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M12 Motorway Environmental Impact Statement

Appendix J Non-Aboriginal Heritage Assessment Report

Roads and Maritime Services | October 2019

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Abbreviations

CCHMP	Construction Cultural Heritage Management Plan
CHL	Commonwealth Heritage List
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DP	Deposited plan
DPC	Department of Premier and Cabinet
EIS	Environmental Impact Statement
EP&A Act	Environment Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
Fairfield LEP	Fairfield Local Environmental Plan 2013
Heritage Act	Heritage Act (NSW) 1977
ICOMOS	International Council on Monuments and Sites
JAJV	Jacobs Arcadis Joint Venture
Jacobs	Jacobs Group (Australia) Pty Ltd
LEP	Local Environment Plan
Liverpool LEP	Liverpool Local Environment Plan 2008
NHL	National Heritage List
NSW	New South Wales
NTAR	National Trust of Australia (NSW) register
Penrith LEP	Penrith Local Environmental Plan 2010
PPAL	Australian Heritage Council priority assessment list
RNE	Register of the National Estate
RAAF	Royal Australian Air Force
SEARs	Secretary's Environmental Assessment Requirements
SHI	State Heritage Inventory
SHR	State Heritage Register
SoHI	Statement of Heritage Impact

Executive Summary

Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). The project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport.

Purpose of this report

This report has been prepared to support the environmental impact statement (EIS) for the M12 Motorway project. The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364) and to enable the Minister for Planning and Public Spaces and the Commonwealth Minister for the Environment to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to impact non-Aboriginal heritage.

Overview of potential impacts

An initial review of existing research and previous heritage studies identified 13 heritage items and potential heritage items within the study area. Following a comparative analysis, only nine heritage items have been assessed as having either local, State or National heritage significance. These are:

- Item 1: McGarvie Smith Farm
- Item 2: Fleurs Radio Telescope
- Item 3: Luddenham Road Alignment
- Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
- Item 6: McMaster Field Station
- Item 7: Fleurs Aerodrome
- Item 8: Cecil Park School, Post Office and School Church
- Item 10: Exeter Farm Archaeological Site
- Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape.

A summary of the potential impacts on the nine heritage items is provided in **Table E-1-1**.

Of the nine heritage items within the study area, five heritage items were found to be subject to physical impacts from the project. Following management measures, the following impacts are anticipated on the five heritage items:

- Major heritage impact
  - McGarvie Smith Farm
  - McMaster Field Station
  - Fleurs Aerodrome
  - Cecil Park School, Post Office and Church Site.
- Minor heritage impact:
  - The Fleurs Radio Telescope Site.

Table E-1-1 Summary of non-Aboriginal heritage items including significance and potential impacts

Heritage item name and heritage register number (if applicable)	Potential impacts	Heritage significance and implications
Item 1: McGarvie Smith Farm (Penrith LEP 857)	Demolition of three buildings, two sheds and silo – reduction of the intactness of the complex, impact on understanding of its layout and principal characteristics, impact on historical significance by reducing examples of buildings across entire history of development of site, Bisection of property by motorway – impacts on setting of the experimental farm, and its modified landscape and the features demonstrating innovative water harvesting practices; impacts the principal characteristics Ancillary facilities –ground disturbance and physical impact to features, impacts on setting of the experimental farm, and its modified landscape and the features demonstrating innovative water harvesting practices; impacts the principal characteristics Potential for accidental or incidental impacts from vehicles and other machinery during construction on elements outside construction footprint.	Listed under Penrith LEP as Local, but assessed as State. There would be both construction and operational impacts. Both the buildings and landscape of the heritage item would be impacted by the construction of the project. Operational impacts would be applicable as the proposed carriageway bisects the heritage item. The proposed works within McGarvie Smith Farm would be of medium-large scale and moderate intensity, with some of the changes being permanent and irreversible. As such, the level of impact on the heritage items overall would be **major**.
Item 2: The Fleurs Radio Telescope Site (Penrith LEP 832)	Demolition of one element of the Shain Cross (SC01) – one of the antenna poles forming the larger array Further information about Fleurs Radio Telescope can be found in **Annexure A**. Other impacts may include architectural noise treatment and landscape and vistas.	Listed under Penrith LEP as Local, but assessed as State and potentially National. The proposed works within Fleurs Radio Telescope site would be of at a localised scale and low intensity, with the demolition of the one element of the Shain Cross being permanent and irreversible. As such, the level of impact on the heritage item overall would be **minor**.
Item 3: Luddenham Road Alignment (Penrith LEP 843)	Nil	Listed under Penrith LEP as Local. There are no adverse impacts on the Luddenham Road alignment based on current proposed activities and design.

Heritage item name and heritage register number (if applicable)	Potential impacts	Heritage significance and implications
Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir (SHR 01373)	Potential for accidental physical damage to the Tunnel Shaft 4 from road construction machinery, vehicles or other activities, and the potential for vibration impacts on the Upper Canal System from construction works in the vicinity. No demolition would occur therefore no impact to significance.	Listed under State Heritage Register as State Listed under Liverpool LEP as Local. The proposed works within the heritage curtilage of the Upper Canal System are not planned to physically impact the heritage item as the motorway in this location is a raised structure, and any potential impacts are able to be prevented through implementation of protective measures. Additionally, there would be no impact on views to the heritage item. As such, the level of impact on the heritage item would be **negligible** during construction and operation.
Item 6: McMaster Field Station	The project would bisect the landscape of the McMaster Farm overall as the dual carriageway and interchange would be located within the property. Some modified landscape elements would be destroyed by the project. A potential construction laydown area overlaps with the complex of buildings on the property, and may be reused as construction offices and facilities.	Not currently listed but assessed in this report as State. There would be construction and operational impacts to the site. The landscape of the heritage item would be impacted by the construction of the project. Operational impacts would be applicable as the proposed motorway bisects the heritage item. The proposed works within McMaster Field Station would be of medium-large scale and moderate intensity, with some of the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be **major**.
Item 7: Fleurs Aerodrome	The proposed construction footprint would bisect the previous runway to the north of the existing runway. A remnant metal object is located 13 m south of the construction footprint and is unlikely to be impacted by the project. The metal structure (13 metres south of the construction footprint) and other sections of the Fleurs Aerodrome outside the construction footprint would not be subject to direct impacts from the project but may be inadvertently or accidently damaged during construction from vehicles or machinery in the vicinity, therefore protective temporary fencing should be erected to protect the structure, prior to works taking place.	Not currently listed but assessed in this report as Local. There would be both construction and operational impacts to the Fleurs Aerodrome as the proposed carriageway bisects the heritage item. The proposed works within the Fleurs Aerodrome would be of medium-large scale and moderate intensity, with the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be **major**.

Heritage item name and heritage register number (if applicable)	Potential impacts	Heritage significance and implications
Item 8: Cecil Park School, Post Office and Church Site	The project would physically disturb and destroy the area of archaeological potential through ground disturbance activities.	Not currently listed but assessed in this report as Local. Construction impacts to Item 8 would cause physical damage to the entire area of archaeological potential within the heritage item, with the exception of the Cecil Park school site. As the construction would remove most of the archaeological aspects of the heritage item, it would no longer be of significance and would therefore not be subject to further operational impacts. The proposed works within the Cecil Park historical complex would be of medium-large scale and moderate-high intensity, with the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be **major**.
Item 10: Exeter Farm Archaeological site	Currently located 50 metres south of the Construction Footprint and therefore no impact.	Not currently listed but assessed in this report as Local. There are no works planned to occur within the curtilage of the Exeter Farm archaeological site, therefore there are no construction impacts to the item. However, as the item is located within 50 metres of the construction footprint, shifting the alignment to the south may result in physical damage to the item. Due to the distance of the motorway from the site, there are also no operational impacts to the heritage item. As such, the level of impact on the heritage item would be **negligible** during construction and operation.
Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	There are no works planned to occur within the curtilage of the South, Kemps and Badgerys Creek Scenic Landscape, however there is the potential for indirect impacts to the hydrology of South Creek, and visual impacts to the heritage landscape. These impacts would also continue during operation.	Not currently listed but assessed in this report as Local. There are no direct physical impacts on the heritage item, the visual impacts have been minimised as much as possible through project design, and the hydrological impacts are minor and localised and able to be prevented through the implementation of management measures. As such the level of impact on this heritage item, during construction and operation are **negligible**. As such, the level of impact to the South, Kemps and Badgerys Creek Scenic Landscape is **negligible**.

Summary of environmental management measures

Specific environmental management measures have been developed for each of the nine heritage items within the study area. A Construction Cultural Heritage Management Plan (CCHMP) would be prepared for the project as part of the Construction Environment Management Plan (CEMP) in consultation with the Department of Premier and Cabinet (DPC) (Heritage). The CCHMP would include as a minimum:

- A list, plan and maps with GIS layers showing the location of identified heritage items both within, and in proximity to, the construction footprint
- A significance assessment and statement of significance for each item (**Chapter 6**)
- Protocols and procedures including inductions and toolbox talks for all contractors and subcontractors working in the area to be informed of all exclusion zones, the elements and their significance, to prevent accidental damage or encroachment (**Chapter 10**)
- Protocols and procedures to be implemented during construction to avoid or minimise impacts to items of heritage significance including protective fencing
- The Roads and Maritime Unexpected Heritage Items Procedure (Roads and Maritime 2015b) which would be followed in the event that unexpected heritage finds are uncovered during construction

A suitably qualified heritage specialist would be engaged to prepare a heritage interpretation framework to guide development of the detailed urban design for the project. This framework would be prepared in accordance with the Interpreting Heritage Places and Items Guidelines (NSW Heritage Office 2005) and would include:

- Integrations of heritage themes and values to be incorporated
- Collaboration with other design elements and themes for the project, including those associated with Western Sydney Airport and Sydney Metro Greater West, to develop an integrative design approach with surrounding development
- Opportunities for design responses for Aboriginal and non-Aboriginal heritage

Impacts to non-Aboriginal heritage items would be avoided or minimised where reasonable and feasible. Where impacts are unavoidable, works would be undertaken in accordance with the measures for individual non-Aboriginal heritage items outlined in **Table 10-1**.

A copy of this non-Aboriginal heritage assessment report would be provided to the appointed construction and design team to ensure that key heritage themes are elements are integrated into:

- The urban design of the project
- Interpretation plan
- Any Master Plans prepared by the University of Sydney.

Site-specific management measures would be applied at heritage sites that have been identified as being subject to impact due to the activities associated with construction of the project, Management measures include archival photographic recording, protective fencing, exclusion zones, interpretive strategies and archaeological test excavation. Site specific management measures are detailed in **Chapter 10**, and would be described in the CCHMP that would be developed for the project.

Conclusions

This non-Aboriginal heritage assessment has been undertaken in accordance with the SEARs and relevant heritage guidelines.

Thirteen potential heritage items were identified and assessed as part of this assessment with only nine reaching the local or state threshold for significance. Of these, three heritage items were previously registered. The remaining five non-Aboriginal heritage items were not previously registered. This heritage assessment has identified one of the five heritage items as potentially State significance, and the remaining four as having Local significance.

Five heritage items would be impacted as a result of the project, four subjected to major impacts and one to minor impacts. This report outlines management measures for the heritage sites that may be impacted by the project, including protective measures to ensure that sites on the periphery of the construction footprint are not inadvertently impacted.

1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). In addition, the project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport. The project would commence about 30 kilometres west of the Sydney central business district, at its connection with the M7 Motorway. The project traverses the local government areas of Fairfield, Liverpool and Penrith. The suburbs of Cecil Park and Cecil Hills are found to the east of the M12 Motorway, with Luddenham to the west.

The project is predominately located in greenfield areas. The topography in and around the project comprises rolling hills and small valleys between generally north–south ridge lines. The existing land uses are semi-rural residential, recreational, agricultural, commercial and industrial. The main residential areas are Kemps Creek, Mount Vernon and Cecil Hills.

The project is required to support the opening of the Western Sydney Airport by connecting Sydney's motorway network to the airport. The project would also serve and facilitate the growth and development of the Western Sydney which is expected to undergo significant development and land use change over the coming decades. The motorway would provide increased road capacity and reduce congestion and travel times in the future and would also improve the movement of freight in and through western Sydney.

The project location is shown in **Figure 1-1** in relation to its regional context.

