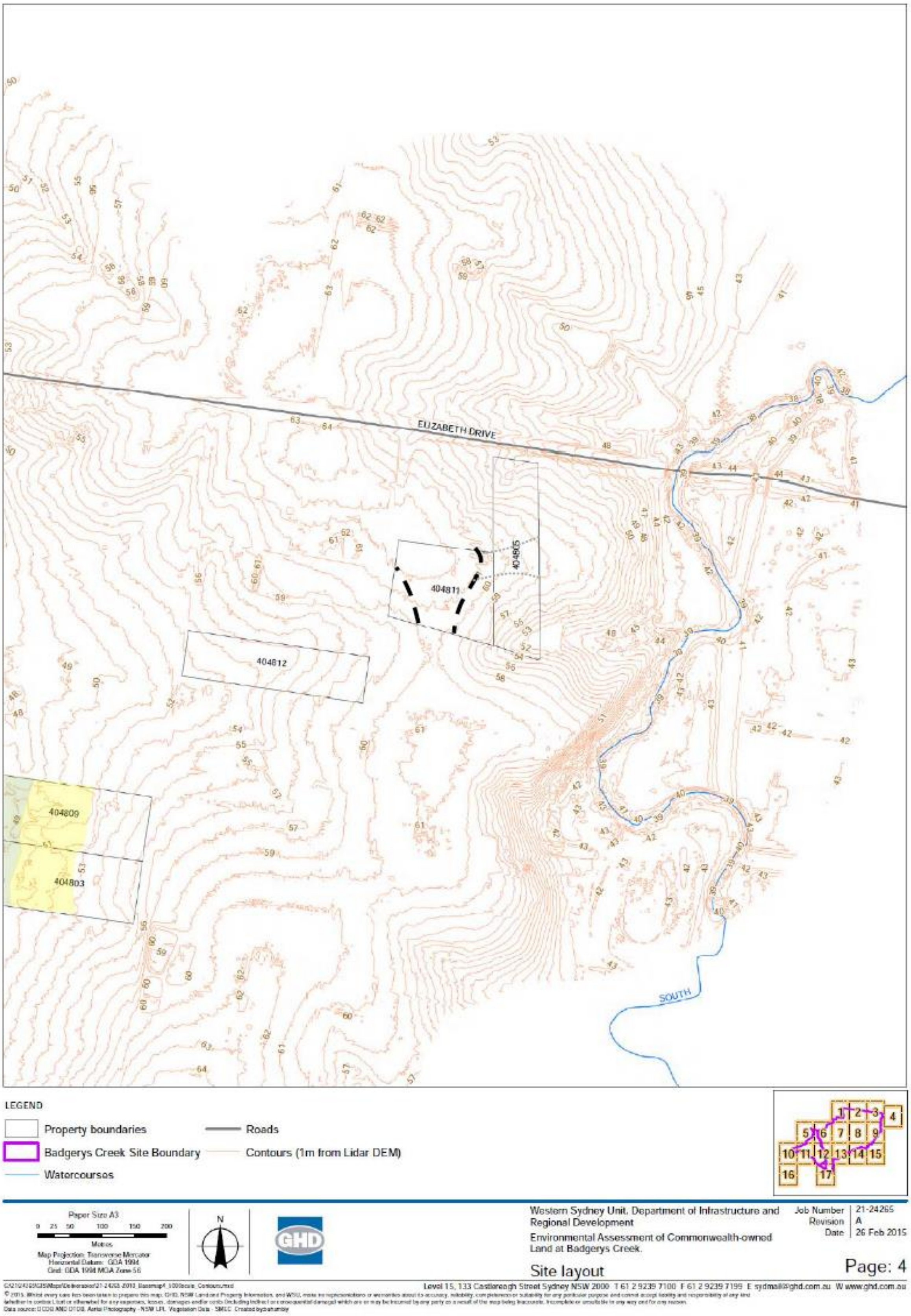

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Watercourses
Paper Size A3
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GHD
Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.
Job Number 21-24265
Revision A
Date 26 Feb 2015
Site layout
Page: 4
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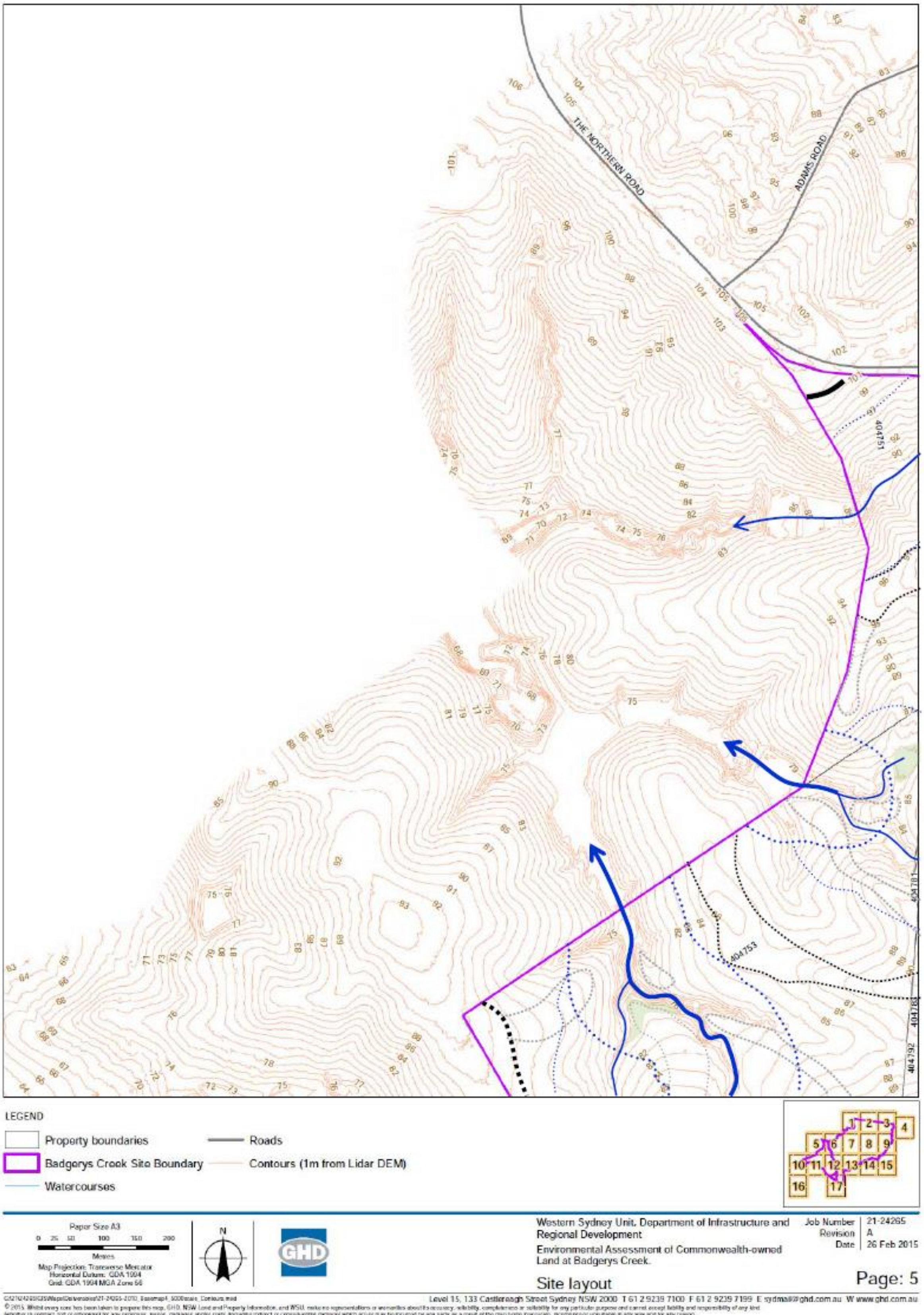
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GHD
Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 5
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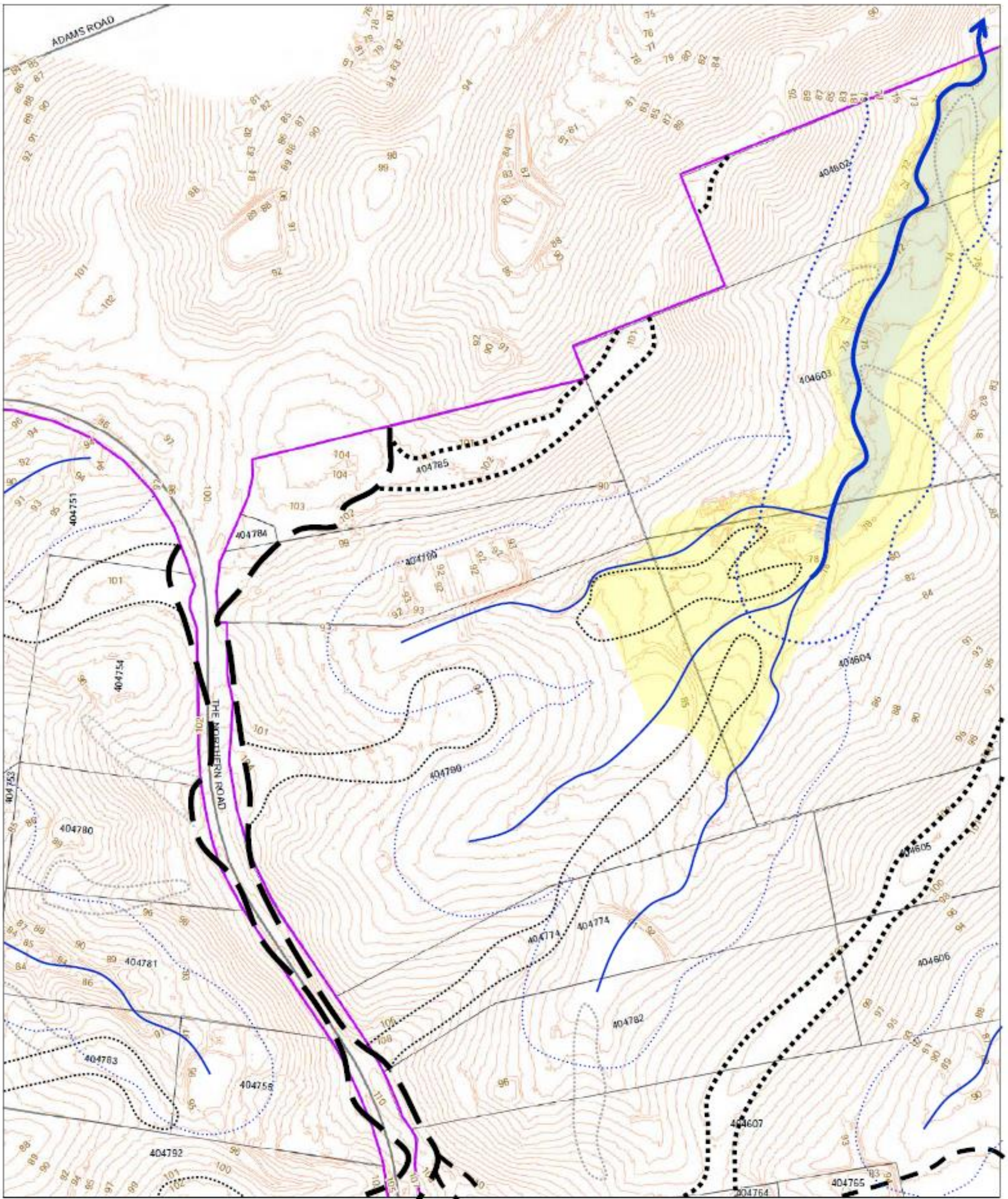

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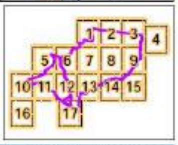

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Grid: GDA 1994 MGA Zone 56

Western Sydney Unit, Department of Infrastructure and Regional Development

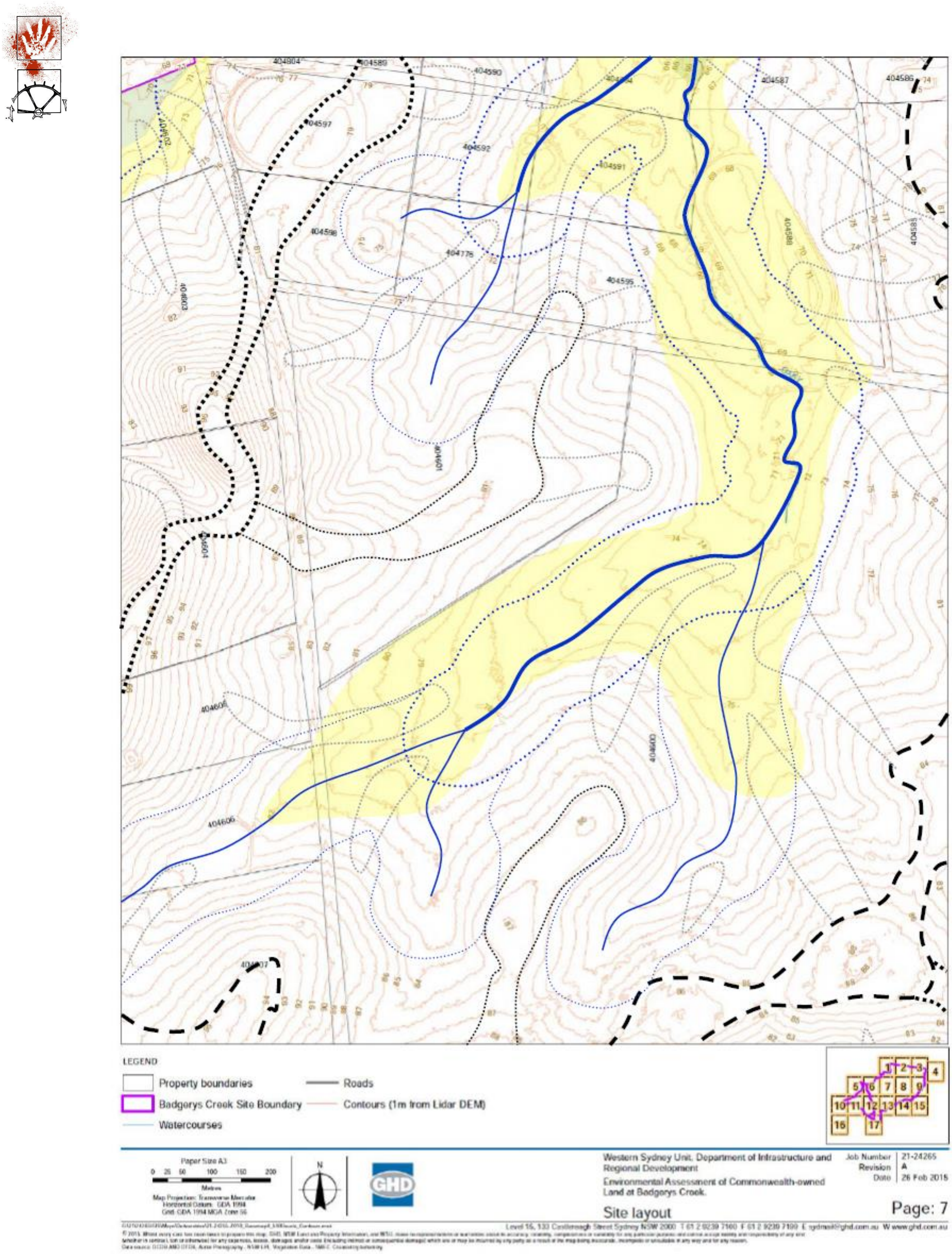
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek

Site layout

Job Number	21-24265
Revision	A
Date	26 Feb 2015

Page: 6

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au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Watercourses
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Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 7
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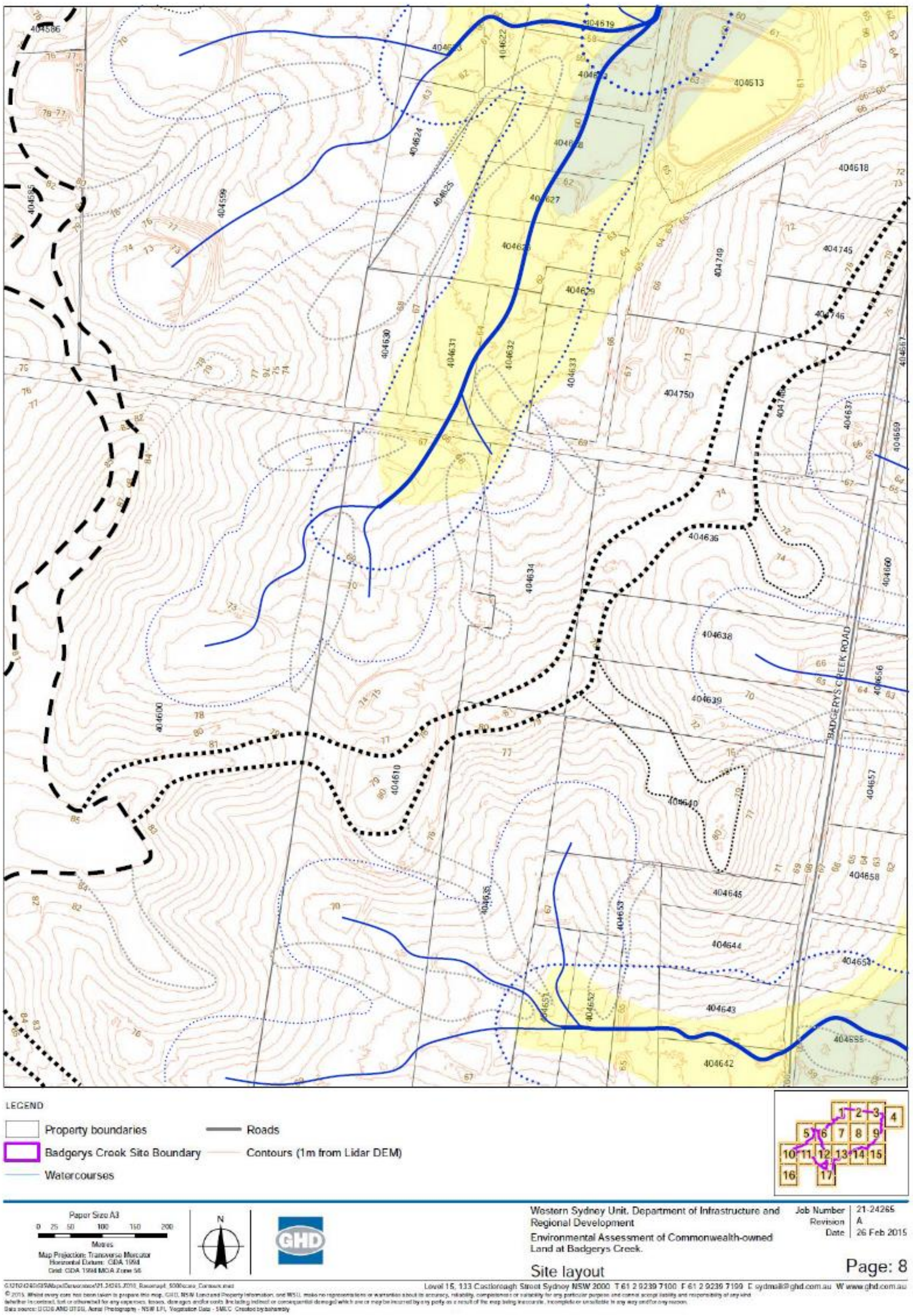
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Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 8
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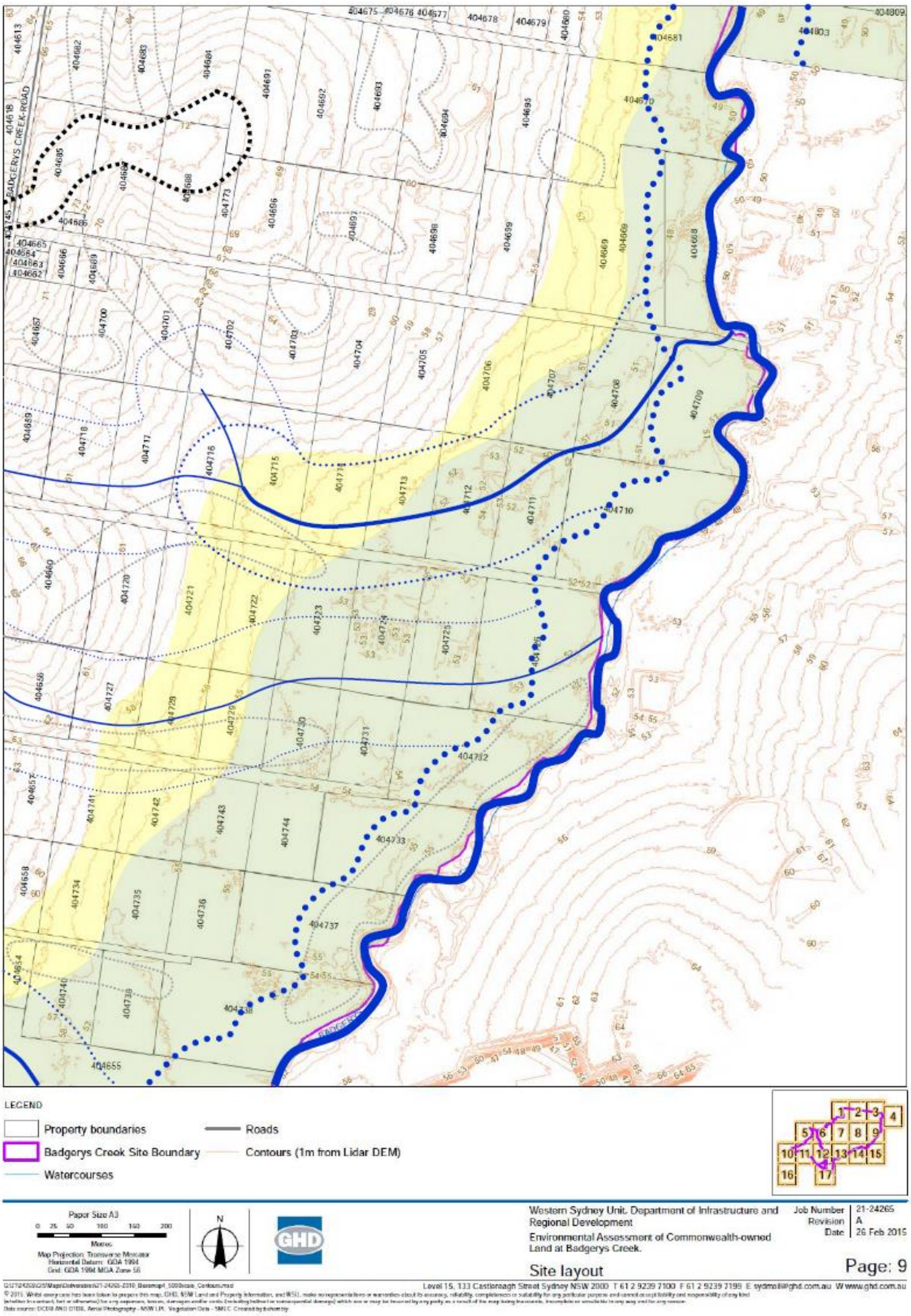
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Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 9
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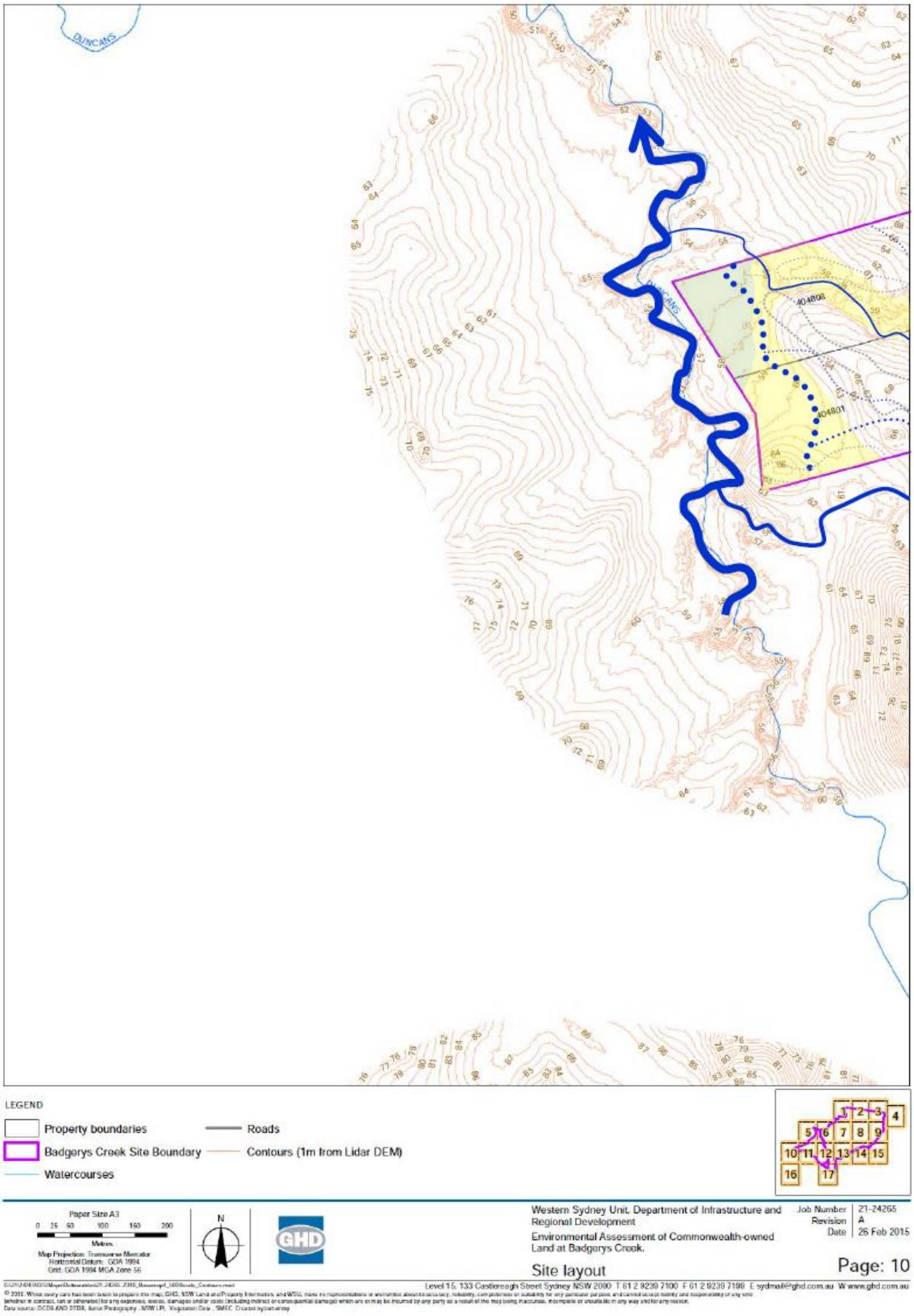
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Watercourses
Roads
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Metres
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GHD
Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 10
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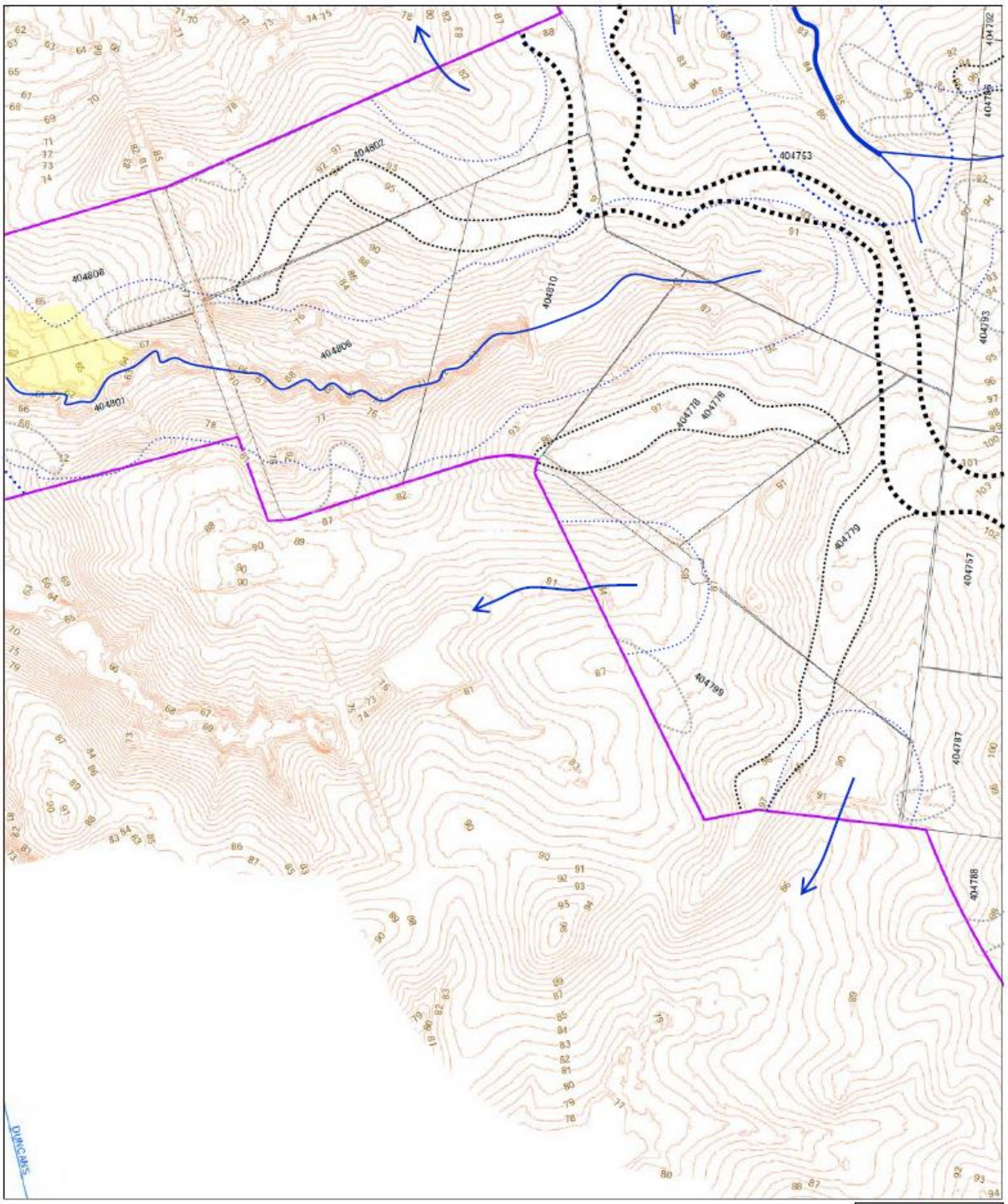