1.2 Project overview

The project would include the following key features:

- A new dual-carriageway motorway between the M7 Motorway and The Northern Road with two lanes in each direction with a central median allowing future expansion to six lanes
- Motorway access via three interchanges/intersections:
  - A motorway-to-motorway interchange at the M7 Motorway and associated works (extending about four kilometres within the existing M7 Motorway corridor)
  - A grade separated interchange referred to as the Western Sydney Airport interchange, including a dual-carriageway four lane airport access road (two lanes in each direction for about 1.5 kilometres) connecting with the Western Sydney Airport Main Access Road
  - A signalised intersection at The Northern Road with provision for grade separation in the future
- Bridge structures across Ropes Creek, Kemps Creek, South Creek, Badgerys Creek and Cosgroves Creek
- Bridge structure across the M12 Motorway into Western Sydney Parklands to maintain access to the existing water tower and mobile telephone/other service towers on the ridgeline in the vicinity of Cecil Hills, to the west of the M7 Motorway
- Bridge structures at interchanges and at Clifton Avenue, Elizabeth Drive, Luddenham Road and other local roads to maintain local access and connectivity
- Inclusion of active transport (pedestrian and cyclist) facilities through provision of pedestrian bridges and an off-road shared user path including connections to existing and future shared user path networks

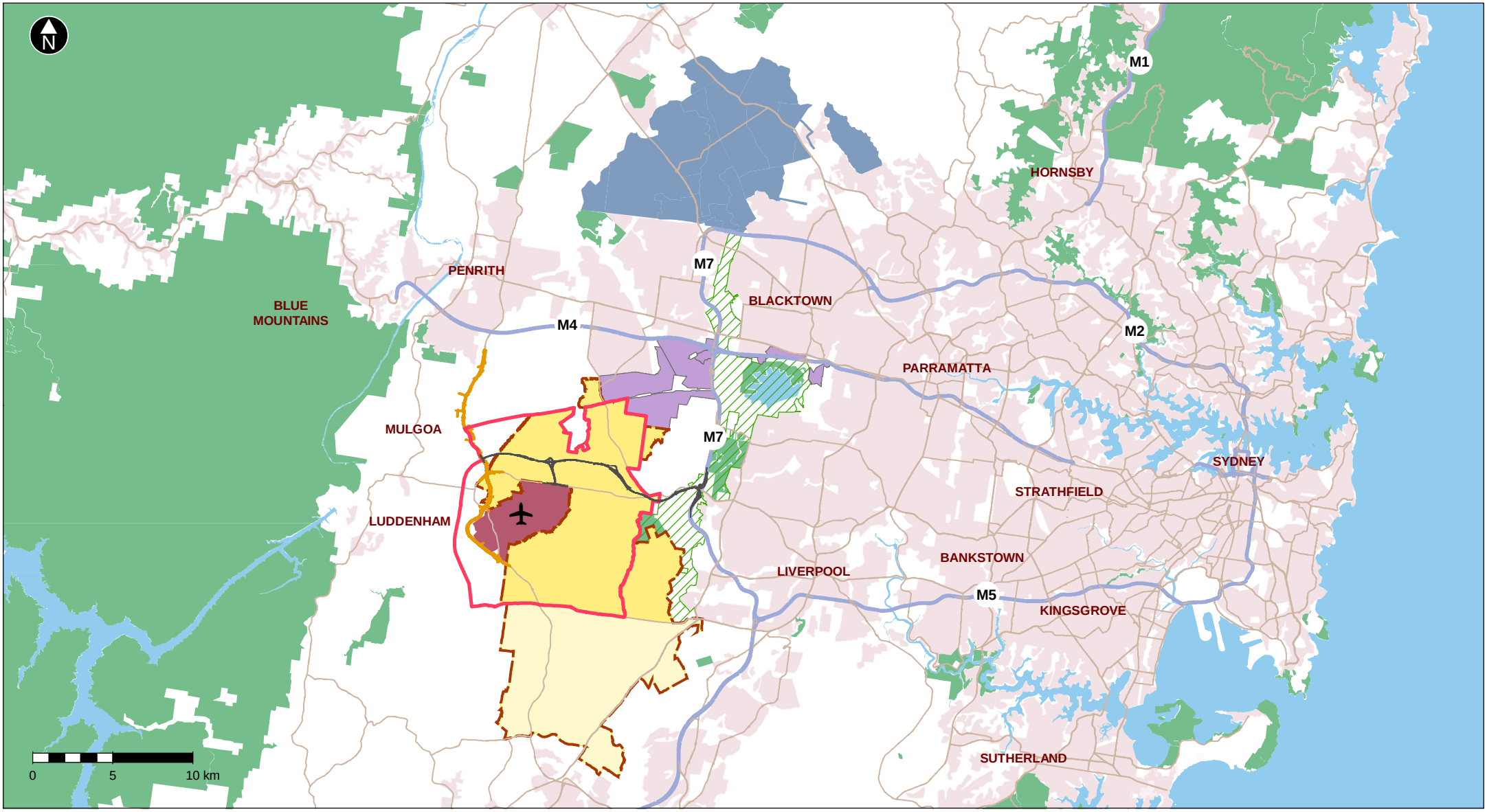

Figure 1-1 Project location (regional context)

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- Modifications to the local road network, as required, to facilitate connections across and around the M12 Motorway including:
  - Realignment of Elizabeth Drive at the Western Sydney Airport, with Elizabeth Drive bridging over the airport access road and future passenger rail line to the airport
  - A realignment of Clifton Avenue over the M12 Motorway, with associated adjustments to nearby property access
  - Relocation of Salisbury Avenue cul-de-sac, on the southern side of the M12 Motorway
  - Realignment of Wallgrove Road north of its intersection with Elizabeth Drive to accommodate the M7 Motorway northbound entry ramp
- Adjustment, protection or relocation of existing utilities
- Ancillary facilities to support motorway operations, smart motorways operation in the future and the existing M7 Motorway operation, including gantries, electronic signage and ramp metering
- Other roadside furniture including safety barriers, signage and street lighting
- Adjustments of waterways, where required, including Kemps Creek, South Creek and Badgerys Creek
- Permanent water quality management measures including swales and basins
- Establishment and use of temporary ancillary facilities, temporary construction sedimentation basins, access tracks and haul roads during construction
- Permanent and temporary property adjustments and property access refinements as required.

The project overview presented in this document represents the proposed concept design. If the project is approved, a further detailed design process would follow, which may include variations to the concept design. Flexibility has been provided in the concept design to allow for refinement of the project during detailed design, in response to any submissions received following the exhibition of the environmental impact statement (EIS), or if opportunities arise to further minimise potential environmental impacts.

The key features of the project are shown on **Figure 1-2**.

1.3 Purpose and scope of this report

This report has been prepared to support the EIS for the project. The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364), as well as the Australian Government assessment requirements under the EPBC Act. The EIS for the project provides sufficient information to enable the NSW Minister for Planning and Public Spaces and the Commonwealth Minister for the Environment to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to impact non-Aboriginal heritage.

1.4 SEARs

On 18 June 2018, the Secretary of the NSW Department of Planning, Industry and Environment (Planning and Assessment) issued to Roads and Maritime the draft Secretary's environmental assessment requirements (SEARs) for the M12 Motorway EIS. The SEARS were finalised and reissued on 12 July 2018. The project was then determined to be a controlled action under the EPBC Act, and updated SEARs were issued on 30 October 2018 that include the Commonwealth assessment requirements under the EPBC Act. **Table 1-1** lists those requirements relating specifically to the assessment of the project's potential impacts on non-Aboriginal heritage, with a reference to the chapter or section of this report where each requirement is addressed.

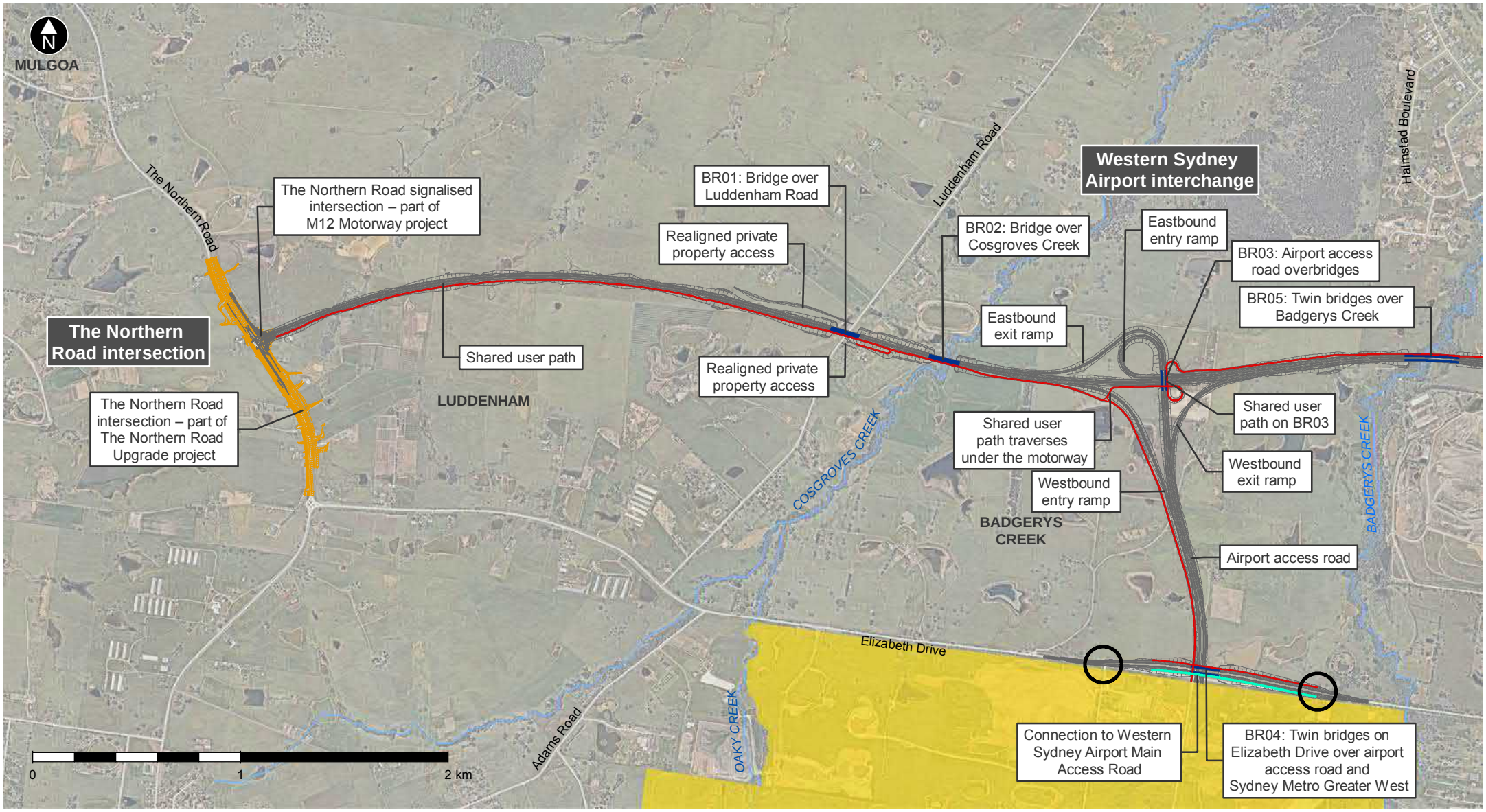

Figure 1-2 Key features of the project

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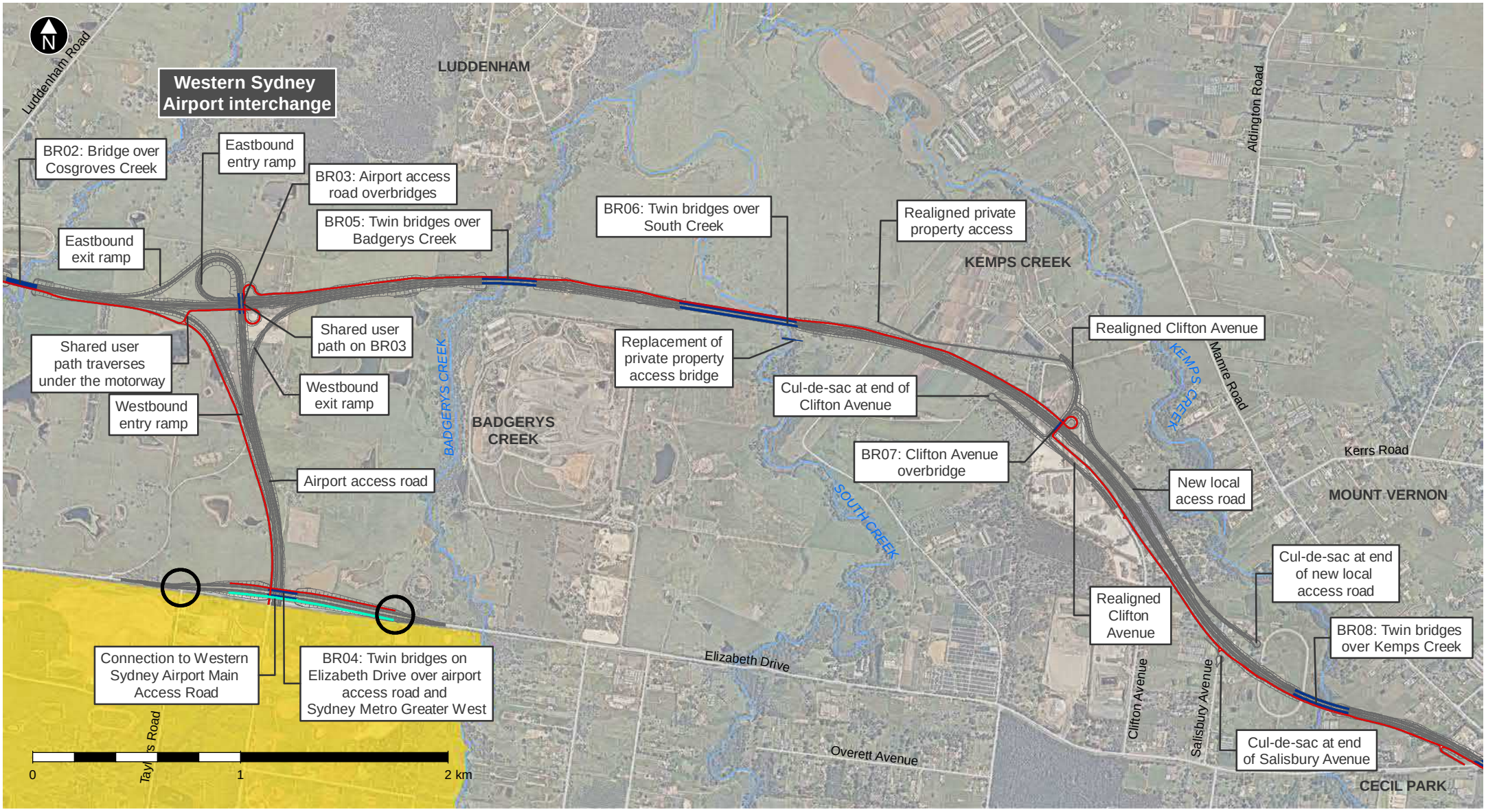


The project

Part of The Northern Road upgrade project

Shared user path

Future shared user path (by others)

Existing roads

Waterways

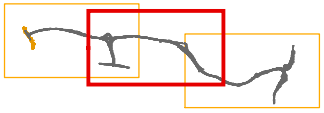
Bridges

Western Sydney Airport

Note. The roads within this zone are being removed as part of airport construction.

Potential future intersections (by others)

Note: Locations to be confirmed



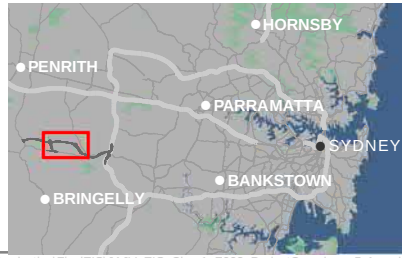


Figure 1-2 Key features of the project

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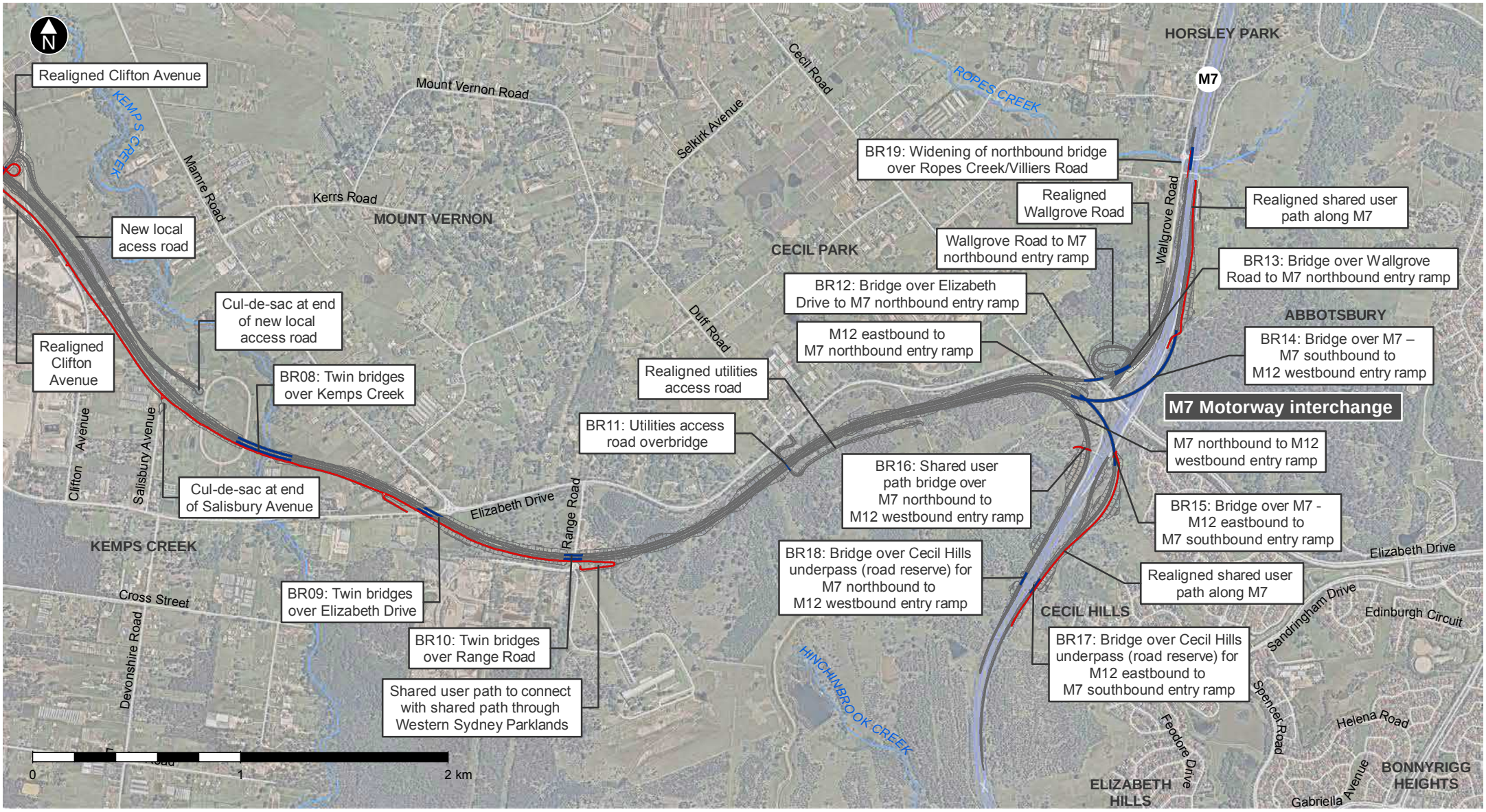


The project

Part of The Northern Road upgrade project

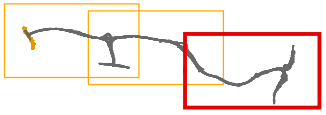
Shared user path

Future shared user path (by others)

Existing roads

Waterways

Bridges



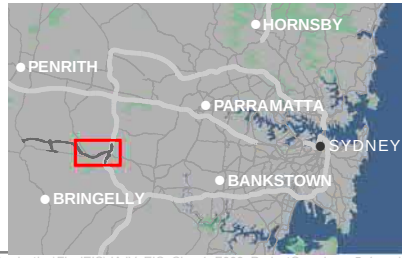


Figure 1-2 Key features of the project

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Table 1-1 SEARs - non-Aboriginal heritage

Secretary's requirement	Where addressed
5. Heritage	
1. The Proponent must identify and assess any direct and/or indirect impacts (including cumulative impacts) to the heritage significance of:	Direct and indirect impacts are identified and assessed in **Section 7, Section 8** and **Section 9.**
a. Aboriginal places and objects, as defined under the National Parks and Wildlife Act 1974 and in accordance with the principles and methods of assessment identified in the current guidelines;	Appendix I of the EIS
b. Aboriginal places of heritage significance, as defined in the Standard Instrument – Principle Local Environment Plan;	Appendix I of the EIS
c. environmental heritage, as defined under the *Heritage Act 1977*; and	**Section 3, Section 4, Section 5** and **Section 6**
d. items listed on the National and World Heritage lists.	There are no heritage items within the study area that are registered on the National and World Heritage lists. Refer to **Section 4.2.2.**
2. Where impacts to State or locally significant heritage items are identified, the assessment must: a. include a statement of heritage impact for all heritage items including the Fleurs Radio Telescope Site and the McGarvie-Smith Farm Site (including significance assessment);	Significance assessments and statements of significance are outlined in **Section 6**. Statements of heritage impact are outlined in **Section 8**.
b. consider impacts to the item of significance caused by, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, visual amenity, landscape and vistas, curtilage, subsidence and architectural noise treatment (as relevant)	Statements of heritage impact outlined in **Section 8** include listed impacts.
c. outline measures to avoid and minimise those impacts in accordance with the current guidelines; and be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria).	Proposed management measures are outlined in **Section 10.** Details of the qualifications of the heritage consultants undertaking this assessment are provided in **Table 3-2** and **Table 10-1.**
3. Where archaeological investigations of Aboriginal objects are proposed these must be conducted by a suitably qualified archaeologist, in accordance with section 1.6 of the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010c). In the event that harm to existing archaeological relics cannot be avoided, a Research Design and Excavation Methodology should be prepared to guide excavation works.	Appendix I of the EIS.
4. Where impacts to Aboriginal objects and/or places are proposed, consultation must be undertaken with Aboriginal people in accordance with the current guidelines. The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be assessed.	Appendix I of the EIS.

2. Policy and planning setting

2.1 State legislation

2.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that environmental impacts are considered in land-use planning, including impacts on Aboriginal and non-Aboriginal heritage. Division 5.2 of the EP&A Act applies for projects designated as State Significant Infrastructure. This influences the way in which other legislation, including the *Heritage Act* 1977 is applied.

2.1.2 Heritage Act 1977

The *Heritage Act 1977* provides a number of mechanisms by which items and places of heritage significance may be protected. The Act is designed to protect both listed heritage items, such as standing structures and potential archaeological remains or relics. Different parts of the Act deal with these different situations.

Approvals under Part 4 or an excavation permit under s139 of the Heritage Act are not required for an approved project under Division 5.2 of the EP&A Act, however, this assessment follows the intent of the Heritage Act and the conditions of the approval which are based upon the Heritage Act requirements.

State Heritage Register

The Heritage Council of NSW maintains the State Heritage Register (SHR). Only those items which are of state-level heritage significance in NSW are listed on the SHR. Listing on the SHR controls activities such as alteration, damage, demolition and development.

Approved projects to which Division 5.2 applies do not require approval under Part 4 of the *Heritage Act* 1977 (eg a Section 60 approval) for items on the SHR. However, Division 5.2 projects must outline proposed heritage management measures.

Archaeological relics

Part 6 Division 9 of the *Heritage Act 1977* protects archaeological 'relics' from being 'exposed, moved, damaged or destroyed' by the disturbance or excavation of land. This protection extends to the situation where a person has 'reasonable cause to suspect' that archaeological remains may be affected by the disturbance or excavation of the land. It applies to all land in NSW that is not included in the SHR. A 'relic' is defined by the *Heritage Act 1977* as:

> *"Any deposit, artefact, object or material evidence that (a) relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and (b) is of State or local heritage significance."*

Section 139 of the *Heritage Act 1977* requires any person who knows or has reasonable cause to suspect that their proposed works would expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to Section 140), unless there is an applicable exception (pursuant to Section 139(4)). In cases where a Section 139 permit is not required for projects assessed under Division 5.2 of the EP&A Act, works would need to be conducted in accordance with the intent of the Heritage Act.

Section 146 of the Heritage Act 1977 requires any person who is aware or believes that they have discovered or located a relic must notify the Heritage Council of NSW providing details of the location and other information required.

2.2 Commonwealth heritage legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) includes 'national heritage' as a matter of National Environmental Significance and protects listed places to the fullest extent under the Constitution. It also establishes the National Heritage List (NHL) and the Commonwealth Heritage List (CHL).

The following is a description of each of the heritage lists and the protection afforded places listed on them.

Commonwealth Heritage List

The CHL is established under the EPBC Act. The CHL is a list of properties owned by the Commonwealth that have been assessed as having significant heritage value. Any proposed actions on CHL places must be assessed for their impact on the heritage values of the place in accordance with *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies (Significant Impact Guidelines 1.2)*. The guidelines require the proponent to carry out a self-assessment process to decide whether or not the action is likely to have a significant impact on the environment, including the heritage value of places. If an action is likely to have a significant impact an EPBC Act referral must be prepared and submitted to the Minister for approval.

National Heritage List

The NHL is a list of places with outstanding heritage value to Australia, including places overseas. Any proposed actions on NHL places must be assessed for their impact on the heritage values of the place in accordance with Management of National Environmental Significance (Significant Impact Guidelines 1.1). The guidelines require the proponent to carry out a self-assessment process to decide whether or not the action is likely to have a significant impact on a matter of National Environmental Significance, including the national heritage value of places. If an action is likely to have a significant impact an EPBC Act referral must be prepared and submitted to the Minister for approval.

Register of the National Estate

The Register of the National Estate (RNE) was formerly compiled as a record of Australia's cultural and Aboriginal heritage places worth keeping for the future. The RNE was frozen on 19 February 2007, which means that no new places have been added or removed since that time. From February 2012 all references to the RNE were removed from the EPBC Act. The RNE is maintained on a non-statutory basis as a publicly available archive.

2.3 Relevant guidelines

2.3.1 Guidelines and Policies

The non-Aboriginal heritage impact assessment addresses archaeology, heritage items and conservation areas, in accordance with the following guidelines:

- Australia ICOMOS Charter for Places of Cultural Significance (Burra Charter) (Australia ICOMOS, 2013)
- Statements of Heritage Impact (Heritage Office and Urban Affairs and Planning 1996, revised 2002)
- NSW Heritage Manual (Heritage Office and Urban Affairs and Planning, 1996)
- Roads and Maritime Cultural Heritage guidelines (Roads and Maritime, 2015)
- Assessing Heritage Significance (Heritage Office, 2001)
- Criteria for the assessment of excavation directors (NSW Heritage Council, 2011).

3. Assessment methodology

3.1 Overview

The term 'heritage item' is used throughout this report to indicate any non-Aboriginal historical heritage place including buildings, structures, and archaeological remains. Each heritage item is individually numbered but may include either a single component or multiple components making up a broader complex with direct historical and cultural associations.

The overall approach to the non-Aboriginal heritage assessment comprised identifying heritage items within and adjacent to the study area through a review of previous heritage studies, searches of relevant heritage registers and schedules, and by undertaking field survey. The significance of each heritage item was assessed in accordance with the NSW Heritage Office (2001) guidelines and the *Australia ICOMOS Charter for Places of Cultural Significance 2013* (The Burra Charter) (Australia ICOMOS 2013).

The potential impacts of the project on each heritage item were then assessed, both for direct and indirect impacts including impacts from vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment. A Statement of Heritage Impact (SOHI) was prepared in accordance with NSW Heritage Office (1996) guidelines for each heritage item where impacts would occur. Appropriate management measures were identified to avoid, minimise and manage impacts to each heritage item. This methodology was applied to the construction and operational aspects of the project. The assessment was carried out by a team of suitably qualified heritage consultants under the direction of Dr Karen Murphy (Technical Director, Archaeology and Cultural Heritage, Jacobs). A description of the team's qualifications is provided in **Section 3.6**.