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Property boundaries

Badgerys Creek Site Boundary

Watercourses

Roads

Contours (1m from Lidar DEM)

Paper Size A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Western Sydney Unit, Department of Infrastructure and Regional Development

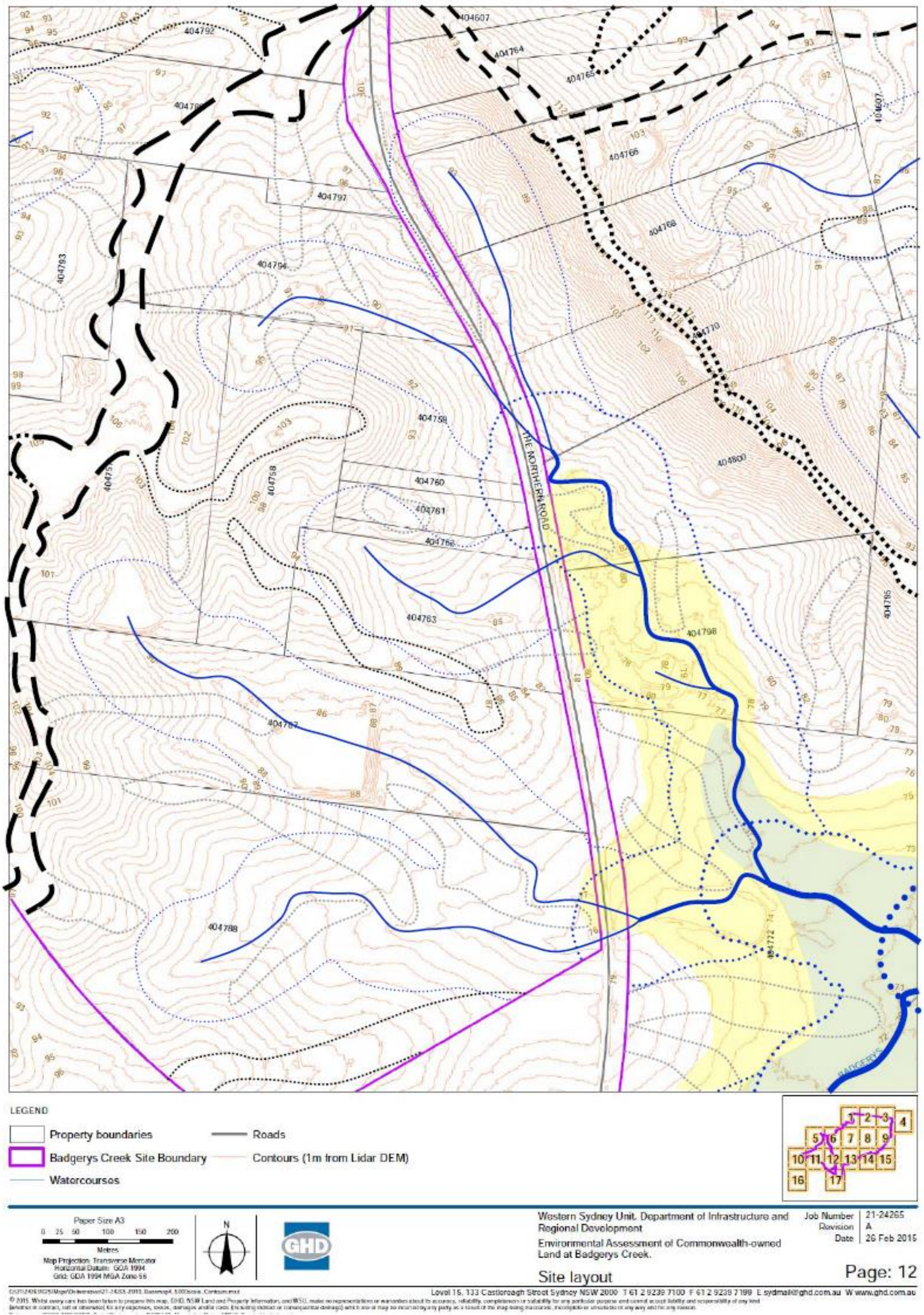
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek

Job Number 21-24265
Revision A
Date 26 Feb 2015

Site layout

Page: 11

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au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404772
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LEGEND
Property boundaries
Badgerys Creek Site Boundary
Watercourses
Roads
Contours (1m from Lidar DEM)
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5 6 7 8 9
10 11 12 13 14 15
16 17
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Metres
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GHD
Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek
Site layout
Job Number 21-24265
Revision A
Date 26 Feb 2015
Page: 12
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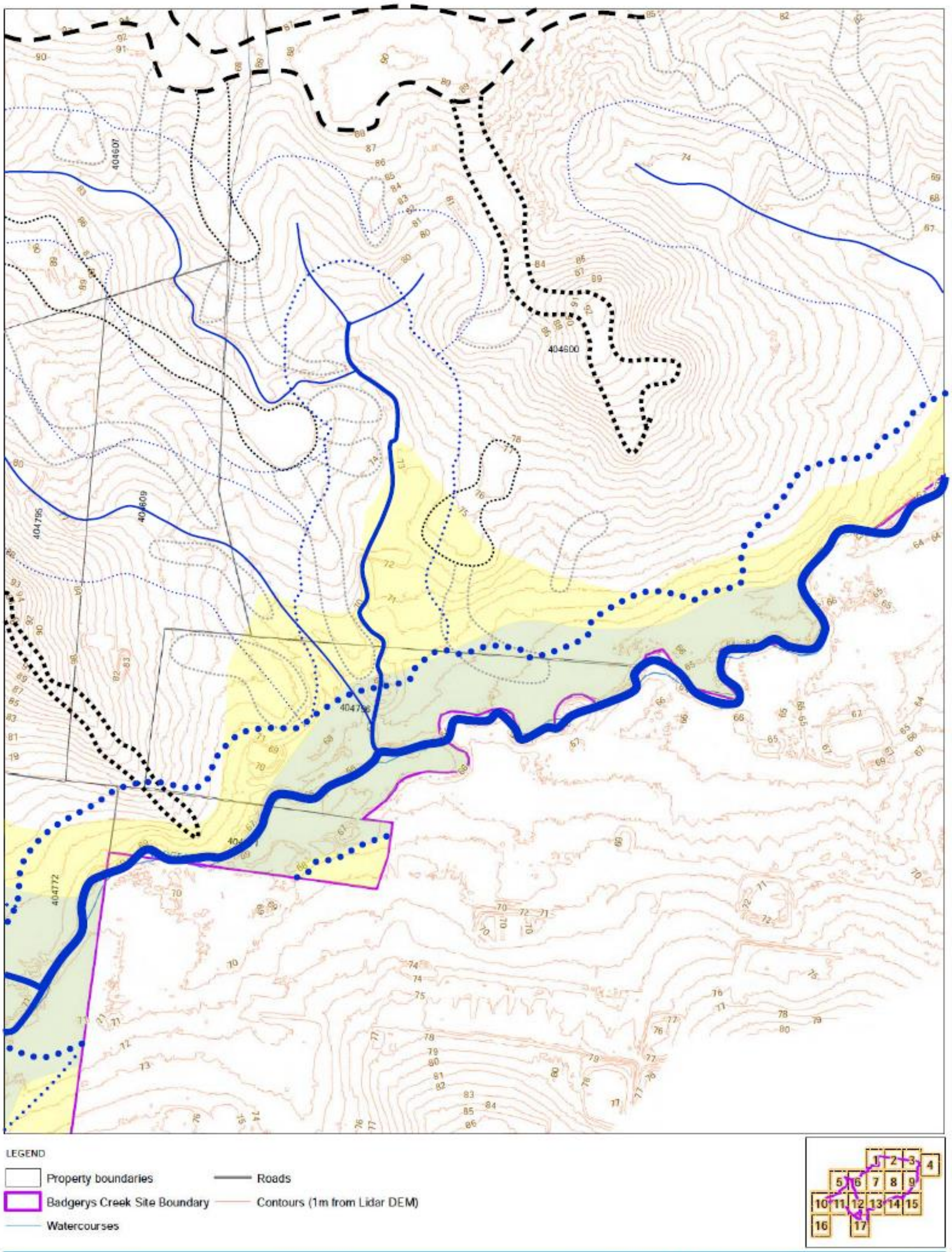


Western Sydney Unit, Department of Infrastructure and Regional Development

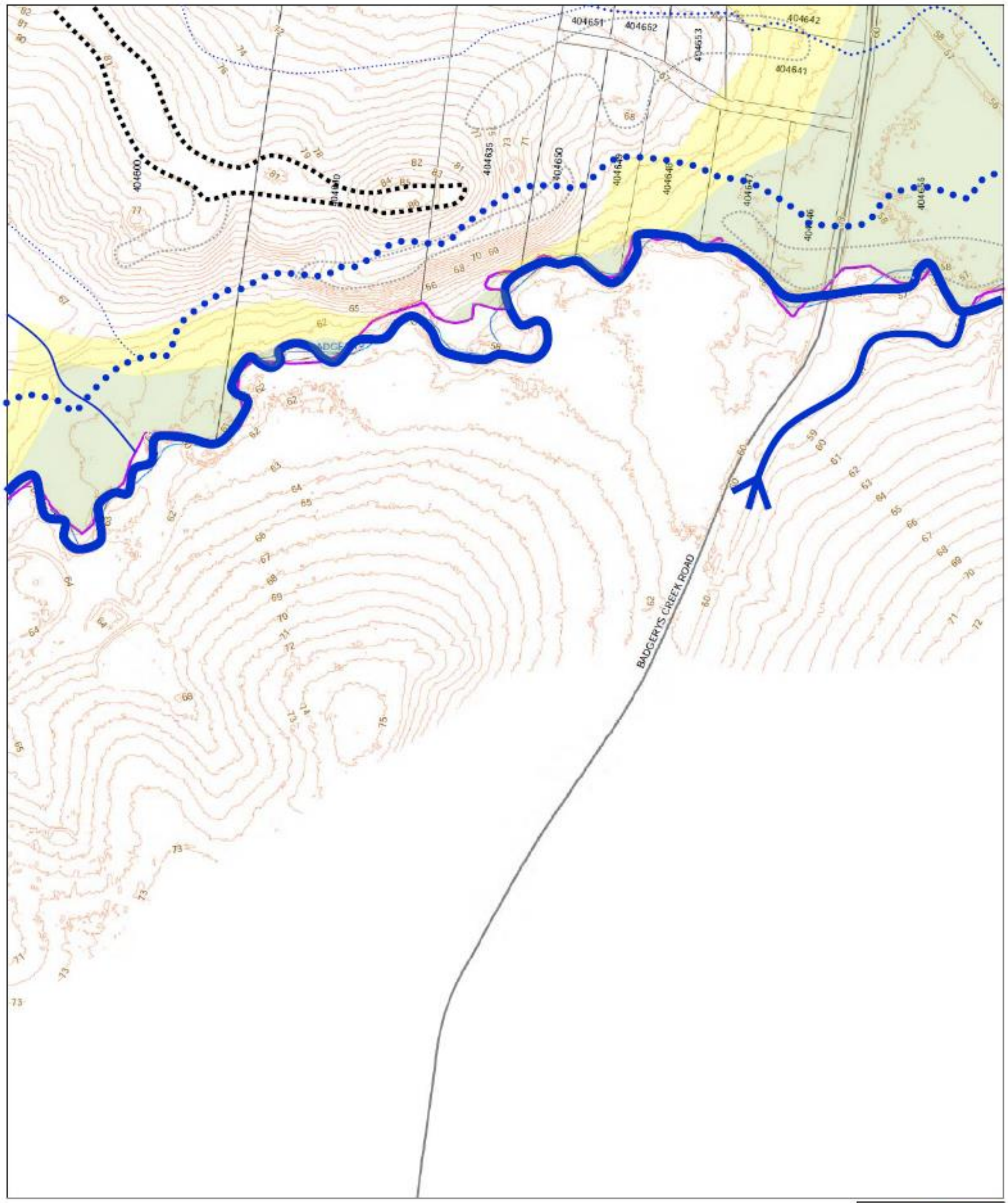
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.