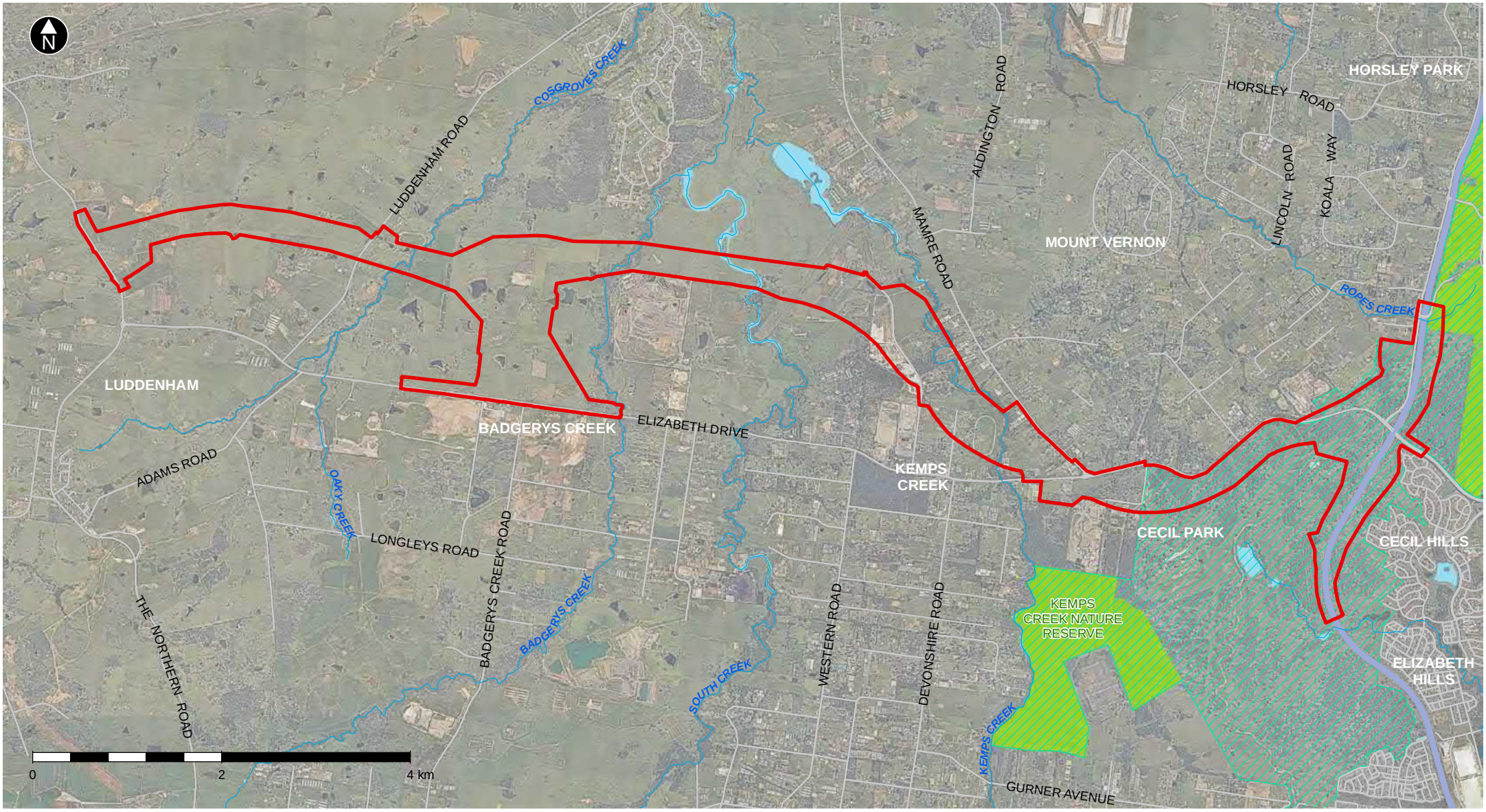
A separate assessment for the Fleurs Radio Telescope site was undertaken, at the request of Roads and Maritime. This was undertaken by Dr Alice Gorman (Wallis Heritage Consulting). The results of that assessment are summarised within this report, and the full assessment report provided at **Annexure A**.

The detailed steps of the assessment approach are as follows:

- Review relevant heritage legislation
- Search of all available historical heritage registers for the study area. The full list is provided in the following section.
- Collate any known heritage curtilage (boundary) information as part of the heritage searches
- Complete a literature review including previous archaeological reports, historical heritage studies, local heritage studies, conservation management plans, as well as regional and local history documents and maps where available
- Prepare summary contextual history
- Develop a predictive model for occurrence of historical site types in the landscape, including the use of historical and modern aerial imagery, and apply this to the study area to identify priority areas for field survey
- Carry out field survey of the identified priority areas to inspect known historical heritage items, identify previously unidentified historical heritage items and assess potential for historical archaeology
- Provide a list of historical heritage items and features located within or adjacent to the study area
- Complete targeted survey to record identified historical heritage items, identify previously unidentified historical heritage items and determine heritage curtilages. This includes archaeological test excavations of a former historical complex identified in Cecil Park (**Annexure B**)
- Prepare SoHI (including assessments of significance) for all historical heritage items potentially impacted by the project
- Recommend management measures.

3.2 Study area

This assessment has investigated items and sites of potential heritage significance likely to be impacted by the project. The study area is shown in **Figure 3-1** and comprises primarily a rural (peri-urban) landscape with some urban, commercial and industrial developed areas. While this report identifies known heritage items across a wider area (see **Section 4.2** and **Figure 4-7**), the statements of heritage impact focus on the study area illustrated in **Figure 3-1**.



Study area
Western Sydney Parklands
Waterways
NPWS estate / reserves
Motorway
Main roads

Figure 3-1 Location of the study area

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3.3 Desktop assessment

A search of all available non-Aboriginal heritage registers was carried out to identify heritage items within or immediately next to the study area. The following registers were searched using a combination of online databases and where available using spatial data in Global Information System format by Andrew Wilkinson (Project Archaeologist, Jacobs) on 5 October 2017 and again on 21 August 2018 by Deborah Farina (Senior Heritage Consultant, Jacobs):

- NSW State Heritage Inventory (SHI)
- SHR
- Section 170 Registers (on SHI)
- National Trust Register (NTR)
- Register of the National Estate (RNE)
- Commonwealth Heritage List (CHL)
- National Heritage List (NHL)
- World Heritage List (WHL)
- Fairfield Local Environmental Plan 2013 (Fairfield LEP)
- Liverpool Local Environmental Plan 2008 (Liverpool LEP)
- Penrith Local Environmental Plan 2010 (Penrith LEP).

The desktop assessment also included a review of previous heritage assessment and local heritage studies to identify previously identified, unregistered heritage items. A review of aerial imagery was also undertaken to identify the potential for previously unidentified heritage items in the study area.

3.4 Site investigations

Prior to undertaking the field survey, priority areas were identified using background information including aerial images, the predictive statement for historical site types, previous studies and field surveys, and historical heritage register listing. This provided a summary of target areas for survey.

The field survey was carried out between 13 and 17 November 2017 and between 26 February and 2 March 2018 by Jennifer Chandler (Senior Archaeologist, Jacobs) and Andrew Wilkinson (Project Archaeologist, Jacobs). An additional round of surveys was undertaken by Deborah Farina (Senior Archaeologist, Jacobs), Fiona Leslie (Principal Archaeologist, Jacobs) and Chelsea Jones (Graduate Archaeologist, Jacobs) between 30 July 2018 and 1 August 2018. A final survey was undertaken for properties previously unable to be accessed by Deborah Farina (Senior Archaeologist, Jacobs) on 7 March 2019.

The study area was inspected on foot where grass was not long and permission to access the property had been given. Some vehicle survey was also carried out where grass was long and/or the property was large in size. Photographs were taken of each survey area and notes made regarding relevant description and condition details. Mapping of features located during the survey was carried out using a Differential Global Positioning System (DGPS) Unit (Trimble® GeoXH™ GeoExplorer®) using GDA94/MGA55 for Eastings and Northings.

A separate field survey was undertaken for the Fleurs Radio Telescope site, at the request of Roads and Maritime. Prior to undertaking the field survey, background research was undertaken by Dr Alice Gorman (Wallis Heritage Consulting) for historical site information, previous studies and field surveys, and historical heritage register listing. This provided a summary of target areas for survey.

The survey of the Fleurs Radio Telescope site consisted of pedestrian and vehicle transects over the area. The aim was to identify remains of the three arrays and any other associated infrastructure and artefacts. Mapping of features located during the survey was carried out with a hand-held Garmin GPS unit. Each feature was photographed and documented with a description.

The survey started from the antenna complexes on South Creek, identified Shain Cross elements and recorded the North Fleurs Synthesis Telescope (FST) antenna, followed by pedestrian transects on the Kemps Creek side of the site. The instrumentation buildings and associated rubbish mounds were then recorded. A detailed recording of rubbish mound contents was unable to be undertaken due to time constraints. Further information on the Fleurs Radio Telescope site field survey is provided in **Annexure A**.

Archaeological test excavation of the former Cecil Park historical complex was conducted over a five day period from 1 to 5 July 2019 by a small team of archaeologists, including the Excavation Director (Fiona Leslie, Jacobs Principal Archaeologist) two assistant archaeologists (Deborah Farina, Jacobs Senior Archaeologist; Clare Leevers, Jacobs Archaeologist) and an experienced site planner (Kerry Platt, Jacobs). The results of this investigation are summarised in this report and a copy of the full excavation report is provided in **Annexure B**.

3.5 Assessment of significance

The concept of cultural heritage significance helps in estimating the value of places. Places which are likely to be significant are those which 'help an understanding of the past or enrich the present, and which would be of value to future generations' (Australia ICOMOS, 2013). In Australia, the significance of a place is generally assessed according to the following values:

- Aesthetic value
- Historic value
- Scientific value
- Social value.

The NSW Heritage Council has adopted specific criteria for heritage assessment, which have been gazetted pursuant to the *Heritage Act 1977*. The seven criteria upon which the following assessment of significance is based are outlined below:

- Criterion (a) an item is important in the course, or pattern, of NSW cultural or natural history
- Criterion (b) an item has strong or special association with the life or works of a person, or group or persons, of importance in NSW cultural or natural history
- Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW
- Criterion (d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons
- Criterion (e) an item has potential to yield information that would contribute to an understanding of NSW cultural or natural history
- Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW cultural or natural history
- Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW cultural or natural places or cultural or natural environments.

Components of the NSW Heritage Manual, published by the NSW Heritage Office and Department of Urban Affairs and Planning (NSW Heritage Office 2001) (now the Department of Premier and Cabinet (Heritage) (DPC (Heritage)), sets out a detailed process for conducting assessments of heritage significance. These guidelines have also been used to conduct the significance assessment outlined in **Section 6**.

3.6 Impact assessment

3.6.1 Level of impact

The level of impact on the heritage significance of each heritage item in the study area has been assessed based on the definitions and framework for assessing severity of impacts from the EPBC Act Significant impact guidelines 1.2 (Department of Sustainability Environment Water Population and Communities 2013) as there are currently no NSW or other guidelines for identifying the level of impacts on heritage places.

The following criteria were used to assess the level of impact:

- The scale of the proposed works and its impacts
- The intensity of the proposed works and its impacts
- The duration and frequency of the proposed works and its impacts.

The levels of impact used in this assessment are defined in **Table 3-1**. For impacts to meet a certain level they generally need to have two or more of the characteristics noted. The level of impact assigned to each heritage item is based on the level assessed following implementation of management measures.

Table 3-1 Definitions of levels of impacts

Two or more characteristics	Scale	Intensity	Duration/Frequency
Major	Medium – large	Moderate – high	Permanent / irreversible
Moderate	Small-medium	Moderate	Medium – long term
Minor	Small / localised	Low	Short term / reversible
Negligible	Little or no physical impact; or little or no impact on heritage significance from physical impacts; or potential physical impacts are able to be prevented through implementation of management measures (eg vibration).		

3.6.2 Statements of heritage impact

A SOHI is used to identify what impact the project would have on the heritage items identified in the assessment. A SOHI, together with supporting information, addresses:

- Why the item is of heritage significance
- What impact the proposed works would have on that significance
- What measures are proposed to mitigate negative impacts
- Why more sympathetic solutions are not viable (NSW Heritage Office 2002).

A SOHI has been prepared for each State or locally significant heritage item impacted by the project in accordance with the NSW Heritage Office (2002) *Statements of Heritage Impact guidelines*, except for those heritage items that are located in the study area but would not be impacted.

3.7 Authorship

This assessment has been prepared by Jennifer Chandler (Senior Archaeologist, Jacobs), Deborah Farina (Senior Heritage Consultant, Jacobs), Andrew Wilkinson (Project Archaeologist, Jacobs) and Clare Leevers (Archaeologist, Jacobs) with a separate assessment of the Fleurs Radio Telescope site provided by Dr Alice Gorman, and a separate archaeological assessment, research design and test excavation of the Cecil Park historical complex prepared by Fiona Leslie (Principal Archaeologist, Jacobs). Mapping was prepared by Ajay Arcot (Senior Spatial Consultant, Jacobs). Supervision of the assessment and technical review of the deliverables was undertaken by Dr Karen Murphy (Technical Director, Archaeology and Cultural Heritage, Jacobs). The qualifications of each heritage consultant are provided in **Table 3-2**, overleaf.

Table 3-2 Heritage consultants undertaking this assessment

Name	Qualifications	Role
Dr Karen Murphy	PhD (Historical Archaeology) Bachelor of Arts (Honours) (Archaeology)	Management and direction of overall assessment Technical review of report
Jennifer Chandler	Master of Cultural Heritage Bachelor of Archaeology (Honours) Honours thesis: Historical heritage	Field survey Writing and preparation of report
Andrew Wilkinson	Bachelor of Archaeology	Field survey Writing and preparation of report
Deborah Farina	Bachelor of Arts (Honours) (Archaeology and Palaeoanthropology)	Field survey Research Writing and preparation of report
Fiona Leslie	Bachelor of Science (Plant Ecology), Bachelor of Arts (Honours) (Historical and Prehistorical Archaeology)	Field survey Writing and preparation of report – Cecil Park Historical Complex Archaeological Assessment, Research Design and Test Excavation
Dr Alice Gorman	PhD (Archaeology)	Field survey, research, writing and preparation of report – Fleurs Radio Telescope site
Clare Leevers	Bachelor of Archaeology Graduate Diploma Archaeology	Background research Writing and preparation of report

4. Existing Environment

4.1 Historical context

The study area traverses several regions with association to the agricultural practices of early settlers to the west of Sydney. An overview of the historical context of these regions is provided in the following sections.