Job Number	21-24265
Revision	A
Date	26 Feb 2015

Site layout

Page: 13

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au



LEGEND

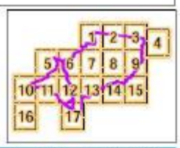
Property boundaries

Badgerys Creek Site Boundary

Watercourses

Roads

Contours (1m from Lidar DEM)



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Western Sydney Unit, Department of Infrastructure and Regional Development

Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.

Site layout

Job Number	21-24265
Revision	A
Date	26 Feb 2015

Page: 14

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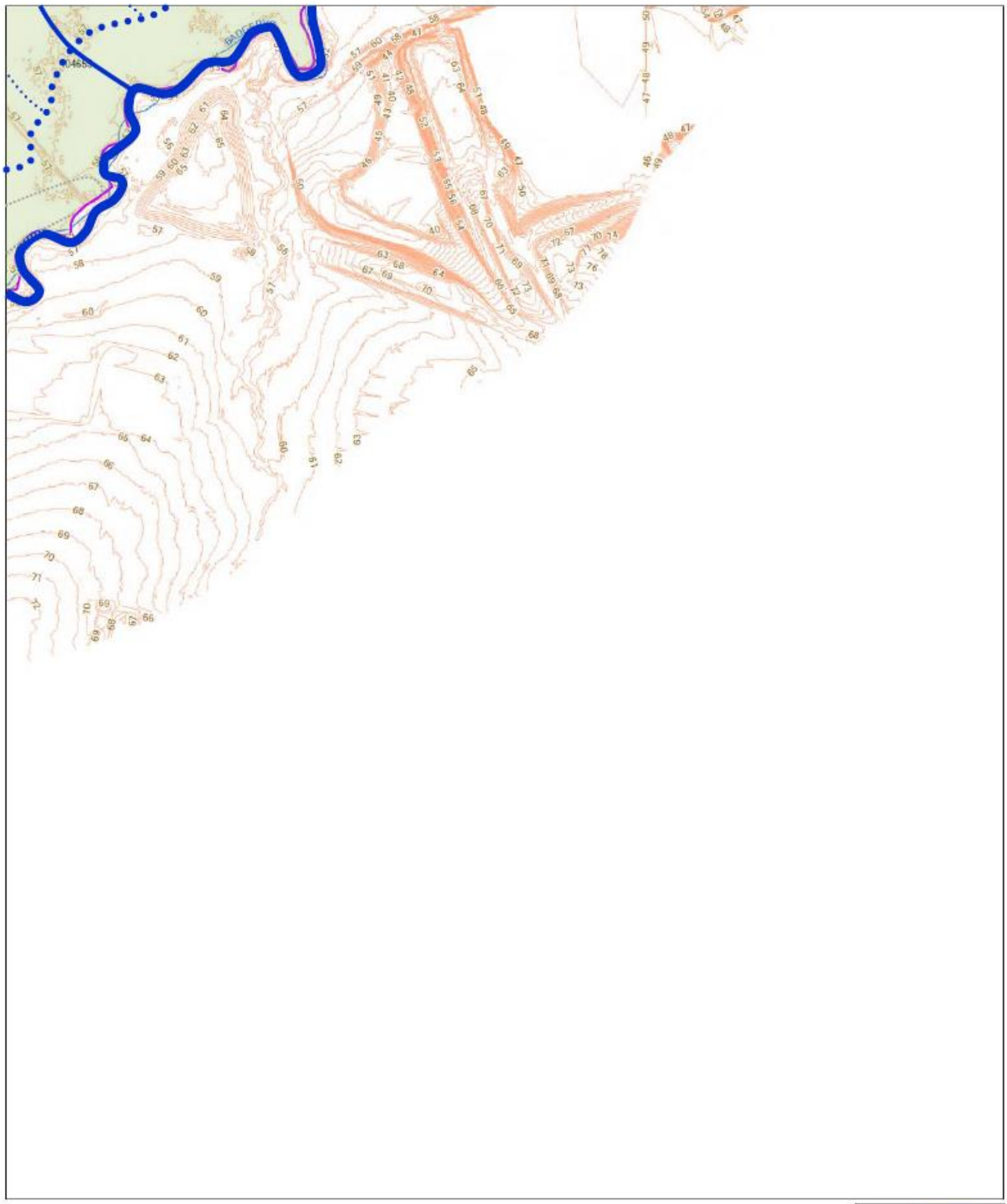

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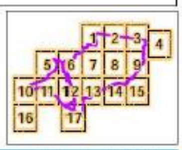
- Property boundaries
- Badgerys Creek Site Boundary
- Watercourses
- Roads
- Contours (1m from Lidar DEM)



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Western Sydney Unit, Department of Infrastructure and Regional Development

Environmental Assessment of Commonwealth-owned Land at Badgerys Creek

Job Number 21-24265
Revision A
Date 26 Feb 2015

Site layout

Page: 15

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au


GREENDALE ROAD
404807
LEGEND
Property boundaries
Roads
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Contours (1m from Lidar DEM)
Watercourses
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Metres
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Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.
Site layout
Job Number 21-24265
Revision A
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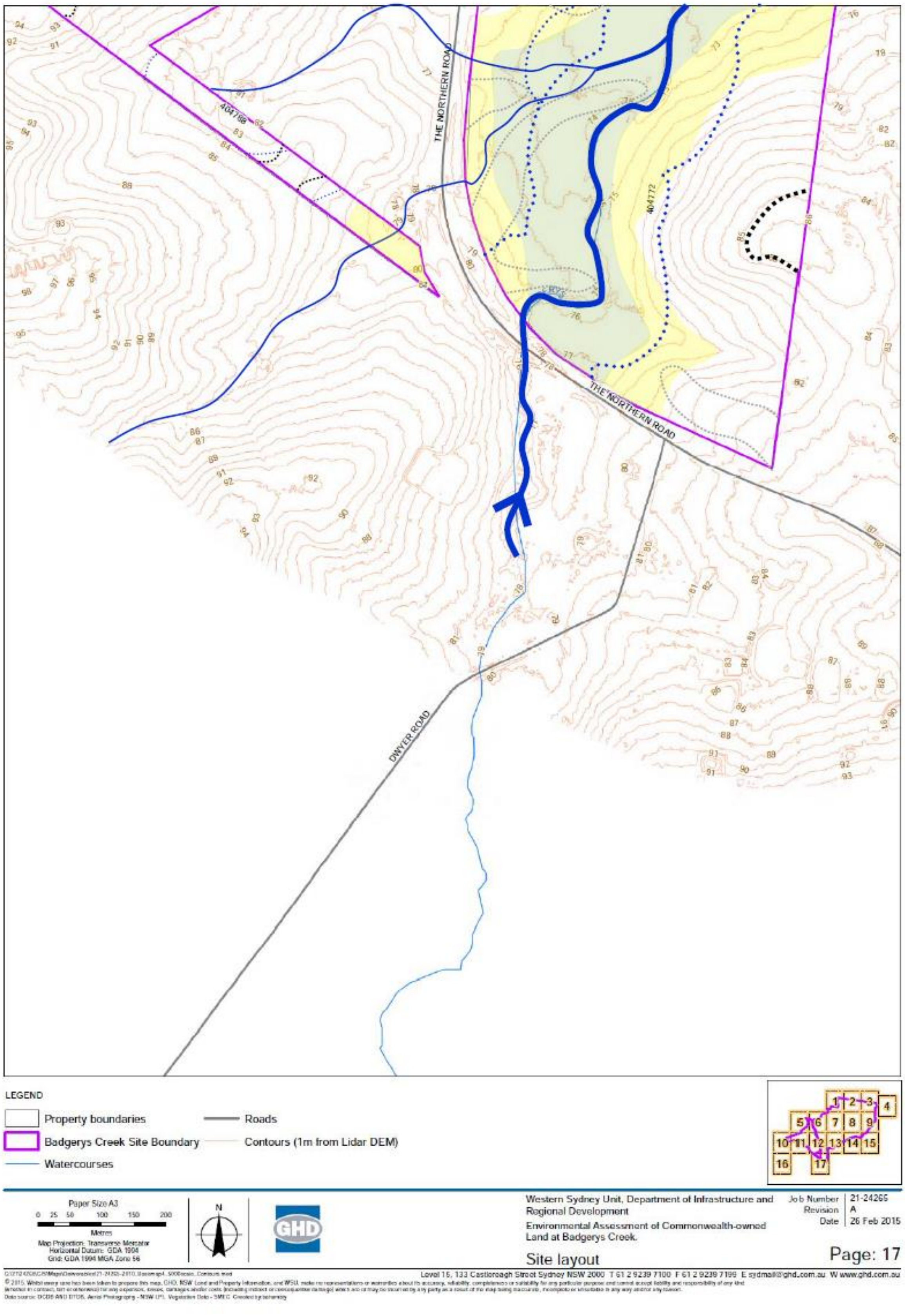
THE NORTHERN ROAD
THE NORTHERN ROAD
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404768
404772
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Roads
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Watercourses
Paper Size A3
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GHD
Western Sydney Unit, Department of Infrastructure and Regional Development
Environmental Assessment of Commonwealth-owned Land at Badgerys Creek.
Job Number 21-24265
Revision A
Date 26 Feb 2015
Site layout
Page: 17
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

A5.2 Test pit locations

Maps from this section have been removed for the unrestricted access version of this report

Appendix 6

Geoarchaeological overview of the historical borehole data, Western Sydney Airport

Specialist report by Anthony Barham
Navin Officer Heritage Consultants

A6.1 Introduction

This report examines the potential value of borehole data for improving understanding of the known and potential archaeological resource at the airport site. The desktop study reviews data from historic geotechnical investigations across the Commonwealth owned lands at Badgerys Creek. Data reviewed comprise borehole and test pit records, mapping and geotechnical reports supplied by GHD to Navin Officer Heritage Consultants.

This review was restricted to historic geotechnical data, acquired during the late 1980s and 1990s. Because of time constraints, the data provided were sampled.

The core aim was to establish whether borehole and test pit geotechnical data might be used to improve understanding of the archaeological resource across the planned impact areas of the airport site, as part of the conditions of any development approval.

The review briefly examines the landform history across the area. An interim conclusion was that the geologically ancient nature of weathering across the airport site, coupled with tectonic warping, does create a geographic context across the airport site in which near surface modification of regolith may have occurred through ancient fluvial activity, and subsequent drainage diversions. This may lead to significant uncertainties regarding deposit ages and depths occurring across the area, mainly in regolith within 5 m of surface. Some older regolith may have archaeological significance. This particularly relates to remnants of past weathered land surfaces, surviving as thin cappings (e.g. lateritized deposits possibly including silcretes) and traces of former high level alluvial “palaeochannel” deposits. These deposits are “palaeosols” in the broadest geological sense. Such deposits (being geologically ancient) predate human occupation of the Australian continent by millions of years. The archaeological potential significance of such deposits lies in their potential as procurement source deposits - areas of near-surface raw material which Aboriginal people may exploit to make stone artefacts.

The geotechnical data provided were then sampled. The aim was to test whether any boreholes and test pits log stratigraphy of the “residual types” anticipated in the review, and in particular if evidence for palaeosols and other chronostratigraphy of potential archaeological significance may exist in the data sets.

It was assumed geotechnical investigations would preference particular areas. The historic data will not randomly sample the land surface across the scheme footprint as now defined. Also the geotechnical data variably included maps, and when mapped were set to varying scales. The scope of the review did not allow full geo-referencing of the historic data to a common modern mapping base, or evaluate it with respect to:

a) the spatial map of the archaeological test pit assessment outcomes undertaken by NOHC for the current investigation, or

b) the mapping of geotechnical investigations conducted for the current investigation.

The drivers of the short review were forming preliminary answers to the following questions:

- Might borehole and test pit (geotechnical) data assist in reducing uncertainties regarding the depth and spatial extent of archaeological deposits across the area?
- Is there evidence in the historic geotechnical data pointing to locations, areas or stratigraphic sequences which might be archaeologically significant?
- Can palaeosols, stratified deposits or chronostratigraphic potential be seen in the data?
- Can geotechnical data guide and prioritise areas for further phases of archaeological mitigation, especially as conditions of the EIS?

- If there is potential – what methodologies and strategies can best utilise both historic geotechnical data, and new geotechnical data now being acquired across the development footprint?

The initial review of sampled data suggests there will be considerable value in integrating a model of the near-surface geometry of unconsolidated deposits over bedrock (a regolith model based on geotechnical data) with requirements set for post-EIS archaeological salvage. The geotechnical data are sufficiently detailed to permit direct comparison with archaeological field results from subsurface testing (e.g. as depths of topsoil; recorded depths to subsoil; evidence or not of saprolite or bedrock rockhead near surface. In areas where shallow archaeological excavation have been completed (often to 0.3-0.5 m metres to "clay") geotechnical data can provide broad cross-checks of the stratigraphy likely to lie below the depths investigated. However, as spatial variation in near surface regolith depths is high, such cross-checking will only provide broad areal information.

However, the historic geotechnical data have neither sufficient spatial coverage, nor the consistency of investigative methods, to profitably drive a full geoarchaeological model applicable to the archaeological assessment stage, such as that conducted for the current investigation. In particular, field verification of historic data would be needed ahead of investigating deeper regolith for archaeological purposes.

In addition, the historic data do not provide sufficient coverage to drive deep archaeological investigations, especially in "high risk" landforms such as upper (1st order) tributary floors and slope margins.

A more efficient approach will be to marry the historic geotechnical data, with the array of new borehole and test pit data recently acquired for this EIS and for future post EIS investigations. The combined data will generate a geospatial "net" and mode:

a) with much improved coverage of the geometry of shallow regolith cover over bedrock (superficial deposits) and

b) a specific relationship to scheme "cut and fill" geometry.

The larger data set model can then be used to verify and cross-check outcomes from archaeological assessment testing conducted for the EIS assessment. In particular, areas of "uncertainty" can be refined where combined archaeological testing and geotechnical sources of data show either:

a) high archaeological potential at depth or

b) areas and zones of "high uncertainty and risk" predicted from geotechnical data - which justify deeper archaeological investigations at specific "known" points in the landscape.

Building and applying this geometry model using a geoarchaeological methodology could form one part of the archaeological salvage strategy to be conducted in the event of development approval. The methodology would require specific stipulations of geoarchaeological criteria used for interpreting geotechnical data. A common Digital Terrain Model (DTM) and geo-referencing system would be required to integrate data.

A6.2 Methodology of this study

The methodology of this review is based on the concept of a "regolith". Regolith is a term which describes all materials stored over bedrock on the earth`s surface (Eggleton 2004). Conceptually the approach has advantages as it does not require differentiation of soils from sediments. The concept is inclusive of all materials and as such includes archaeological artefacts, plants materials, biological organisms, soil properties, and fluids and gases. The regolith concept is especially useful when assessing profiles in boreholes where sediments, soils and various forms of weathered bedrock may all be present. For terminology and definitions used in this review please refer to the specialist glossary provided in Section A6.12.

A full analysis of the historic borehole data was outside of the scope of this review. Also, the spatial sampling patterns represented in the historic data are highly skewed to particular areas. The sets of raw data are currently “tuned” to landforms, (such as the landform model used for the NOHC archaeological test pitting program), making it difficult to provide a reliable “test” of improving subsurface archaeological understanding across the scheme. Considerable amounts of georectification, standardization and checking of the historic geotechnical data would be required to make the historic data reliable for predictive archaeological purposes.

Instead, this study sampled the data provided and sought to identify whether the types of data gathered in boreholes and test pits can, with further work and remapping, assist in identifying tasks for archaeological salvage post-EIS.

At this stage it is assumed “best practice” would be incorporated in the required archaeological management strategies which form part of any development approval.

The aim – with respect to subsurface uncertainty regarding Potential Archaeological Deposits – would be to refine surface investigations by splicing with geoarchaeologically interpreted geotechnical borehole/test pit information. Key tasks would be to:

a) initially integrate the full set of historical archived boreholes for the area to a common geospatial data set

b) incorporate the results of the NOHC surface archaeological assessment and mapped soil landscape layers into the common geospatial data set

c) subsequently incorporate newly acquired borehole and test pit data, as the data are generated.

A model would then be available in which archaeological salvage could be undertaken, tuned to both the airport impact (especially “cut” and “cover” geometry) and also to areas of uncertainty regarding subsurface archaeological significance.

A particular set of uncertainties apply to the extent of fills (colluvium and alluvium) situated within the contemporary valley tributary systems associated with slope base/valley floor landforms. Such regolith zones are likely to be small in area relative to overall scheme footprint. The likely landform locations are mostly not sampled by the historical borehole set. The majority of boreholes are located on plateau/interfluve sites. Upper tributary fills are a particular set of unknowns.

A second set of uncertainties exist with respect to depth of regolith associated with ancient palaeo-drainage lines across the area. Ancient rivers crossed this area and have left remnant deposits, typically lag gravels. The deposits will not map onto the present drainage network pattern. Deposits of this type can be provisionally identified in the historic data set. These deposits have potential significance in two ways a) as deposits influencing water flow and possible spring sources in the landscape and b) as possible sources /outcrops of lithic materials suitable for use in making stone artefacts. Mapping from boreholes may assist in identifying stone procurement sites.

The initial review suggests that borehole loggers are sufficiently familiar with both Bringelly Shale bedrock facies variations, and variability in Bringelly Shale saprolite and weathered subsoils, that most logs do pick up subsurface deposit anomalies that could signify archaeological potential. Logged observations of thin beds of near surface gravels and records of clast composition (e.g. quartz gravel lags) indicate valuable data exist in the historic data.

Identified benefits of modelling subsurface deposits according to geoarchaeological criteria all involve reducing uncertainty with respect to the possibility of archaeological deposits being present at depth across the scheme area. Using existing geotechnical data sources is cost-effective.

For modelling (as part of the salvage and management actions required in the event of development approval) key aims would be to:

- Determining areas where the regolith sequence is so shallow over bedrock that no further archaeological concerns exist regarding stratigraphy (for regolith depths below the depths already tested by subsurface archaeological test pitting)

- Identifying areas of landform/regolith conjunction where palaeosols and/or deeper stratified deposits of archaeological potential may exist at depth

- Mapping the relationship of regolith over bedrock in relation to terrain surfaces such that possible palaeovalleys and areas of natural sediment storage which could contain Potential Archaeological Deposits at depth are identified.

Key objectives of this review were to assess the qualitative value of extant geotechnical records and in particular assess:

  - The potential of available geotechnical data to assist with archaeological evaluation of the terrain, soils and sediments forming regolith across the airport site?

  - To specifically address whether geotechnical data may assist in establishing whether palaeosols or buried soils may exist within the airport site?

  - Examine whether geotechnical data may assist in establishing the potential for archaeological assemblages to occur at depth, associated with palaeosols or potentially stratified beneath deposits of alluvium or colluvium?

A6.3 Data sources reviewed

The sources reviewed are a series of reports and geotechnical studies completed mainly in the 1990s. All data sources provided were briefly examined.

The following sets were then examined in more detail however the following actions fell outside of the scope of this review:

- assessment of the adequacy or the spatial coverage in relation to the proposed airport footprint.

- assessment of “representivity” of historical geotechnical data locations according to landform segment or type; soil landscape units or AHD elevation.

Table A6.1 Data sources examined in this study

Study	Date	Authorship	Data	Method
Geotechnical Investigation – Appendix C	1994	SMEC	56 test Pits	Mechanical Excavator
Badgerys Creek Airport Geotechnical Studies Inception Report – Report No S9222/1-AE and Appendix A	May 1990	Gutteridge Haskins & Davey Pty Ltd	2 BH and 1 TP	Truck rig and excavator
Badgerys Creek Airport – Soil and Rock Test Results – report No S9222/1-AS	Oct 1990	Gutteridge Haskins & Davey Pty Ltd	Lab results	N/A
Badgerys Creek Airport – Geotechnical Investigation Draft Borehole Logs D36 to D55 report No S9222/1-AU	Oct 1990	Gutteridge Haskins & Davey Pty Ltd		Fully cored BHs D36, D37, D38 and D39 (4) and Pengo Drill (D40-D55)
Attachment A - Borehole Logs from 1999 EIS - Vol 4 – Appendices to supplement (A to E5)	Nov 1998	PPK Environment and Infrastructure		Pioneer P160 Rig

A6.4 Geology across the airport site

The area of investigation is underlain by the Bringelly Shales of the Wianamatta Group.

Structurally the geology of the area sits within part of the Sydney Basin. Rocks at outcrop represent the upper parts of very thick sequences of fine grain lithologies originally laid down in a foreland basin through late Permian and Triassic time (Herbert 1997). The Cumberland Plain represents a subset of the inner Sydney Basin. The Wianamatta Group lithologies represent the uppermost Triassic lithofacies which were laid down during marine regression as prograding epimarine, intertidal, back-swamp and alluvial sediments (Jones and Clarke 1991; Smith 1979).

The Wianamatta Group consists, in order of deposition up-sequence:

- The Ashfield Shales Formation grading from sideritic shales to fine sandstones and siltstones laminates (Smith 1979) laid down in shallow marine and lacustrine conditions. Outcrop is very limited on the Cumberland Plain.

- The Minchinbury Sandstone Formation - a quartz lithic sandstone normally up to 6 metres thick. The lithofacies exhibit low angle cross-bedding indicative of a prograding bar barrier or beach system

- The Bringelly Shales - predominantly consisting of claystone and siltstones with thin laminate layers and locally discontinuous, thin and often sinuous sandier units (former channel lithofacies).

The implications for both surface drainage, topography and the nature of near surface regolith is that subtle variations from siltstone to sandstones (and occasionally laminates) exist in the nearsurface outcrop Bringelly Shale outcrops across the airport site. This makes detailed correlation, both in unweathered rockhead and saprolite, difficult between adjacent boreholes/test pits. There is considerable subtle heterogeneity in bedding and fine-grain rock composition in the Bringelly Shales. This reflects the channel, channel-marginal and back-barrier lagoonal facies environments in which Triassic sedimentation originally occurred.

The consequence is that bedrock outcrop, saprolite and saprock, and derived regolith across the airport site will be inherently (and subtly) variable. Subtle textural variability in sediments, weathered clasts and lags will be expected in boreholes, test pits and the base of archaeological excavations.

This will reflect:

- underlying bedrock (facies) variability in the Bringelly Shales;
- differential Tertiary laterization and survival of laterized weathering lags and products of the underlying bedrock;
- variations due to lateral mass movement (including sorting) of regolith across and downslope;
- ancient (pre-Quaternary) and recent Quaternary lag formation; and
- late Quaternary and Holocene reworkings of those lags in relation to modern slope topography, stream tributary systems, catenary soil profile development and pedogenesis.

A6.5 Post-Triassic and Quaternary geology and deposits

The Triassic Wianamatta Group sediments, laid down across broad low angle plains, represent the last major phases of sedimentation across the Cumberland Plain. Alluvial channel and gravel aggradational deposits were unconformably laid across the Plain from the ancestral Hawkesbury-Nepean river systems during the Cretaceous and Paleogene/Neogene, leading to unconformable deposition of SW-NE aligned paleochannel and gravel floodplain/terrace units mapped as the Rickabys Creek Gravel (Bishop and Hunter 1990; Jensen 1911; Smith 1979).

These deposits pre-date the Cenozoic uplift of the Blue Mountains and rapid valley incisions of that structural block and the downcutting of the Hawkesbury River into its contemporary west-east alignment at the Hornsby Warp (Bishop et al. 1982; Carter 2011; Fergusson et al 2010); Graham et al 2010).

The Rickabys Creek Gravels formed within high energy braided stream networks with clasts up to 0.5 m in size, and a wide range of clast lithologies reflecting sources in the Lachlan Fold Belt (Bishop and Hunter 1990; Hall 1926; Herbert 1997; Hickin 1970).

The units are locally overlain by the finer grain Londonderry Clay (within a Palaeogene age basin developed on the erosional surface of Triassic rocks). Deposition of the Londonderry Clay was low energy and either in a lacustrine environment (Hall 1926) or (more probably) as a fluvial fining upwards floodplain aggradational stack relating to episodic blocking/damming at the downstream knick point of the developing Hawkesbury-Nepean system relating to incision timings at the Hornsby Warp (Carter 2011).

Recent reviews of the diverse evidence for timings of uplift and tectonics (Bishop and Hunter 1990; Bishop et al 1982; Graham et al 2010) suggest uplift of the Hornsby Plateau at around 45-55 Ma (million years) and the Hawkesbury River maintaining its course through the Hornsby Warp at that time. Initiation of faulting/movements at the Lapstone Structural Complex, around 45 Ma led to depression and flooding around the Richmond area and consequent deposition of the Londonderry Clay. Erosion and gorge formation through the Hornsby Gap re-initiated effective fluvial drainage across the northern Cumberland Plain south of the Hornsby Plateau.

Ages of the Hornsby Warp activity are constrained by K-Ar (Potassium – Argon) dating of the Maroota Basalt capping the uplifted Maroota Sand which indicates eruption/basalt flow deposition prior to uplift dating to c. 45Ma (Graham et al 2010). Eruptive events in the Blue Mountains where basalt flow architectures sit within pre-existing deeply incised palaeovalleys (Van der Beek et al. 2001) indicate substantial palaeovalley incision/uplift prior to eruptions around 20.1-14.5 Ma.

Development of Quaternary terraces marginal to the present inset stream course of the Hawkesbury-Nepean indicates the main drainage alignments were well developed by the early Quaternary (Nanson et al 2003). Moreover, the surviving Paleogene/Neogene river terrace was the primary locus for deposition of the Rickabys Creek Gravel, while Londonderry Clay also overlies Bringelly Shale in the south. Both units outcrop on the uplifted Lapstone Monocline (Carter 2011).

The overall implication of these histories is that drainage across the airport site has developed over a long (>40 Ma) timescale, with the watersheds and plateau areas being progressively decoupled from the ancestral and Quaternary courses of the Hawkesbury-Nepean as it incised to the west.

Present tributaries across the airport site reflect multiple periods of drainage diversion, river capture and shifts in catchment boundaries. Deposits relating to the ancestral abandoned courses of palaeo-rivers probably preserve in patches and reworked lags across the airport site.

A6.6 Landform and regolith relationship across the airport site

This brief review of literature confirms that the airport site is located in an area of the Cumberland Plain which is primarily associated and underlain by Bringelly Shale bedrock and associated regoliths. Regolith sequences across the area are primarily weathered residual products and soils developed on Bringelly Shales, which exhibit variable sandstone, laminate and shale/mudstone facies.

The airport site locates well south of the area on the Cumberland Plain where old river aggradational lithofacies dating to paleoeoflow regimes of the proto-Hawkesbury, align SW-NE, preserved on interfluves and as residual geology overlying Wianamatta Group rocks. These units include the Londonderry Clay, and the Rickabys Creek Gravels. Both these units show laterization at outcrop.

While these deposits appear to be largely unmapped or absent from the airport site, the airport site locates in the upstream catchment area of the SW-NE streams which produced the Rickabys Creek Gravels. Remnants of those older palaeovalleys and deposits may therefore exist across the airport site, or may be cryptically present as residual lags of the original deposits in younger regoliths.

A6.7 Geoarchaeological review of historic borehole and test pit data sources

All of the historic data made available from GHD were briefly reviewed as part of a desk top study, and then more detailed analysis of individual boreholes was undertaken as a sampling exercise.

The principle aims were:

- To gauge the utility of this data as an interpretive data set against which preliminary stratigraphic observations from archaeological field assessment/testing can be compared or contextualised
- To assess whether borehole and test pit data may inform the broader question of the depths and nature of the regolith sequence (near surface) which is likely to preserve archaeological materials
- To seek trends in near surface deposit - landform relationships across the study site. Such trends, if found, may inform where potential archaeological deposits are more likely (or not) to occur/survive across the landscape[1].

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[1] For example, identification of stable lag deposits and overlying texture-contrast soils across parts of interfluve areas might indicate longer term residence times for near surface deposits. This in turn might indicate higher probability of a) long-term survival of archaeological evidence on that landform-regolith unit and b) more likely concatenation of numerous discreet archaeological discard events into an archaeological palimpsest across that landscape unit.

- To define depth envelopes to bedrock/saprolite – this provides:

  a) a measure of “maximum potential storage” of Quaternary sediments which might contain archaeology, and

  b) indications of areas of regolith accumulation/stripping and storage

- To address whether the presence /absence of archaeologically indicative stratigraphy can be seen in borehole/test pits
- Specifically address if the presence /absence of buried soils/palaeosols across the landscape can be seen in the borehole/test pit data.