4.1.1 Settlement west of Sydney

The poor sandstone soils of the Sydney Cove area encouraged exploration seeking better agricultural conditions west of Sydney, and by 1788 Europeans had settled around Parramatta. In 1789 Governor Phillip and Lieutenant Watkin Tench travelled further west where Governor Phillip discovered the Hawkesbury River, and Tench discovered the Nepean River which flows north into the Hawkesbury River. The Nepean follows the base of Blue Mountains and is west of the study area. The alluvial plains east of the Nepean River were described by early surveyors as favourable soil for farming, and towns were established at Richmond and Windsor, along the Hawkesbury River in the early 1790s. Settlement to the south on the Cumberland Plain was established progressively after this with Penrith and Liverpool established by 1818 (Morris and Britton 2000:14).

Although initial settlement appeared to occur largely unchecked, later land surveys began to formalise the settlement process through land grants. Governor King reported in 1801 that the Hawkesbury-Nepean agriculture region provided the primary supply of grain to the Sydney colony. The land potential was not fully assessed and by 1804 Governor King had set aside much of it as commons and or for stock. In 1806, 3300 acres of land was granted to Major George Johnson (“King’s Gift”, later “Horsley”) and Captain Edward Abbot (“Abbotsbury). in what is now known as Fairfield. These grants were made by Governor King in recognition of Johnson’s and Abbot’s roles in the Vinegar Hill uprising in 1804.

4.1.2 Early land grants

The original grants of land in the study area are depicted on early Parish maps. Elizabeth Drive forms the southern boundary of two of those parishes, being Melville (eastern end of study area) and Claremont (western end of study area). The parish maps are crucial in understanding settlement patterns of the study area, as well as providing important information on the people who settled it.

In the early colonial years, all free settlers and ex-convicts were entitled to a land grant, provided they were “of good conduct and disposition to industry”. Each male was entitled to 30 acres with an additional 20 acres provided if he was married, and 10 acres per child at the time of the grant (New South Wales Archives, undated). Larger grants were therefore made to free settlers and ex-military officers.

In both parishes, the majority of the land grants were made by Governor Macquarie, often as either rewards for good deeds or as incentives to newly arrived settlers. The grantees within the study area became pioneers of both the area and the colony in general.

4.1.3 Development of villages and settlements

As Sydney expanded the pressure for residential land increased. Large holdings began to subdivide to make way for smaller agricultural lots. These smaller lots began to develop into settlements and eventually, villages and suburbs.

Luddenham

In 1807 John Blaxland, a wealthy land owner and merchant, migrated from Kent in England to the new colony on a promise of investing £6000 in return for free passage and freight, 8000 acres of land and 80 convicts (JCIS Consultants 2017:5). On arrival in New South Wales (NSW) Blaxland took up cattle, rather than the government preference of agriculture (Irving 1966). Blaxland was not initially given the full entitlements promised to him, prompting a disagreement with Governor Bligh. He also had difficulty in establishing and maintaining business relationships for a number of ventures. He returned to England in 1808 to petition the parliament for the balance of that promised to him, returning in 1812 with a written assurance the original agreement was to be honoured. Some land was finally granted to him, although other demands he made that were at odds with the vision for the colony were not (Irving 1966).

In 1813, Blaxland was granted land on South Creek which he named *Luddenham* after his home village in England. This land also covered part of present day Badgerys Creek and Wallacia. While some of the land was used to establish Blaxland's business enterprises the majority was retained for grazing. In 1840 Blaxland's eldest son John M Blaxland (Jnr) died and the property was administered by, but remained separate to, *Luddenham Estate*. Blaxland (Snr) died in 1845, and in 1851 the land was sold to Sir Charles Nicholson. In 1858 the land was surveyed and subdivided (JCIS Consultants 2017:8)

The Village of Luddenham was a private village comprising a number of buildings associated with agricultural and pastoral purposes. Those still situated within the study area include sheds (Lot 506 DP 587193), and a weatherboard house and Old Dairy, Luddenham (Lot 502 DP 580982, 2787 Northern Road). Other buildings which had been established at the Village after 1859 included a Chapel, School and Lawson's Store and Inn (Stuart and Cummins-Stuart 2017). These other buildings were situated south of the current study area.

Badgerys Creek

James Badgery and his wife Elizabeth arrived in Sydney in 1799 where he leased property for a bakery, and 11 acres of land along the Hawkesbury River for intensive farming. In 1803 Badgery was granted 100 acres on the Hawkesbury River, however the floods of 1806 forced him to seek property elsewhere. Although he initially sought 840 acres, Badgery was eventually granted 640 acres between South Creek and what is now known as Badgerys Creek, north of present-day Elizabeth Drive. Elizabeth Drive began as a roadway to access the land grants in the area and was a 'corduroy' road (built with logs laid across the road).). Elizabeth Drive was originally named Orphan School Road and later Mulgoa Road. Badgery's farm was named Exeter Farm after his home town in England (refer to **Figure 4-1**). Over subsequent years the Badgery family extended the holdings of Exeter Farm by acquiring properties south of Elizabeth Drive. James Badgery was also granted a large parcel of land in the Southern Highlands and named that holding "Exeter" as well, with the local village eventually taking the same name (Liverpool City Council, 2007).

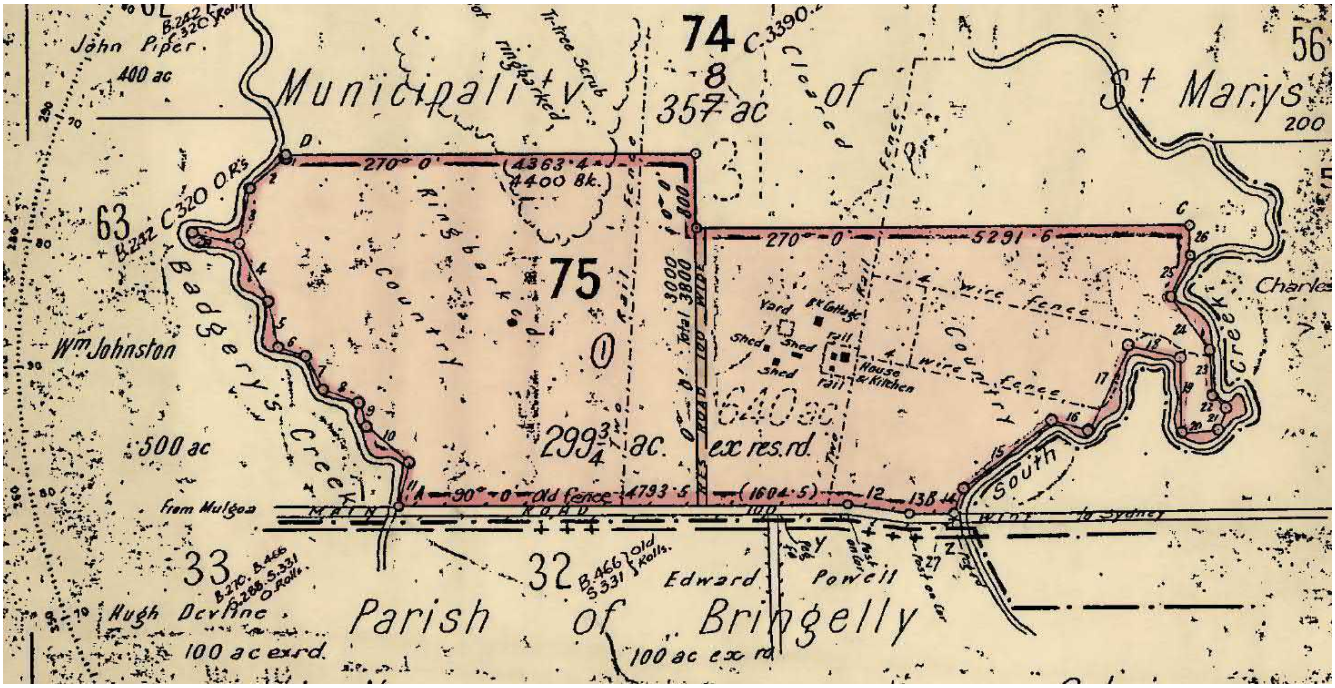


Figure 4-1 Detail of Crown Plan showing Exeter Farm buildings, c.1920

Source: Land & Property Information, Crown Plan C3391-2030

In the 1880s, the Luddenham Estate was opened for subdivision. In the 1890s the Badgery lands south of Elizabeth Drive were also subdivided into smaller lots, known as the Exeter Farms subdivision. The subdivisions of these two large holdings opened the area for smaller farms that carried out a variety of activities which included fruit orchards, dairy farming, bee keeping, poultry farming and timber getting. With the rise in population came the need for more services. A village was planned south of Elizabeth Drive between Badgerys Creek and South Creek, known as the Exeter Farms subdivision (refer to **Figure 4-2**), however this never eventuated, possibly owing to the gradual growth of the nearby village of Badgerys Creek.

Services established at Badgerys Creek included a butchers' shop in 1842, a school in 1895, as well as post office and general store. A Methodist Church (built 1898) and Anglican Church (built 1912) were also built at Badgerys Creek at the instigation of local community members (RPS Manidis Roberts 2015:31). These buildings that made up Badgerys Creek village were demolished following the resumption of land for the construction of the Western Sydney Airport.

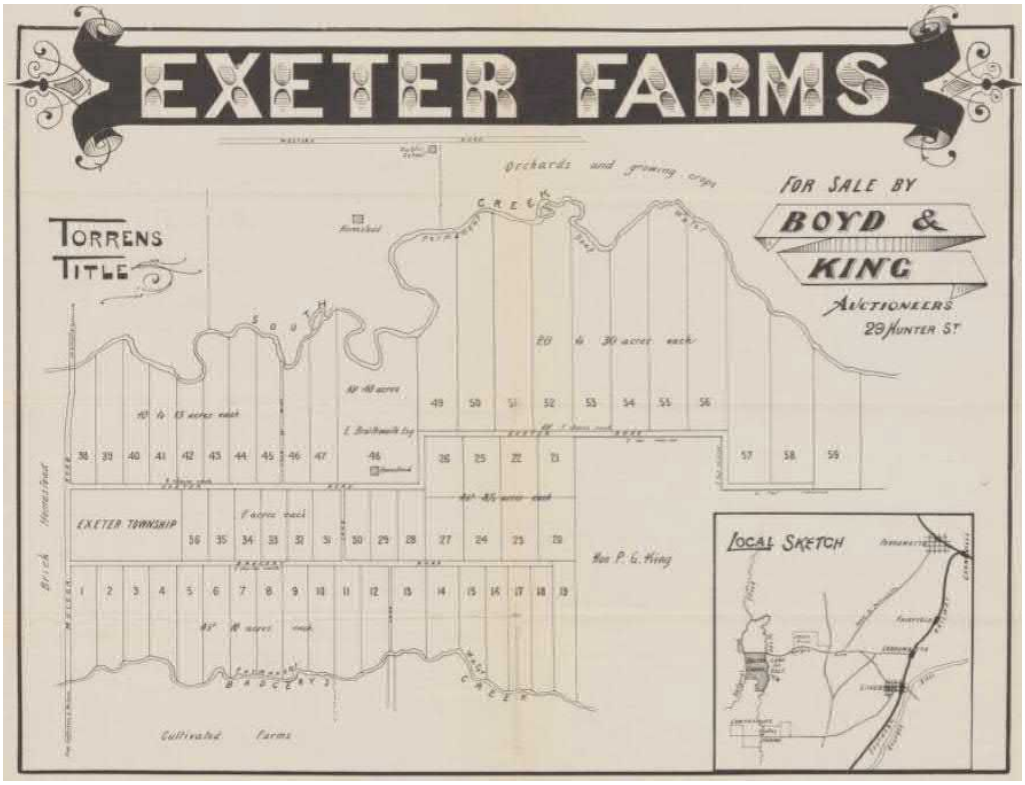


Figure 4-2 Subdivision of Badgery's lands south of Elizabeth Drive, c.1890

Courtesy: National Library of Australia

Kemps Creek and Mount Vernon

In 1809, Anthony Fenn Kemp, a soldier in the NSW Corps and a merchant, received an initial grant of 500 acres of land in the Parish of Cabramatta, on the eastern side of Kemps Creek. This was augmented by a further grant of 300 acres in 1820. Kemp had visited the United States in his younger years and had met General George Washington. This meeting left a lasting impression and he developed an admiration for General Washington, naming his grant "Mount Vernon" after Washington's home (Browne 1930:9). Mount Vernon comprised steep slopes, contrasting with the surrounding flatter regions to the north and west (Paul Davies Pty Ltd 2007:164). Initial industry in the surrounding area focused on wheat and timber getting, however, later market gardens and fruit orchards developed on smaller farm properties. Kemp eventually sold up and moved to Tasmania where he died in 1868.

Kemp received his grant after siding with Colonel George Johnson in the deposition of Governor William Bligh, commonly known as the "Rum Rebellion". When Johnson was court-martialled back in London, Kemp travelled there to appear as a witness on behalf of Johnson. As with many land grants made during the rebel Government under Colonel Johnston, some of Kemp's land grants were cancelled following Macquarie's arrival.

Initial industry in the surrounding area focused on wheat and timber getting, however, large land holdings, such as Mount Vernon, were subdivided into smaller lots in the late 19th century. These smaller lots held market gardens and fruit orchards. One such subdivision was known as Amy Park, and involved lands south of Elizabeth Drive in the vicinity of the current village of Kemps Creek (**Figure 4-3**).

Figure 4-3 Subdivision Plan of Amy Park, c.1882
Courtesy: State Library of New South Wales

The first school in the Kemps Creek area was a 17 feet by 14 feet timber structure built in 1885. Six schools have since serviced the Kemp Creek community, with the last one built in Cross Street. In 1908, the foundation stone was laid for the St Andrews Church, and a post office opened in 1927. Although the Kemps Creek area remains largely rural, a number of small shops and commercial businesses can be found in the area today. Residential development of Mount Vernon dates to after 1970 with no extant historical buildings remaining (Paul Davies Pty Ltd 2007:164).