A6.8 Interpretation of borehole data

The quality of the borehole data examined was high. Descriptive terminologies are comparable across different data sets. The nature of the drilling method determines presence/absence of measured data (e.g. Standard Penetrometer Test (SPT) results). Where available such data were examined to assess and confirm written visual descriptions of rockhead/saprolite depths.

For this exercise observed trends and attributes which assist in determining presence/absence of palaeosols might occur include:

- Depths of topsoils as logged. These observations in geotechnical boreholes and test pits provide sources directly comparable with stratigraphy (and deposit depths) investigated by archaeologists in subsurface testing.
- Depth to weakly weathered/unweathered rockhead (it was assumed any archaeological significant horizons will be stratified above rockhead[2])
- The reference to laminations in unweathered grey to dark grey shales (taken to indicate *in situ* Bringelly Shales Bedrock and/or rockhead).
- Reference to cutans/cutan coatings in clayey soils and on clasts (taken as inferring horizon is part of a soil, or subsoil profile, palaeosol or intrusive in uppermost saprolite level).
- Plasticity (medium to high) – taken to *more probably* indicate a soil, subsoil or saprolite level
- Evidence of well-defined stratification with sharp contacts /interfaces and up- or down profile textural changes or sorting in unconsolidated deposits (possibly indicating alluvium and colluvium in which soils/palaeosols might occur)
- Evidence of clastic gravels in the described sequence (unlikely in the *in situ* Bringelly Shales)

In the analysis no assumptions were made regarding the maximum depths at which soils and palaeosols can occur.

Generally it was thought that cryptic “soil” properties at depths >5 m *were less likely to be archaeologically significant* where located on higher plateau areas, interfluves and slopes. In tributaries and larger valley floors no assumptions are made regarding maximum depths for palaeosols/archaeological significance.

[2] This does not equate to lithified units in a simple way. In this review if the terms “indurated” or weakly cemented were present, or co-associate with references to ferricrete or silcrete, those stratigraphies were deemed to be potentially of interest. Properties of induration can indicate “palaeosols” and can be of diverse ages in the Australian landscape. Weak lithification (induration) can be acquired quickly in some soils, so the term induration does not preclude a recent eg Holocene age or archaeological significance.

A6.9 Review of data – specific "archaeologically significant" examples

A number of boreholes were identified which show quite specific records and descriptions which might drive further subsurface investigations aimed at improving the archaeological understanding of the scheme impact subsurface.

The data below are examples which show the value of the approach. No complete review of all data was possible in the time available. These logs show a sub-sample of what may exist in larger data sets.

Attachment A - Borehole Logs from 1999 EIS - Vol 4 – Appendices to supplement (A to E5)

These logs describe deep (e.g. 25 m) and shallow (e.g. 5 m) drill results. The small sample (16 BHs some shallow + deep duplicates at single locations) covers a representative range of elevations across the airport site. All logs clearly identify transitions into relatively unweathered grey shales (or siltstones), reporting laminate structures and limonite staining in upper bedrock. Transitions to rockhead are typically identified between 3.0 - 5.5 m below surface and occasionally as deep as 7.0 m (BH "F"). There is a tendency for the transition into bedrock at shallow depth (eg 3.0 metres below surface) to be sharp. Shallow depths to bedrock can occur at both high elevations (105 m AHD in BH "D") and lower elevations (e.g. 66.5 m AHD in BH).

Most logs describe thin topsoils (<0.3 m) which are locally silty or sandy and generally red-brown. These grade into generally silty or sandy silty clays which vary from yellow-brown, pale grey, red-brown and show limonite and haematite staining at many locations. These subsoils are variably 3.0 to >7.0 metres in depth and grade into weathered shales at depth. The logs frequently record gradational trends from weathered red-brown and yellow-brown low plasticity clays into moderately weathered dark grey shale bedrock. This indicates saprolite over bedrock has variable thickness, is discontinuous, and locally has been reworked in the geological past to yield gravelly lags.

No boreholes in this set show deep topsoils. Most topsoils are reported to be about 0.2-0.3 m deep.

Two boreholes (Table 2) indicate sources of gravels at depth which may represent residual deposits from older land surfaces or landforms. The presence of ferricrete and silcrete in these gravels indicate a possible near-surface weathering origin. These deposits might be either *in situ* (a residual ancient palaeosol capping) or a reworked or re-transported residual gravel.

Table 2 Borehole evidence for sources of gravels at depth which may represent residual deposits from older land surfaces or landforms

BH ID	Easting	Northing	AHD BH surface (m)	Depth below surface	Deposit attributes	Potential Archaeological Significance
BH "C"	270473	1248025	66.59	Band at 3.5 - 4.0 m depth	Ferricrete - "dark brown iron indurated siltstone; some silcrete with conchoidal fracture". Deposit is overlain by silty clay subsoils and underlain by extremely weathered shale /saprolite. Rockhead at 5.0m. Could be *in situ* ancient palaeosol "capping" or reworked gravel lag from older land surfaces.	Indicates natural occurrence of rock materials suitable for making artefacts within airport site. Assist in interpreting artefact occurrence as local versus distant potential sources. Indicates silcrete/ferricrete sources may outcrop now/ have outcropped in the past within airport site.

BH ID	Easting	Northing	AHD BH surface (m)	Depth below surface	Deposit attributes	Potential Archaeological Significance
BH "E"	272676	1245812	78.25	Ferricrete band 1.1 to 1.3 depth. Clayey sand (1.3 -2.8m) within which moderately indurated silcrete horizon at 2.3m depth	Ferricrete "dark brown indurated siltstone" overlying clayey sand – brown to yellow brown fine grain well sorted. At 2.3m moderately indurated silcrete horizon. Water at 2.6m.	Indicates natural occurrence of rock materials suitable for making artefacts within airport site. Assist in interpreting artefact occurrence as local versus distant potential sources. Indicates silcrete/ferricrete sources may outcrop now/ have outcropped in the past within airport site

Three boreholes record shallow thin units of gravel that are either quartz or quartzose in composition. These deposits are most unlikely to be derived from weathering of the Bringelly Shales. This evidence points again to the occurrence of lag gravels derived from ancient paleolandsurfaces across the airport site. These may be remnants of ancient river gravels from the "palaeo-Hawkesbury" and most probably up-catchment remnants of the same alluvial valley fills and ancestral rivers which deposited the Rickabys Creek Gravels to the north and east.

Table A6.3 Borehole record of shallow thin units of gravel which may be lag gravels derived from ancient paleolandsurfaces across the airport site.

BH ID	Easting	Northing	AHD BH surface (m)	Depth below surface	Deposit attributes	Potential Archaeological Significance
BH "G"	275626	1247625	58.79	4.0-5.0 m	Gravelly clay – "yellow-brown surrounded to sub-angular red-brown quartz gravel	Potential source of quartz in landscape – possible procurement source for artefact manufacture. Possible river gravel lag and/or alluvial or colluvial deposit. Weathered alluvial or colluvial gravel? Gravel lag in valley floor?
BH "I"	275067	1246075	72.35	2.0-2.5m	Gravelly clay – "red-brown sticky with red-brown quartzose sub-angular gravel" (overlain by red clay subsoil and underlain by yellow clay)	Potential source of quartz in landscape – possible suitable for artefact manufacture. Possible river gravel lag and/or alluvial or colluvial deposit. Note: "angular quartz" makes *in situ* alluvial origin less likely. Colluvial reworked ancient gravels?

BH ID	Easting	Northing	AHD BH surface (m)	Depth below surface	Deposit attributes	Potential Archaeological Significance
BH "J"	274824	1243803	70.90	2.0-3.5m	Orange brown sub-angular quartz + iron oxide stained ferricrete fragments and minor organic fragments	Potential source of quartz in landscape – possible suitable for artefact manufacture. Possible river gravel lag and/or alluvial or colluvial deposit. Note: "angular quartz" unlikely far-travelled fluvial gravels. Significance of "minor organics" not known.

A6.10 Discussion

The sampled sets of data are sufficiently standardised to be suitable for building a general geoarchaeologically predictive model of subsurface deposits over bedrock across the impact areas of the scheme.

This is expected. Geotechnical data has to be evaluated against strictly defined and professionally agreed standards for design purposes. We can now address the questions posed earlier.

Might borehole and test pit (geotechnical) data assist in reducing uncertainties regarding the depth and spatial extent of archaeological deposits across the scheme area?

Simple parameters such as depth to unweathered rockhead can be readily and reliably mapped from the historic data. New data would be as high quality or better. Mapping simple parameters like "depth to rockhead" quickly identifies areas where shallow archaeological testing has approached the maximum depth necessary, and conversely, areas where deeper unknown superficials occur and "uncertainty" might exist. Almost all logs viewed record data in sufficient detail to map depths to bedrock and/or or saprolite to +/- 0.5 m and many to a precision of +/-0.2 m depth.

All data viewed would be adequate to this type of mapping, and most data viewed would provide a higher level of detail which would resolve saprolite and /or saprock depths overlying unweathered bedrock, and thus allow a refined general model of "maximum depth of archaeological potential" - which would equate to the depth of deposit over saprolite.

Stratification within upper unconsolidated deposits could be seen in some boreholes suggesting the possibility of colluvial and/or alluvial sequences stratified above the saprolite. Logs have "potential" but do not provide sufficient information to model a chronosequence. Examination of stored core or resampling would normally be needed to move to establishing "possible age significance" from an archaeological perspective.

The historic data thus provide pointers to where in the landscape further investigations might be required. They will not normally be sufficient to determine the equivalent of subsurface "potential archaeological deposit" in a precise chronological sense.

Most data show quite shallow depths to bedrock. As the majority of data points are on interfluves/plateau areas this does not help resolve whether, for example, small narrow areas of significant archaeological deposit might exist at the edge of small tributary valley floors, or under small colluvial fans.

The general limitation of the data viewed is therefore adequacy of spatial coverage across all landforms, and sub-landform (landform elements).

With incorporation of all geotechnical data (historic and new data being acquired), improvement would be expected. However, as potential archaeological deposits are inherently "patchy"– some purposive drilling or machine test pitting will always be required to check micro-landforms, and areas of high potential (eg at the base of slopes to examine fans; within areas of linear alluvial fill (especially "chains of ponds type fills) in upper tributary valleys.

Is there evidence in the historic geotechnical data pointing to locations, areas or stratigraphic sequences which might be archaeologically significant?

A small number of individual locations were seen where stratified unconsolidated deposits, some showing grading, or fining upwards trends could be inferred from the logs. Most sequences of this type relate to observations of "gravel" some of which is quite specifically described as "silcrete" or quartzose or quartz. In all cases the deposits are clearly superficial and not directly associated with the underlying Bringelly Shales.

Such deposits are clearly described as stratifying above saprolite and are often within 2-3 m of the present land surface.

The records thus pinpoint locations where useful additional supplementary archaeological investigations might take place.

They do not map units or areas. More data points and much more detailed analysis of elevation/topography/deposit relationships would be needed to assign "archaeological significance" unequivocally.

Can palaeosols, stratified deposits or chronostratigraphic potential be seen in the data?

As indicated above the broad answer is affirmative. But while there is clear evidence of weathering, possible stratification and locations worth testing, evidence of age is weak. Such units need not relate to the period of human occupation of Australia – broadly the last 50,000 +/-5000 years BP.

Gravels, where logged near surface have potential, but could be millions of years old and represent minor unmapped upstream remnants (or age-equivalents) of the "Rickabys Creek Gravels".

No palaeosols were seen in logged data which suggest unequivocally recent (late Pleistocene or Holocene) ages. No records were observed which document wood, or peat, tufa or other types of clearly recent sediments with unequivocal dating potential, despite waterlogging and high tables within 5 m of surface in many logs.

Can geotechnical data guide and prioritise areas for further phases of archaeological mitigation, especially as conditions of the EIS?

Here the answer is unequivocally affirmative. If all the historic geotechnical data were geo-rectified to modern DTM and then interpreted to well-defined criteria a model would quickly emerge which could relate subsurface depths of potential deposits to landforms at surface.

Some specific localities would emerge which might warrant specific investigations – especially those described as being silcrete gravels.

More importantly, zones of uncertainty would also be mappable – where depths to Bringelly Shale are unusually deep (possibly indicating palaeochannels) or where stratified unconsolidated deposits clearly overlie saprolite.

If there is potential – what methodologies and strategies can best utilise both historic geotechnical data, and new geotechnical data now being acquired across the development footprint?

There is potential. The data examined indicate what can be achieved, but did not indicate that the NOHC test pit investigations would have been substantially improved had their distribution been guided by meshing with subsurface data from historic sources. This is because of significant skew in patterns chosen for borehole transects, preference for interfluve/plateau locations for geotechnical testing in the past (and present) investigations.

The optimum approaches would now be stepwise and involve:

- Georectifying data on position of historic boreholes/test pits to overlay mapping layers which include scheme design “cut and fill”; the results of the current program of NOHC archaeological surface testing; high quality DTM and in particular predicted areas of sediment storage (e.g. in upper tributaries and valley slope lower margins).

- Setting clear criteria for interpreting borehole/test pit data and also for creating ranked categories of potential archaeological significance subsurface.

- Mapping out subsurface predicted geoarchaeological “potential” and then identifying locations being sampled as part of ongoing geotechnical sampling where observations/core will permit testing archaeological potential without additional investigations.

- Identifying areas where archaeological salvage is anticipated from NOHC’s recent assessment which overlap with possible areas for possible deeper investigation as predicted from boreholes/test pit geotechnical data.

- Setting out protocols and methods to be incorporated into development approval conditions sufficient to drive the above tasks.

A6.11 References

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Appendix 7

Summary of previous heritage investigations, and Outline of changes in archaeological approach since 1997

A7.1 Outline of changes in archaeological approach since the 1997 EIS

A7.1.1 A paradigm shift from surface to subsurface archaeological evidence

Following an increase in the systematic conduct of archaeological test excavation as part of environmental impact assessments across the Cumberland Plain, advances in our knowledge of the archaeological resource have presented a number of challenges to analysts. It is now established that Aboriginal stone artefacts within subsurface contexts are distributed across the full spectrum of landscape variation. The areal incidence of this distribution is discontinuous and uneven, but broad and relative categories of artefact incidence can be reliably predicted according to landform types and variables. These categories are related to the past accessibility of resources, notably permanent fresh water, food and exploitable sources of stone (refer to Chapter 5). Localised and small-scale areas of higher artefact incidence may relate to single large occupation events, or to multiple smaller events.