Cecil Park/Cecil Hills

In 1817 Governor Macquarie made a 1,000-acres grant to Thomas Wylde, known as “Macquarie Park” on the northern side of Elizabeth Drive and west of present day Wallgrove Road (**Figure 4-4**). The following year Macquarie appointed Wylde as Clerk of the Peace and Solicitor to the Crown (Watson 1917:493). Thomas Wylde’s grants now comprise the suburb of Cecil Park, located in the eastern portion of the study area, as well as a small portion of a 200-acres grant made to Simeon Lord, a well-known convict-turned-merchant. Macquarie also made a grant of 2000 acres in the Parish of Cabramatta to Wylde’s son, Sir John Wylde, who was at the time the Judge Advocate. Sir John Wylde’s grant was named “Cecil Hills” and now comprises the suburb of that name. The Cecil Hills grant was located opposite Wylde Snr’s grant, with Elizabeth Drive forming its northern boundary.

Thomas Wylde died in 1821 and his land interests passed to his son. The Wylde family held the land at Cecil Park/Cecil Hills until the late 1800s when it was purchased and subdivided, first into large lots in 1886 (**Figure 4-5**) then into smaller rural lots in 1906 (**Figure 4-6**) (Primary Application 8326). In **Figure 4-6,** the areas shaded dark grey represent sold lots. The approximate location of the school and post office is circled in red

As with other villages in the study area, as land holdings became smaller the population grew necessitating an increase in services. A school had opened on Elizabeth Drive near the intersection with Wallgrove Road by 1898, at which time residents were petitioning the government for new school buildings. A post office opened in 1897 and was run by the school master, Mr William Flood. A school church was opened to the east of the post office in 1903.

A newspaper article in 1938 describes the locality as follows:

> *Cecil Park is situated nine miles out of Liverpool. It is a very small place, with a post-office and a public school. The public school holds about 25 pupils. The dance hall is almost next to the school, and dances are held here every Saturday night. The people of Cecil Park go in mostly for poultry farming, but some have orchards and cattle. There is a sheep station also. Altogether, Cecil Park is a very lovely place."* (The Sun, 1938:3)

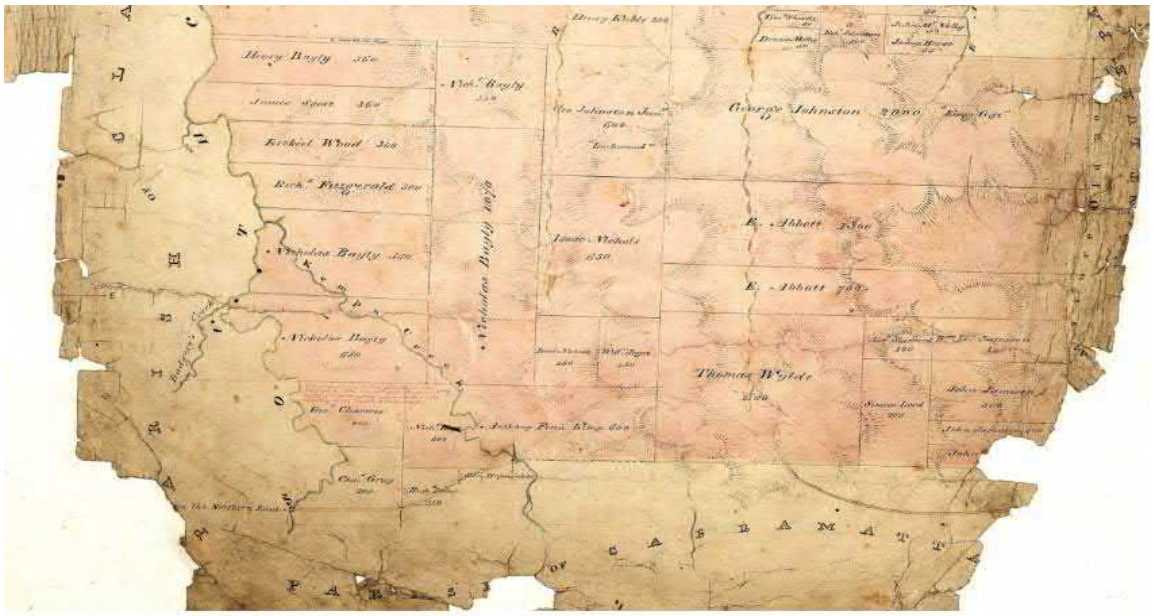


Figure 4-4 Parish of Melville, County of Cumberland map showing Thomas Wylde's land holdings in Cecil Park
Source: A.O. Map no. 331, date unknown

Figure 4-5 Early subdivision plan for Cecil Park, c.1886. Approximate location of school and post office circled in red
Courtesy: State Library of New South Wales

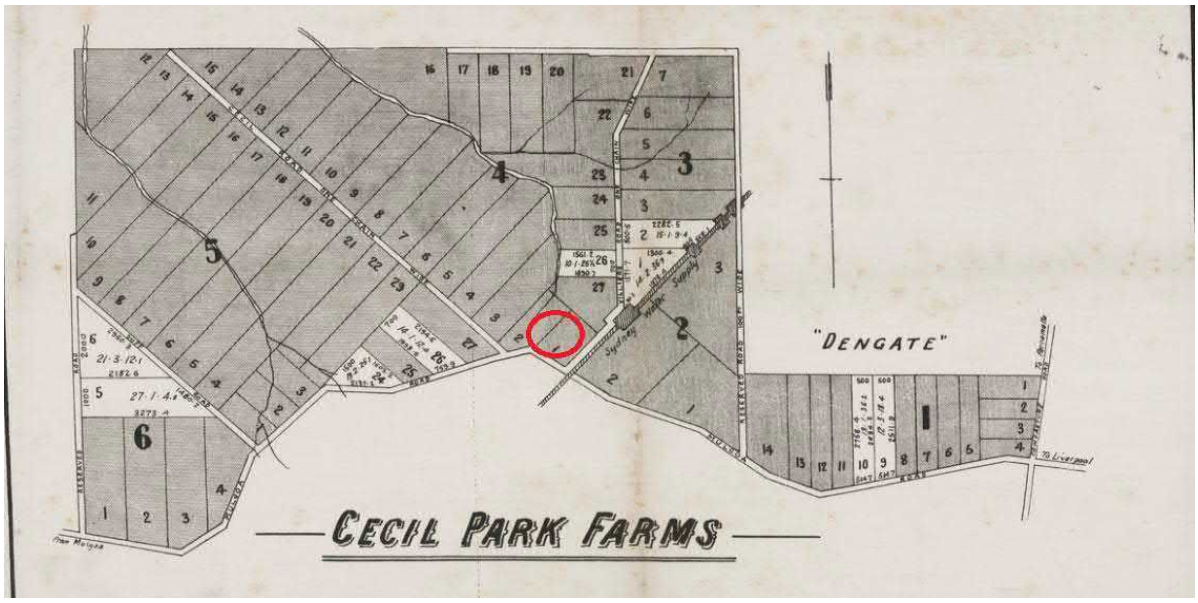


Figure 4-6 Further subdivision of Cecil Park, c.1906.
Courtesy: State Library of New South Wales

4.2 Heritage context

4.2.1 Previous heritage assessments

M12 Motorway: Strategic Route Options Analysis, Heritage Working Paper (Aurecon 2016)

Aurecon Australasia Pty Ltd was engaged by Roads and Maritime to complete a strategic route options analysis for the M12 Motorway between the M7 Motorway, Cecil Park and The Northern Road, Luddenham. The Aurecon study area encompasses the current study area.

During their investigation, ten non-Aboriginal heritage items were identified within Aurecon's M12 Motorway strategic study area, and eight heritage items were identified close to their study area boundaries.

The following registered heritage items (all listed on statutory registers) identified in the route options analysis are situated wholly or partly within the study area as described in **Section 3.2** and mapped in **Figure 3-1**:

- Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
- Luddenham Road Alignment
- Sydney University McGarvie Smith Farm
- Site of the former Fleurs Radio Telescope arrays.

Although two previously identified non-Aboriginal sites, within the shortlisted route options, were related to the Upper Canal System (Pheasants Nest Weir to Prospect Reservoir), these were not inspected during the site survey. The Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) was assessed as meeting the threshold for State level significance (Aurecon 2016:79).

Investigation of the McGarvie Smith Farm indicated that a number of standing structures and earthworks were present on the site. Two structures are of composite construction and similar in architectural design suggesting 1930 to 1950 construction. The site was assessed as being significant in the history of animal husbandry and pastoral experimentation at both a state and national level.

The Luddenham Road alignment was not directly inspected during the field survey. It was assessed as having low historical significance at a local level.

The southernmost extent of the Fleurs Radio Telescope site was inspected in the study. One telescope dish was located within the northernmost option. Limited access prevented further inspection of additional elements and the condition of inspected structures indicated the integrity of the site had been compromised. Further archaeological and historical research of the Fleurs Radio Telescope site was recommended.

Ten items of potential non-Aboriginal heritage value were also investigated. After a strategic review of route options, the study area was further refined. Seven of these are within, or immediately adjacent to, the current study area and are listed in **Table 4-1**.

The study also investigated a number of landscapes identified in previous heritage assessments as having heritage value (Aurecon 2016:29). These landscapes included themes of radiophysics, animal husbandry and military defence (Aurecon 2016:78) Two of these heritage landscapes are within, or immediately adjacent, to the current study area and are listed in **Table 4-2**. The study included landscapes with values related to ecology/biodiversity. These landscapes are not further assessed in this Non-Aboriginal heritage assessment as only those landscapes with cultural or natural heritage values (such as aesthetics, etc) are addressed here.

Direct citations shown in italics in **Table 4-1** and **Table 4-2.**

The Northern Road Upgrade – Mersey Road to Glenmore Parkway (Chandler and Waller 2017)

Jacobs was commissioned by Roads and Maritime to complete a non-Aboriginal heritage assessment for the EIS for The Northern Road Upgrade from Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park. The assessment included a desktop study and field survey of The Northern Road alignment which includes the western portion of the M12 Motorway study area.

One registered heritage item that was identified in The Northern Road study area was Lawson's Inn site (Liverpool LEP 53), about four kilometres south of the current M12 study area. One additional heritage item, Miss Lawson's Guesthouse, located opposite Lawson's Inn, was identified and assessed to be of significance. Two additional heritage items along The Northern Road were identified and assessed for heritage values, with historical research prepared by Dr Iain Stuart and Jane Cummins-Stuart (2017) of JCIS Consultants. These two potential heritage items – Weatherboard House, Slab Hut and Old Dairy (2787 The Northern Road), and Weatherboard House and Sheds (2825 The Northern Road) – 2825 and 2787 The Northern Road Luddenham – are adjacent to the western portion of the M12 Motorway study area but were assessed as not being of heritage significance at either a local or State level. Other registered or potential heritage items identified during the assessment for The Northern Road EIS, are not located in proximity to the M12 Motorway study area and are not discussed here.

Western Sydney Airport Gateway, Badgerys Creek Planning Proposal Submission: Non-Aboriginal Heritage Desktop Assessment (Roberts 2016)

The University of Sydney engaged Jacobs (Roberts 2016) to complete a non-Aboriginal heritage desktop assessment of the Western Sydney Airport Gateway, Badgerys Creek. The study area included the University of Sydney property north of the proposed Badgerys Creek Airport that comprises part of the current M12 study area.

The study identified three non-Aboriginal heritage items of local significance, being the WWII airstrip (Fleurs Aerodrome), the Fleurs Radio Telescope site and the McGarvie-Smith Farm. The Fleurs Radio Telescope site and the McGarvie-Smith Farm have been identified as being of local heritage significance and are registered on the Penrith LEP (2010). The study concluded that the assessed area was likely to have a low potential for previously unidentified non-Aboriginal heritage due to the high degree of previous research completed in the area (Roberts 2016:20). Details of the three heritage items are provided in **Table 4-3**.

Table 4-1 List of potential non-Aboriginal heritage items identified in 'M12 Motorway: Strategic Route Options Analysis' (Aurecon 2016) within the current study area

Item name	Lot/DP number	Proximity to study area	Description and significance
Cottage 1918	Lot B DP 102214	Curtilage intersects	Cottage and sheds. The significance of the cottage does not appear to have been assessed in the study.
Cecil Park Public School 1906	Lot 1 DP 724970	Intersects	*No standing structures remain, although there is the potential for archaeology on this site* (Aurecon 2016:63).
Standing Structure	Lot 6 DP 629798	Intersects	*There is evidence on a 1906 reconnaissance map for the Liverpool Army Camp and an aerial photograph from 1930 indicating that there was a structure/dwelling within the general area of this location. The current building site may not relate to that of the structure indicated in 1906. There is potential for subsurface archaeological deposits to be present at the site of the 1906 structure. If such remains have a nineteenth to early twentieth century origin, they may have a local level of significance* (Aurecon 2016:71). Access to the property of the Standing Structure was not granted at the time therefore it was not assessed for archaeological potential.
Structure	Lot 26 A DP387529	Intersects	*There is evidence on a 1906 reconnaissance map for the Liverpool Army Camp and an aerial photograph from 1930 indicating that there was a structure/dwelling in this general location. Contemporary aerial photography indicates that the structure in question no longer exists and that a modern residence exists in the same general area. It is noted on Google Earth 2005 imagery (1 October 2005) that a dwelling and associated structures are situated between the Standing Structure and the Structure, up until its demolition around 2006. This structure had a hipped gable roof. It is possible that this was the structure identified from the historic plan and aerial photograph. The allotment on which this dwelling was located no longer contains stranding structures and there has apparently been little disturbance since its demolition. If archaeological traces of former nineteenth to early twentieth century structures remain, they may have a local level of significance. This site may have potential archaeological significance at a local level* (Aurecon 2016:71). Access to the property of the Structure was not granted at the time therefore it was not assessed for archaeological potential.
South Creek Bridge	Lot 21 DP 258414	Intersects	*The South Creek Bridge located downstream of the road crossing on Elizabeth Road, the main thoroughfare, indicates a means of crossing between properties over the creek away from the main transport infrastructure. It is not the only example of this kind of crossing along South Creek. The South Creek Bridge has historical significance, as it represents an early means of fording the waterways separating properties. Its condition, however, renders it minimal to low in its value* (Aurecon 2016:105).

Item name	Lot/DP number	Proximity to study area	Description and significance
McMaster Farm	Lot 101 DP848215	Intersects	*The McMaster Farm, an experimental enterprise by Commonwealth Scientific and Industrial Research Organisation (CSIRO) in the 1930s, is associated with the University of Sydney's F.D. McMaster Building (a State heritage listed building), both named in honour of Sir Frederick Duncan McMaster. His original gift to CSIRO in 1929, for the construction of the Division of Animal Health's first laboratory, located at Sydney University, marked the beginning of a new era of veterinary research in Australia that saw Australia forge an international reputation for excellence in veterinary research. While no other physical evidence of standing structures was observed within the footprint options for motorway development, it was noted that the landscape was culturally modified for the purposes of CSIRO research: cultivated fields, fence lines, dams and groves of trees. The potential archaeology and intactness of this landscape rates it as moderately significant at a local or State level. The contribution by this farm to the national arena may be of significance at a national level* (Aurecon 2016:124).
WWII Era Airstrip (Fleurs Aerodrome)	Lot 2 DP88836	Curtilage Intersects	*The Fleurs Aerodrome has a potential historical significance at a high local or State level. The low to moderate intactness of this site is likely to render it significant only at the local level. While the footprints of the aerodrome remain relatively intact, a great number of its elements have been disturbed. This site was historically important in the defence of the Pacific during the Second World War through the establishment of a network of aerodromes of which Fleurs was one of the largest.* *Encroaching development on most of western Sydney's aerodromes and landing strips has endangered the integrity of these sites and places. So whilst not technically rare, the Fleurs Aerodrome is a good representation of a near intact parent aerodrome, one of the largest in NSW during the Second World War. Fleurs was the parent aerodrome for at least six satellite landing strips, the greatest number for any parent aerodrome in Greater Sydney during the war. Its representative significance is moderate at a high local to State level* (Aurecon 2016:119).

Table 4-2 Non-Aboriginal heritage landscapes identified in M12 Motorway: Strategic Route Options Analysis (Aurecon 2016) within or adjacent to the current study area

Item name	Lot/DP number	Proximity to study area	Description and significance
South, Kemps and Badgerys Creek confluence weirs Scenic Landscape	Lot 21 DP258414	Adjacent	*A scenic landscape of assessed regional significance comprising the weirs and surrounds located at the confluences of Badgerys and Kemps Creek with South Creek. The Badgerys Creek weir is no longer functioning* (Aurecon 2016:29).
McMaster Field Station Scenic landscape, Elizabeth Drive, Badgerys Creek	Lot 101 DP848215 Lot 1 DP235124 Lot 1 DP228498 Lot 25 DP604586	Intersects	*A pastoral landscape with constructed lakes and dams, native vegetation and a backdrop of green hills. Of regional significance. Lack of intrusive transmission wires is important* (Aurecon 2016:29).

Table 4-3 Non-Aboriginal heritage landscapes identified in Western Sydney Airport gateway, Badgerys Creek Planning Proposal (Roberts 2016) within or adjacent to the current study area (direct citations shown in italics)

Item name	Lot/DP number	Proximity to study area	Description and significance
WWII airstrip (Fleurs Aerodrome)	Lot 2 DP88836	Intersects	*In 1942/43 a diversionary airfield was built at Fleurs between the courses of Kemps Creek and South Creek, initially for use by the Royal Australian Air Force (RAAF) at Richmond. Construction started on an aerodrome in 1942 which was still under construction in 1944 as part of a proposal to base a United States Navy Fleet Air Wing in Sydney should the need arise. Initially planned with three runways, No.1 (5,000 feet) and No. 3 (6,000 feet) runways were serviceable, however construction of No. 2 runway (5,000 feet) was abandoned. A total of eight aircraft dispersal hideouts were constructed and accommodation included a farm house and a former Civil Constructional Corps camp. The hangars and an aerodrome associated with the World War Two airstrip at Kemps Creek are no longer visible on aerial imagery* (Roberts 2016).
Fleurs Radio Telescope site	Lot 21 DP258414, Lot 1 DP74574, Lot 1 DP88836, Lot 2 DP88836	Intersects	*Associated with radio astronomy, initially being developed by the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Division of Radiophysics. Site of the Fleurs Radio Telescope (FRT) including the earlier Chris-Cross Telescope, otherwise known as the Mills Cross Telescope after the builder Bernard Mills. The telescope was the world's first cross-grating interferometer and the first radio telescope to provide a two-dimensional daily map of the sun. Two of the old 13.7 m dish antennas were relocated to the CSIRO at Marsfield in 2005, as part of a precursor study into the Square Kilometre Array (SKA) development. The associated buildings are however still extant (Orchiston 2004)* (Roberts 2016).
McGarvie-Smith Farm	Lot 62 DP1087838, Lot 63 DP1087838	Intersects	*In 1936 the Veterinary Department of the University of Sydney, in association with the McGarvie-Smith Institute, purchased and developed a 160 ha property at Badgerys Creek for the training of veterinary students in animal husbandry. The McGarvie-Smith Farm was named after John McGarvie-Smith (1844–1918) a colonial character, assayer, bacteriologist, herpetologist and army lieutenant (Royal Society of NSW 1919). McGarvie-Smith is most well-known for developing a vaccine for anthrax. The farmhouse is located on a low elevation hillcrest rising above the floodplain of Badgerys Creek north of Elizabeth Drive (***Figure 4-3***). The farm was originally a part of a 500 acre land grant to William Johnson in 1819 and as such is one of the earliest settler farms in NSW. In the muster return of 1822, Johnson's grant of 1819 comprised 310 acres, with a small area of 10 acres under crop and the balance being used to run 96 head of cattle (Davies 2007). Few details exist on the history of the place, yet the modern farm buildings are located 650 m west of Badgerys Creek and 500 m north of Elizabeth Drive* (Roberts 2016).

Western Sydney Airport EIS (RPS Manidis Roberts 2016)

An EIS was completed for the Western Sydney Airport project (RPS Manidis Roberts 2016). The study included background research, field survey and test excavation. The north section of their study area included the McGarvie Smith Farm and property north of Elizabeth Drive which are situated within the current study area. A total of 22 non-Aboriginal heritage items were identified and assessed within the RPS Manidis Roberts study area. The only previously unregistered heritage items located within the current (M12 Motorway) study area relates to the Northern Road alignment.

Two registered heritage items identified in the RPS Manidis Roberts report are located within the current study area:

- McGarvie Smith University Farm at 124 Elizabeth Drive, Badgerys Creek (Lot 63 DP 1087838) is considered to have local significance and is listed in the Penrith LEP (857). The McGarvie Smith Farm is considered to have heritage significance for its historic, associative and technical values. The Farm was established in order to teach animal husbandry to the University of Sydney veterinary students and has association with Sir Frederick Tout (RPS Manidis Roberts 2016:68). The McGarvie Smith Farm was nominated for the NHL, however is now ineligible as it was not included for two consecutive work plans. A nomination ruled ineligible may be eligible again for consideration.
- Luddenham Road Alignment is considered to have local significance and is listed in the Penrith LEP (843). The Airport development was considered to have a visual impact to the southern alignment of Luddenham Road because of the proposed Elizabeth Drive realignment.

The report also assessed The Northern Road alignment which is within the western extent of the current study area. The Northern Road alignment is not currently listed on any heritage register. Within the Commonwealth-owned airport site the alignment was "… considered to be historically significant as one of the earliest roads in the area, predating the subdivision of early land grants in the area" (RPS Manidis Roberts 2016:66). The report assessed The Northern Road alignment within the airport site as meeting the following Commonwealth heritage significance criterion:

- Events and processes – "The Northern Road has been an important historic thoroughfare linking the nascent communities of Camden and Windsor. Although it has been upgraded and alignments in some sections have changed, it has followed the same basic route since the early nineteenth century"
- Research – "The alignment of the road has been well mapped since its construction. However, there may be areas of original alignment that demonstrate early road building techniques and materials" (RPS Manidis Roberts 2016:143).

The report recommended that archaeological investigations be completed for "former parts of The Northern Road alignment to identify whether early road construction technologies such as corduroy were used in the alignment" (RPS Manidis Roberts 2016:77).

One further registered heritage item assessed by RPS Manidis Roberts (2016) is adjacent to the current study area; Pennell's property at 2170 Elizabeth Drive, Badgerys Creek. Access to the property was not permitted at time of the assessment, however archaeological investigations were recommended ahead of the construction of the Western Sydney Airport as the property may contain subsurface evidence of an early homestead (RPS Manidis Roberts 2016:91). The property, located on Commonwealth owned land, was assessed and considered to meet the criteria for Commonwealth heritage significance (Manidis Roberts 2016: 61).

Badgerys Creek Initial Environmental Survey: Historic Heritage (Australian Museum Consulting 2014)

Australian Museum Consulting undertook a study of the Commonwealth-owned land at Badgerys Creek for the proposed new airport in Western Sydney for Commonwealth Department of Infrastructure and Regional Development. The study area comprised much of area within the suburbs of Badgerys Creek and Luddenham, both located to the immediately south of the current study area. Due to a constrained timeframe the investigation was limited to available historical documentation, vehicular survey and pedestrian field survey. The study identified a number of heritage items and archaeological sites related to the early settlement and establishment of commercial enterprises in the region, none of which are in the current study area.

Penrith Heritage Study (Paul Davies Pty Ltd 2007)

Paul Davies Pty Ltd undertook a non-Aboriginal heritage study for the Council of the City of Penrith. Post-contact Aboriginal heritage and natural heritage values were also assessed where relevant. The study area centred on the regional city of Penrith and included the 34 localities that made up the city council area. The study included the localities of Luddenham, Badgerys Creek and Kemps Creek which overlap with the north and western portion of the current study area. The study included consultation with the broader community and the establishment of a heritage study reference group.

Within the current study area, the following suburbs were subject to the assessment: Glenmore Park, Mulgoa, Orchard Hills and Luddenham. The results for each suburb are summarised below and the heritage items within the current study area presented in **Table 4-4**:

- Badgerys Creek – Located in the southern section of the Penrith Heritage Study area, there were three known heritage items, and one existing nominated natural heritage item identified. The three known heritage items are within the current study area.
- Kemps Creek - Located in the southern section of the Penrith Heritage Study area, there were three known heritage items, and two existing nominated heritage items identified. None of these are located within the current study area. During fieldwork two additional potential heritage items were identified, one of which is within the current study area.
- Luddenham - Located in the southern section of the Penrith Heritage Study area, there were seven known heritage items, and one existing nominated heritage item identified. One known heritage item is within the current study area. During fieldwork three additional potential heritage items were identified. Only one of these is located within the current study area.

Table 4-4 Heritage items identified in Penrith Heritage Study situated within the current study area (direct citations shown in italics) (Paul Davies Pty Ltd 2007)

Suburb	Heritage item number	Heritage item name	Description
Badgerys Creek	BC-02	McGarvie Smith Farm	*A pair of timber and compressed fibre cement sheeted buildings, associated with the establishment of the farm as a research facility by the University of Sydney in 1936* (Paul Davies Pty Ltd 2007:15).
Badgerys Creek	BC-24	McMaster Field Station (also called McMaster Farm)	*The former McMaster Field Station is of historical interest as an important centre for CSIRO animal research from 1936 to c.1990 and is the only known example of a CSIRO rural research institute in the Penrith LGA* (Paul Davies Pty Ltd 2007:15).
Kemps Creek	KC-06	Fleurs Radio Telescope site	*Used from 1954 until 1988 for astronomical research, the Fleurs Telescope site was in the 1950s considered to be one of the world's leading radio astronomy field stations* (Paul Davies Pty Ltd 2007:118).
Kemps Creek	-	Former WWII diversionary airstrip	No description provided.
Luddenham	PC-03	The Northern Road	*The Northern Road was nominated for its historic interest as an early colonial road. While alignment of the road in following a narrow ridgeline continues to be of historic interest the road has been upgraded and roadside margin cleared of trees. The elevation of the road provides impressive views of the Blue Mountains to the west. It is not recommended for listing* (Paul Davies Pty Ltd 2007:158).

Suburb	Heritage item number	Heritage item name	Description
Luddenham	LU-08	Luddenham Road Alignment	*Luddenham Road is an historic road alignment which today is still traverses largely rural land. While no historic farmhouse fronts this section of the road, this section of post and rail estate fencing provides some insight into earlier settlement. The road is characterized by its undulating alignment cut into the slope of the hillside above the tributaries of South Creek and remnant stands of trees. Apart from its aesthetic appeal, the road has historic associations with the predominant pastoral activities of the nineteenth century and first half of the twentieth century commencing with the Blaxland brothers' ownership from the 1810s* (Paul Davies Pty Ltd 2007:159).

Colonial Landscapes of the Cumberland Plain and Camden, NSW. A Survey of Selected Pre-1860 Cultural Landscapes from Wollondilly to Hawkesbury LGAs (Morris and Britton 2000)

Morris and Britton (2000) undertook a heritage study of Colonial Landscapes of the Cumberland Plain and Camden. Early colonial landscapes are considered to be significant and they demonstrate the interaction between early European settlers with the Australian landscape. The study included a survey of selected pre-1860 cultural landscapes in the region which included a number of potential heritage items relating to landscape heritage such as colonial farm estates; however, none of these are located within the current study area. However, Morris and Britton offer useful insights as to the common features of many of these colonial properties.

4.2.2 Heritage register search results

There are four registered heritage items located within the study area, and two situated within 500 metres of the study area. McGarvie Smith Farm (857), the Fleurs Radio Telescope Site (832), and the Luddenham Road Alignment (843) are all listed on the Penrith LEP. The Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (SHR 01373) is listed on the SHR, Liverpool LEP and Section 170 Register. There are no items listed on the CHL, NTR, NHL or WHL within the study area. A list of registered heritage items located within the study area is presented in **Table 4-5** and **Table 4-6** lists registered heritage items located within 500 metres of the project. The locations of registered heritage items considered as part of this impact assessment are shown in **Figure 4-7**.