Based on this understanding of the archaeological resource, the identification and information value of individual site classifications has been reviewed. Most site recordings from the Cumberland Plain are a consequence of a recorder's recognition of stone artefacts visible on the ground surface. With few exceptions, the exposure of surface artefacts is dependent on low vegetation cover, and the erosion of the soil profile, either from natural processes or human land-use impacts. Once it is acknowledged that the subsurface incidence of stone artefacts occurs throughout the landscape, it becomes clear that the location and boundaries of recorded surface sites relate more directly to patterns of erosion and land-use, factors which determine ground surface exposures, than to patterns in Aboriginal occupation.

The past methodological reliance on surface archaeological survey, and as a consequence, exposure dependent site recordings, has encouraged the establishment of an archaeological assessment paradigm which is both site focused and site dependent. Assessments were generated for finite units of archaeological material, bounded either by surface incidence, or a bounded area of assessed archaeological potential. A dependence on bounded discrete entities now runs contrary to the evidence from test excavation programs which reveal subsurface artefact occurrences to be widespread, with diffuse boundaries, and to be largely unrelated to surface distributions or exposure boundaries. Current predictive modelling now allows the extrapolation of subsurface artefact incidence data to untested landforms of the same type. The nature of the predicted archaeological resource can now be mapped in terms of broad area landforms and topographic variables. This has introduced a new paradigm in which the measures generated by the site-based paradigm, such as site frequency, density (areal incidence), and even the identification of discrete potential archaeological deposits, have reduced relevance.

The 1997 EIS assessment determined that the average surface site density for the surveyed portion of the Badgerys Creek study area was 7.7 sites per square kilometre. It then extrapolated these results to predict that if a 100 per cent survey had been conducted, 260 surface sites would have been recorded, in the whole area, and 131 within Option A (which is roughly equivalent to the airport site in the current assessment) (NOHC 1997:5-8 - 5-10). This measure provided a useful relative comparison at the time, but is of limited value to any future resource management because it replicated biases inherent in exposure distribution. Although this calculation remained within the parameters of surface evidence, it illustrates the limitation of the site-based paradigm, and how predictive landform mapping based on excavation results, can more effectively characterise the resource and provide an effective framework for management.

A7.1.2 Terminology used for the predicted archaeological resource

The definition of a site as a location with the confirmed presence of evidence of past Aboriginal occupation remains a useful recording and management tool. However, it is now understood to have limited value as an indicator of spatial patterning or actual rates of artefact discard during past Aboriginal occupation. It is now useful to further qualify recordings of artefact occurrences to identify if the record is based on surface or subsurface evidence. The latter provide an indicator that this information is free from biases caused by erosion and ground surface disturbance.

A wider range of terminology is now used for the identification of the predicted archaeological resource. The category of 'potential archaeological deposit' (pad) is a well-established cornerstone of the site-based paradigm. This category is typically applied to a relatively small and discrete location, defined spatially either by geomorphological, disturbance, or administrative criteria. Within such an area, there is a predicted likelihood that subsurface archaeological material is present, and that this material would warrant archaeological investigation in order to determine its scientific, cultural, or statutory value and status. The latter qualification is a recent methodological refinement intended to avoid the inclusion of predicted low or very low subsurface artefact incidences which, based on more recent modelling, can now be predicted across a majority of assessed landscapes.

Although the pad category is an effective tool when applied at a local level and on a small scale, it has become impractical and inaccurate when applied to larger scales of predicted potential. For example, within small or linear study areas, it remains feasible to systematically identify the resource at a fine scale and at specific locales. However, large and broad area assessments often necessitate a coarser level of resource identification, such as at the level of a landform type or combination of topographic variables. To define such areas as a potential archaeological deposit would be inaccurate. This is because of the expected discontinuous distribution of archaeological material across the defined zone and the very low incidence within some included small-scale landforms. In such cases the concept of 'archaeological sensitivity' is now considered to be more effective. This terminology can be used to indicate an area within which sites and/or pad's are known or predicted to occur at a scale or frequency which necessitates careful management action in the future. This is the basis for the use of the term 'archaeologically sensitive landform' (asl) in this assessment.

Both the categories: archaeological deposit, and archaeologically sensitive landform, can be used on their own where there is evidence of archaeological material, or with the prefix 'potential', where there is a lesser degree of certainty or supporting evidence. The strength and nature of the evidence differs across the respective categories. The basis for identifying an archaeologically sensitive landform is likely to be the interpretation of the results of an applicable program of test excavation, which may or may not have been conducted within a subject study area. Where there are no locally applicable results or model available, identifications must be limited to 'potential' classifications (an example is the use of 'potentially archaeological sensitive areas' (pasa's) in NOHC 2012). For a specific deposit, direct evidence of archaeological material would be needed to remove a 'potential' prefix, such as from a visible soil profile section or test pit.

The basis for the identification of archaeologically sensitive landforms in this assessment is the conduct and results of the test excavation program. Only locales with direct evidence of archaeological material are classified as sites.

A7.1.3 Implications for the assessment of significance

Older approaches to the significance assessment of Aboriginal archaeological sites have typically employed the category of 'site' as a primary unit of analysis, with the assessment of collective values enabled by the grouping of sites into complexes according to spatial, functional and chronological criteria. The expanding knowledge of the interrelation between surface and subsurface evidence has provided a basis for revising the methodology for the assessment of that portion of archaeological resource resident within open context deposits. It is acknowledged that site recordings based on surface-only evidence are unlikely to provide a reliable basis for an assessment of the subsurface resource from which the site is derived. In almost all cases the surface record comprises a residue, the result of erosional processes and land-use impact. An unknown proportion of material is missing, as is contextual information. As such, surface archaeological material is now typically considered to have substantially less significance than any associated subsurface deposit. Some assessments address this issue by including a predictive evaluation of any identified and locally associated subsurface potential.

The paradigm shift in the analysis of artefact occurrences from surface to subsurface evidence has introduced a parallel shift from sites to landscapes. The generation and application of test excavation data is made possible by the building and refinement of models. These models use the close interrelation of past Aboriginal occupation and resource exploitation with landform variables to create a framework for ordering the archaeological resource and its landscape context. It follows then that this framework, when substantiated by locally applicable and excavation derived datasets, can provide a basis for making significance assessments and an effective alternative or complement to the site-based approach. The advantages of this approach are that assessments can be directed at the full predicted scope of the archaeological resource, and include consideration of evidentiary interrelations across landforms and landscapes. This approach avoids surface –based biases introduced by the incidence, frequency and nature of ground surface exposures.

The assessment conducted for this investigation of the significance of the subsurface archaeological resource within the airport site has adopted a landscape approach based on the predictive value of the test excavation program. This is has been combined with a reassessment of the results of the 1997-1999 EIS assessment which employed a site based approach.

A7.2 Summary of previous heritage investigations conducted within the local district of the airport site

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
Haglund (1979)	Kemps Creek	Archaeological survey for proposed substation	No Aboriginal sites identified.	4.26 km east
Koettig (1981)	South St Marys Second Stage Release Area, Erskine Park	Archaeological survey of proposed land release area	No Aboriginal sites identified.	8.0 km northeast
McIntyre (1984)	Portion 7785, Erskine Park	Archaeological survey for proposed quarry extension	1 artefact scatter identified in a disturbed context adjacent to a road, comprising five pieces of flaked silcrete, one chert flake and one piece of broken quartz.	6.2 km northeast
Dallas (1988a)	Luddenham Equestrian Centre, Luddenham Road, Erskine Park	Archaeological survey for proposed recreational and residential development	12 artefact scatters identified; 8 along the bank and flats of Cosgroves Creek, 3 on a ridge near the confluences of Kemps Creek and Badgerys Creek with South Creek, and 1 in disturbed deposits on South Creek. The presence of subsurface fine grained silcrete cobbles and nodules on the ridge was noted. Artefacts were predominantly manufactured from silcrete; other stone types included chert and quartz.	2.18 km north
Dallas (1988b)	Corner Samuel Marsden and Landsdowne Roads, Orchard Hills	Archaeological site inspection for Kindalin School annexe	No Aboriginal sites identified.	8.81 km north
Brayshaw (1989)	Orchard Hills	Archaeological survey for proposed urban subdivision	No Aboriginal sites identified.	7.94 km north
Dallas (1989a)	Lots 1 and 2 DPS217319 & 547057, Luddenham Road, Orchard Hills	Archaeological survey for proposed canine showground	No Aboriginal sites identified.	6.46 km north
Nicholson (1989)	Lot 2, Elizabeth Drive, Kemps Creek	Archaeological survey for proposed quarry	No Aboriginal sites identified.	0.59km north
Dean-Jones (1991)	Lot 3 DP623799, Adams Road, Luddenham	Archaeological survey for proposed clay/shale extraction	1 artefact scatter was identified around the margin of a dam on the edge of the Oaky Creek floodplain, comprising 22 artefacts made of indurated fine sandstone, chert/tuff, and mudstone.	Adjacent to airport site (north west)

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
Kohen (1991)	Lot 2, Elizabeth Drive, Kemps Creek	Archaeological survey for proposed landfill development	1 artefact scatter identified adjacent to Badgerys Creek, comprising 22 artefacts manufactured from silcrete (18 artefacts), chert (2), and quartz (2).	0.59 km north
Brayshaw McDonald (1992)	Herbert Street, Kemps Creek to Bringelly sub-station	Archaeological survey of proposed 33kV transmission line	1 artefact scatter was identified on a low spur 80-150 m from South Creek, comprising 11 artefacts of indurated mudstone, silcrete and chert.	2.47 km southeast
Brayshaw McDonald Pty Ltd (1995)	Cowpasture Road, West Hoxton	Archaeological salvage excavation, residential subdivision	2 previously identified sites were excavated; one on a remnant alluvial terrace overlying Bringelly shale, approximately 40 m from an unnamed tributary of Cabramatta Creek, and the second on the heavily disturbed footslope of a spur with very little topsoil (WH4). 3,672 artefacts were recovered from the terrace, with 90% obtained from two silcrete knapping floors. Artefacts were predominantly manufactured from silcrete (96.6%), with smaller quantities of indurated mudstone/chert (2.1%), quartz (1.1%), and igneous stone (0.1%). No artefacts were recovered from the footslope.	8.61 km east
HLA-Envirosciences Pty Ltd (1995)	Farnsworth Avenue, Warragamba to The Northern Road, Luddenham	Archaeological survey for proposed haulage roads	Ten sites identified in Wallacia, including 7 PADs on Farnsworth Avenue near Megarritys Creek, 1 artefact scatter near the corner of Park Road and Montelimar Place, 1 isolated artefact (stone axe) to the south of Park Road.	1.0 km west

Report Author/ Date	**Location**	**Investigation type**	**Results**	**Approximate distance from airport site**
NOHC (1997)	Badgerys Creek, an enlarged airport study area of 34 km^2 , 17 of which occurred outside of Commonwealth owned land	EIS investigation of Second Sydney Airport proposal at Badgerys Creek or Holsworthy	Assessment based on surface archaeological survey and predictive assessment of the subsurface resource. The assessment documented 111 known surface archaeological sites, of these 58 were open artefact scatters, 8 scarred trees, 44 isolated finds, and nine sites were associated with potentially substantial archaeological deposits. Survey coverage of thirty-seven percent of the total study area was achieved. Potential archaeological deposits were identified within valley floor alluvium and basal slope landforms associated with higher order streamlines. The number of surface artefacts recorded per site ranged from one to 31. 46% of sites with more than one recorded artefact included between three and five artefacts. Twenty two percent contained only two artefacts. The maximum surface artefact incidence was one per square metre.	Included the airport site, and lands extending up to 4km to the southeast.
Steele (1999)	Luddenham & Mamre Roads, Luddenham	Archaeological survey for proposed rural residential subdivision and golf course	5 artefacts scatters, 1 isolated artefact and 1 potential scarred tree were identified. The locations of 5 previously identified sites were confirmed, 7 previously identified sites could not be relocated. Sites on the Cosgrove Creek flat were generally dispersed along the watercourse and had low artefact densities. This area was assessed as having moderate archaeological sensitivity. Sites near the confluences of Kemps Creek and Badgerys Creek with South Creek, in the vicinity of a low gradient spur, are situated closer together. A number of these sites produced large quantities of artefacts. This area was assessed as having high archaeological sensitivity.	2.18 km north
JMCHM (2000)	“Austral Site”, Mamre Road, Erskine Park	Archaeological survey for proposed light industrial subdivision	5 artefact scatters and 3 isolated artefacts were identified on areas with ground surface exposure on unsealed vehicle tracks, cattle tracks and areas of sheetwash erosion. 7 sites were identified on lower hillslopes, 2 on creek banks, and 1 on floodplain.	5.54 km northeast

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
JMCHM (2001a)	1503 Elizabeth Drive, Kemps Creek	Archaeological survey for proposed redevelopment of Nolans Quarry	1 PAD with 1 quartz flake identified on a ridgeline on Bringelly shale, near a headwater tributary of Kemps Creek. Due to poor ground visibility, it was recommended that archaeological test excavation be undertaken prior to development to determine if sub-surface artefacts are present.	2.5 km east
Steele (2001)	Luddenham & Mamre Roads, Luddenham	Archaeological test excavation, rural residential subdivision and golf course	3 geomorphological zones were investigated: the floodplain, slope and a ridgeline spur. A very low density of artefacts was found in alluvial deposits on the floodplain and aggrading lower slope. The highest density of artefacts, as well as naturally occurring silcrete gravels, was found on the ridgeline spur. The artefact assemblage was dominated by silcrete (93.7%), followed by quartz (4.4%) and tuff (1.8%), with a minor amount of other raw materials including volcanics, petrified wood and quartzite (0.1%).	2.18 km north
White (2001)	Lot 70 DP260492, McCann Road and Bringelly Road, Leppington	Archaeological survey for proposed subdivision	Six isolated stone artefacts and one area of PAD were identified on a ridge between South Creek and Kemps Creek.	6.09 km southeast
McIntyre-Tamwoy (2003)	Junction of Mamre Road and Erskine Park Road, Erskine Park	Archaeological survey for proposed road works	4 sites identified, including 1 artefact scatter and 3 isolated finds. The location of 2 previously identified sites were confirmed	5.54 km northeast
NOHC (2003)	Erskine Park to West Sydney sub-station	Archaeological survey of proposed 132kV transmission line	2 sites were identified on basal slopes adjacent to minor drainage lines; one scatter of 4 silcrete and 3 mudstone artefacts, and one scatter of 8 silcrete artefacts. 1 PAD was identified on alluvial soils on a terrace near the junction of Ropes Creek with an unnamed tributary.	7.58 km northeast
Archaeological & Heritage Management Solutions (AHMS) (2005a)	85 Bakers Lane, Kemps Creek	Archaeological survey of proposed development area in Emmaus Village	4 sites identified, including 1 artefact scatter and 2 isolated artefacts on low-lying flats/footslopes, and 1 artefact scatter on a drainage line. All sites were within the Blacktown soil landscape.	5.18 km northeast

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
AHMS (2005b)	85 Bakers Lane, Kemps Creek	Archaeological test excavation, proposed development area in Emmaus Village	11 artefacts and probable artefacts were recovered from 15 test trenches. The artefacts were manufactured from silcrete (7) and tuff (4). The density of artefacts present was considered to be low compared to other sites in the local area (Luddenham), partially attributed to disturbance from erosion and mixing of remnant soils arising from vegetation clearance, ploughing and grazing, and bioturbation.	5.18 km northeast
Brayshaw (2005)	Mamre Road/Erskine Park Road, Erskine Park	Archaeological survey for proposed intersection upgrade	1 artefact scatter, comprising one silcrete flake and one silcrete flaked fragment, was identified on a very gentle slope beside Mamre Road, approximately 60-140 m from an unnamed tributary of South Creek. Three other small fragments of unmodified silcrete were also noted in this area.	6.28 km northeast
Kayandel Archaeological Services (2005)	Lot 330 DP2475, 15th Avenue, West Hoxton	Archaeological survey for proposed residential subdivision	1 artefact scatter comprising 2 silcrete flakes, one probable milky quartz flake, and one milky quartz flaked piece/core fragment, was identified on a spurline.	8.82 km east
NOHC (2005a)	CSR lands, Lenore Lane, Erskine Park	Archaeological test excavation, proposed industrial development	49 artefacts were recovered from 20 of 38 test pits. The lithic assemblage was dominated by silcrete (55.1%, 27 artefacts) and rhyolitic tuff (24.5%, 12 artefacts), with minor quantities of chert, chalcedony, quartz and unidentified stone (20.3%, 10 artefacts). The greatest density of artefacts occurred on locally elevated and relatively level ground adjacent to an unnamed creek line. Lower densities of artefacts were recorded on low gradient slopes along a spurline.	6.2 km northeast
NOHC (2005b)	CSR lands, Lenore Lane, Erskine Park	Archaeological test excavation, proposed industrial development	285 artefacts were recovered from 88 of 256 test pits. Low densities of artefacts were found on all landform units tested, including a ridgeline, spurline, valley floor, and locally elevated and relatively level ground adjacent to a watercourse. The greatest quantity of artefacts was recovered from valley floor contexts, which were assessed as having moderate to high archaeological potential. All other landform units were assessed as having moderate archaeological potential.	6.2 km northeast

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
NOHC (2005c)	Crown road reserve near Mamre Road, Erskine Park	Archaeological test excavation, proposed access road	172 artefacts were recovered from 21 of 24 test pits on a low spurline, previously identified as an area of archaeological potential. The artefact density was considered to be low, with 29.48 artefacts per square metre. The assemblage was dominated by silcrete (72.67%, 96 lithic items) and tuff (17.44%, 30 items), with smaller quantities of milky quartz (2.33%, 4 items), quartzite (2.33%, 4 items), rhyolitic tuff (1.745%, 3 items), unidentified stone (1.745%, 3 items), chert (1.16%, 2 items), and chalcedony (0.58%, 1 item). Some lithic items were heat affected, mostly silcrete and tuff, although it could not be determined if the heat fracturing was from anthropogenic or natural causes.	6.14 km northeast
NOHC (2005d)	Ropes Creek to Erskine Park Road, Erskine Park	Archaeological survey for proposed gas main	1 previously identified site, an artefact scatter with shell (freshwater mussel), was relocated on the elevated eastern bank of Ropes Creek. More than 40 artefacts manufactured from silcrete, tuff/chert, and quartz were noted; however, no shell material was visible.	9.92 km northeast
Kayandel (2006)	Lot 1978 DP792932, 17th and 2nd Avenues, West Hoxton	Archaeological survey for proposed residential subdivision	No Aboriginal sites identified.	8.12 km east
NOHC (2006)	Lot 13 DP707337, between Camden Valley Way and Cowpasture Road, Leppington	Archaeological survey for proposed redevelopment of caravan park	1 stone artefact, a silcrete flaked piece, was identified on a low gradient slope.	9.76 km southeast
NOHC (2007)	Erskine Park Employment Area, Ropes Creek	Archaeological test excavation, proposed industrial development	261 artefacts were recovered from 112 test pits. The lithic assemblage was dominated by silcrete (70%), with smaller quantities of tuff (21.3%), quartz (3.9%), chert (2.6%), volcanics (1.6%), and quartzite (0.6%). The highest concentration of artefacts occurred on the basal slopes, midslopes and crest of a spurline.	6.86 km north

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
Steele (2007)	Twin Creeks Estate, Luddenham Road, Luddenham	Archaeological salvage excavation and monitoring, rural residential subdivision and golf course	120 flaked stone artefacts were recovered from 16 test trenches in shallow colluvial soils. The assemblage was dominated by silcrete (90%, 108 artefacts), with smaller quantities of silicified tuff (6.67%, 8 artefacts), petrified wood (1.67%, 2 artefacts), quartzite (0.83%, 1 artefact), and indurated mudstone (0.83%, 1 artefact). No artefacts showed evidence of h eat treatment. The artefact density was considered to be low, with approximately 7.5 artefacts per square metre. 90-95% of stone material recovered from the salvage excavation and surface collection was amorphous naturally fractured rock. Flakeable quality silcrete cobbles were noted to be present across the surface of the study area.	2.18 km north
Total Earth Care Pty Ltd (2007)	Lenore Lane, Erskine Park	Archaeological salvage excavation, Erskine Centre Industrial Park	1 previously identified artefact scatter of 15 flaked pieces and surrounding area was investigated. The largest number of artefacts were recovered from hilltop excavation areas (81.8% of total assemblage), and from a knoll below the hilltop (15.6%), with relatively few artefacts found mid-slope (2.7%). 1,014 artefacts were recovered, with the distribution of artefact concentrations suggesting the presence of knapping floors around the top of the hill as well as discrete knapping events. The assemblage was dominated by silcrete (87.6%, 888 artefacts), with smaller quantities of quartz (10.7%, 108 artefacts), indurated mudstone (1.0%, 10 artefacts), and silicified tuff (0.8%, 8 artefacts).	7.2 km northeast
Archaeological Surveys & Reports Pty Ltd (2009)	Lot 40, DP738126, Patons Lane, Orchard Hills	Archaeological survey for proposed waste and resource management facility	2 isolated artefacts identified, 1 mudstone/tuff broken flake and 1 quartzite backed blade, identified 100 m and 350 m from Blaxland Creek, respectively	6.26 km north

Report Author/ Date	Location	Investigation type	Results	Approximate distance from airport site
JMCHM (2009)	Mamre Road Biodiversity Lot, Erskine Park	Aboriginal Heritage Management Plan	9 sites previously identified; 5 artefact scatters and 2 isolated finds in the vicinity of minor, first order tributaries of South Creek, and 2 artefact scatters in the vicinity of a second order stream channel. All sites are within 300 m of the closest water source, with most sites between 50-200m. Sites were recorded on lower hillslope landform units (67% of total sites), the interface of lower hillslope and creek bank (22%), and floodplain-creek bank (11%).	5.81 km northeast
AMBS (2013)	Leppington Precinct, South West Growth Centre	Archaeological survey for precinct planning	16 sites identified including11 artefact sites on slopes, 1 artefact site on a slope/crest, and 2 PADs and 2 artefacts sites on creek flats associated with Kemps Creek and unnamed, minor tributaries.	7.36 km southeast
Artefact Heritage (2012)	The Northern Road between The Old Northern Road, Narellan to Mersey Road, Bringelly	Archaeological survey for proposed road upgrade	32 sites identified; including 29 artefact sites, 2 scarred trees and 1 PAD. Landform units on which sites occurred include flats (4 artefact sites and 2 scarred trees), lower hillslope (12 artefact sites), lower hillslope/terrace (1 artefact site), hillslope (4 artefact sites), creek flat/terrace (1 PAD), creek flat (1 artefact site), upper hillslope (4 artefact sites), and low ridgeline (2 artefact sites). In addition, 4 previously recorded sites had been destroyed; including 2 artefact sites and 2 PADs.	Adjacent to airport site (south)
Australian Museum Business Services (AMBS) (2012)	Austral & Leppington North Precincts, South West Growth Centre	Archaeological survey for precinct planning	7 sites identified; including 2 artefact sites on slopes, 4 artefact sites and 1 artefact site/PAD on creek flats associated with Kemps Creek, Bonds Creek, and unnamed, minor tributaries.	4.22 km east

Appendix 8

Protocols to follow in the event of unanticipated discovery of Aboriginal sites

Notes:

- The following protocols are applicable to actions conducted within the airport site prior to the adoption of a project specific conservation management plan (CMP).
- A CMP could be expected to revise some of the provisions of the unanticipated discovery protocol so that required actions are consistent with approved management strategies.

A8.1 Protocol to follow if Aboriginal object(s), other than human remains, are encountered

In the event that object(s) which are suspected of being Aboriginal in origin are encountered during works conducted within the airport site, then the following protocol will be followed:

1. Cease any further excavation or ground disturbance, in the area of the find(s);

    a. The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be temporarily halted; and

    b. The site supervisor and the Principal/Project manager will be informed of the find(s).

2. Do not remove any find(s) or unnecessarily disturb the area of the find(s);

3. Ensure that the area of the find(s) is adequately marked as a no-go area for machinery or further disturbance, and that the potential for accidental impact is avoided;

4. Note the location and nature of the finds, and report the find to:

    a. Relevant personnel responsible for the worksite and project;

    b. The Dept of Infrastructure and Regional Development (DIRD);

    c. The Department of the Environment (DoE);

    d. The NSW Office of Environment and Heritage (OEH); and

    e. The project archaeologist (if appointed).

5. Where feasible, ensure that any excavation remains open so that the finds can be recorded and verified. An excavation may be backfilled if this is necessary to comply with work safety requirements, *and* where this action has been approved by WSU. An excavation that remains open should only be left unattended if it is safe and adequate protective fencing is installed around it.

6. Following consultation with DIRD and DoE, and where advised, any other relevant stakeholder groups, such as key Aboriginal stakeholders, the significance of the finds should be assessed and an appropriate management strategy formulated and followed. Depending on project resources and the nature of the find(s), this process may require input from a consulting heritage specialist.

7. No impact may occur to the object until approval is gained from DIRD and DoE, or relevant authority with delegated authority.

8. If human skeletal material is encountered, the protocol for the discovery of human remains should be followed.

A8.2 Protocol to follow in the event of the discovery of suspected human remains

The following protocol will be actioned if suspected human material is revealed during ground disturbance, excavations or other works within the airport site:

1. All works must halt in the immediate area of the find(s) and any further disturbance to the area of the find(s) prevented.

    a. The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be halted; and

    b. The site supervisor and the Principal/Project manager will be informed of the find(s).

2. If there is substantial doubt regarding a human origin for the remains, then consider if it is possible to gain a qualified opinion within a short period of time. If feasible, gain a qualified opinion (this can circumvent proceeding further along the protocol for remains which are not human). If conducted, this opinion must be gained without further disturbance to the find(s) or the immediate area of the find(s). (Be aware that the site may be considered a crime scene that retains forensic evidence). If a quick opinion cannot be gained, or the identification is positive, then proceed to the next step.

3. Immediately notify the following of the discovery:

    a. The local Police (this is required by law);

    b. The Department of Infrastructure and Regional Development (DIRD) and/or their representative;

    c. The Department of the Environment;

    d. The NSW Office of Environment and Heritage (OEH); and

    e. The project archaeologist (if appointed).

4. Co-operate and be advised by the Police and/or coroner with regard to further actions and requirements concerning the find area. If required, facilitate the definitive identification of the material by a qualified person (if not already completed).

5. In the event that the Police or coroner instigate an investigation, any disturbance to the area of the find(s) are not to resume until approval in writing is gained from the NSW Police.

6. In the event that the Police and/or Coroner advise that they do not have a continuing or statutory role in the management of the finds then proceed with the following steps:

7. If the finds are not human remains but are considered to be archaeological material relating to Aboriginal occupation then proceed with an archaeological assessment methodology as appropriate.

8. If the finds are human remains and Aboriginal or probably Aboriginal in origin, then ascertain the requirements of DoE, OEH, DIRD, the Project Manager (if not DIRD), and the views of Registered Aboriginal Stakeholders, and the project archaeologist.

    Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

    i. Avoiding further disturbance to the find and conserving the remains *in situ*

    i. Conducting archaeological salvage of the finds following receipt of any required statutory approvals;

ii. Scientific description (including excavation where necessary), and possibly also analysis of the remains prior to reburial;

iii. Recovering samples for dating and other analyses; and/or

iv. Subsequent reburial at another place and in an appropriate manner determined by the Aboriginal Stakeholders.

9. If the finds are non-Aboriginal in origin:

   a. Ascertain the requirements of DoE, OEH, DIRD and the Project Manager (if not DIRD), and the views of any relevant community stakeholders and the project archaeologist.

   b. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

      ii. Avoiding further disturbance to the find and conserving the remains *in situ*;

      iii. Conducting archaeological salvage of the finds following receipt of any required statutory approvals;

      iv. Scientific description (including excavation where necessary), and possibly also analysis of the remains prior to reburial;

      v. Recovering samples for dating and other analyses; and/or

      vi. Subsequent reburial at another place and in an appropriate manner determined in consultation with relevant stakeholders.

10. Any disturbance to the area of the find(s) may not resume until written approval is received from the relevant statutory authority, or authority with delegated authority. This may be the Police or Coroner in the event of an investigation, or the DoE and/or OEH in the case of remains outside of the jurisdiction of the Police or Coroner.

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