4.2.3 Review of aerial imagery

A review of current and historical aerial imagery was completed to identify areas of potential heritage. No particular areas of potential heritage were identified. Any further sites of heritage potential are likely to be buildings and structures associated with settlement of the region and of past rural uses related to pastoral and agriculture practices which pre-date historical aerial imagery.

4.2.4 Summary

A review of previous studies and heritage register searches have indicated that there are four registered heritage items located within the study area, these are:

- McGarvie Smith Farm
- The Fleurs Radio Telescope Site
- Luddenham Road Alignment
- The Upper Canal System (Pheasants Nest Weir to Prospect Reservoir).

The registered heritage items located within 500 metres of the current study area (**Table 4-6**) are unlikely to be impacted by the project as they are a sufficient distance from the construction footprint, and are not further considered in this assessment.

Table 4-5 Registered heritage items within the study area

Heritage item name	Register	Number	Significance	Location
McGarvie Smith Farm	Penrith LEP	857	Local	Lot 63 DP 1087838
Fleurs Radio Telescope Site	Penrith LEP	832	Local	Lot 21 DP 258414
Luddenham Road Alignment	Penrith LEP	843	Local	-
Upper Canal System* (Pheasants Nest Weir to Prospect Reservoir)	SHR Liverpool LEP* s170 Sydney Water	01373	State	Lot 11 DP 1055232 Lot 12 DP 1055232 Lot 51 DP 811015 Lot 1 DP 603946 Lot 2 DP 603946 Lot 3 DP 603946

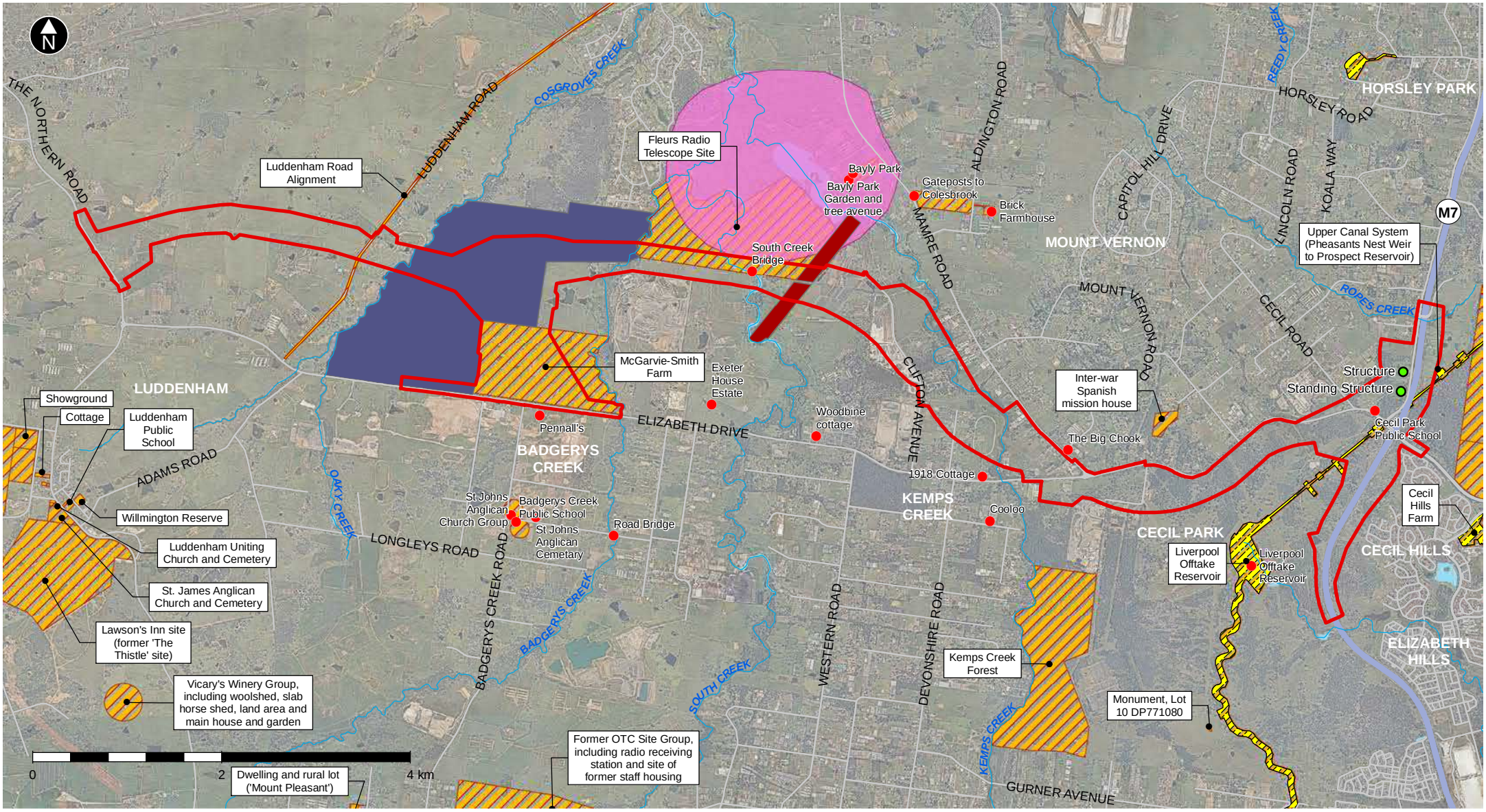
* The listing for the Upper Canal System for Liverpool LEP does not include those lots within the study area

Table 4-6 Registered heritage items within 500 metres of the study area

Heritage item name	Register	Number	Significance	Location	Proximity to study area
Inter-War Spanish Mission House	Fairfield LEP	I43	Local	Lot 190 DP 590666	300 m north
Calmsley Hill Farm Cottage and curtilage	SEPP	I22	Local	Lot 1 DP 553350 Lot 51 DP 634101 Lot 1, DP 221575	325 m east

Table 4-7 Summary of all heritage items identified on heritage registers and previous assessments within the study area

Heritage item name	Register	Number	Significance	Location
McGarvie Smith Farm	Penrith LEP	857	Local	Badgerys Creek, Lot 62/DP1087838, Lot 63/DP1087838
Fleurs Radio Telescope site	Penrith LEP	832	Local	Kemps Creek, Lot 21/DP258414, Lot 1/DP74574, Lot 1/DP88836, Lot 2/DP88836
Luddenham Road Alignment	Penrith LEP	843	Local	Between Mamre Road, St Marys and Elizabeth Drive, Luddenham
Upper Canal System	SHR	01373	State	Elizabeth Drive, Cecil Hills
South Creek Bridge	-	-	Local	Kemps Creek, Lot 21/DP258414
McMaster Field Station	-	-	Local	Kemps Creek, Lot 101/DP848215
Fleurs Aerodrome	-	-	Local	Kemps Creek, Lot 2/DP88836
Cecil Park Public School, Post Office and Church Site	-	-	Local	Cecil Park, Lot 1/DP724970
South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	-	-	Local	Lot 21/DP258414
Standing Structure	-	-	Identified but not assessed by Aurecon	Lot 6 DP 629798 Wallgrove Road, Cecil Park
Structure	-	-	Identified but not assessed by Aurecon	Lot 26 A DP387529 Wallgrove Road, Cecil Park



Study area
Waterways
Motorway
Main roads

Non-Aboriginal heritage items identified in previous assessments
Potential heritage item

Listed or Registered heritage items
LEP Heritage item
State Heritage Register item

Non-listed heritage items
Fleurs aerodrome
McMaster Field Station
South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

Figure 4-7 Location of heritage items on registers and from previous heritage assessments prior to assessment of heritage significance in this report

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Previous heritage studies have also identified a number of sites of potential historic value within or adjacent to the current study area: McMaster Field Station, Cecil Park Public School (name expanded to 'Cecil Park School, Post Office and Church Site' later in this assessment after further research), Fleurs Aerodrome, South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape and South Creek Bridge.

The two potential heritage items, Standing Structure, and Structure, identified but not assessed by Aurecon in their earlier study, were investigated during the current M12 field survey and are described in **Section 4.2.1** of this report.

All known heritage items within or adjacent to the study area identified from the desktop assessment are shown in **Table 4-7**.

There is also the potential for previously unidentified historical heritage items to be situated in the study area, based on the review of aerial imagery, and the nature of the previous heritage assessments which included only limited field survey. Following a search of the above registers, and review of the previous literature, historical background and aerial imagery, the following types of historical heritage items are likely to be found in the study area:

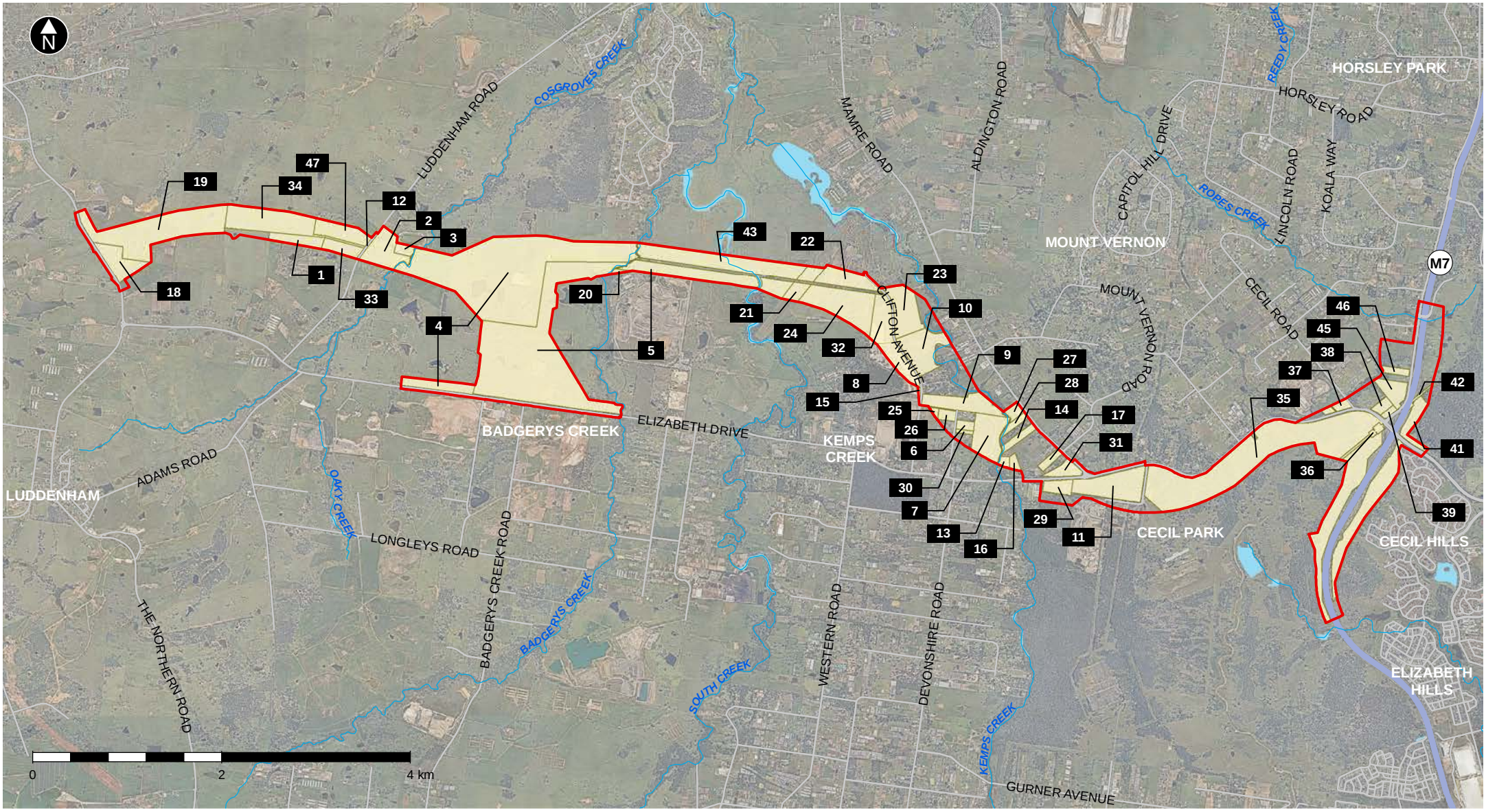
- Houses, homesteads and other buildings associated with the settlement of the region
- Buildings and structures associated with scientific development and practice
- Buildings and structures associated with colonial, WWI and WWII military activity
- Past rural uses related to pastoral and agriculture practices, including stockyards, fences, sheds and outbuildings, orchard trees, and wells.

5. Field survey results

A field survey was undertaken within 47 discrete survey areas located in the study area, mapped in **Figure 5-1**

The field survey targeted areas of known heritage items within or adjacent to the study area that are currently registered or have been recorded in previous heritage assessments. The findings of these targeted surveys of known heritage items is provided in **Table 5-1**. Note that many of the survey areas are comprised of numerous lots.

The results of other surveyed areas, including newly discovered potential heritage items (previously not identified by others) are provided in **Table 5-2.**



Study area
Survey areas
Waterways
Motorway
Main roads

Figure 5-1 Location of survey areas within the study area

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Table 5-1 Known historical heritage items surveyed

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
5	Lot 63 DP 1087838 Lot 62 DP 1087838	Item 1: McGarvie Smith Farm	14 November 2017	A large number of buildings were re-inspected on foot within Lot 63 and are detailed in **Section 5.** The remaining survey area, which was large in size, was surveyed by vehicle. A number of earth features were noted in the area within the existing LEP heritage curtilage (Lot 63) as well as immediately to the north of this area (Lot 62). One of the earth features appeared to lead to Feature 1, located in McMaster Field Station (Survey area no. 4).  Figure 5-2 Silo at McGarvie Smith Farm, facing northwest.  Figure 5-3 Earthworks at Lot 62, facing southwest.

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
5	Lot 21/DP258414	Item 2: Fleurs Radio Telescope site and Item 12: South, Kemps and Badgerys Creek confluence weirs scenic landscape	14 November 2017	The circular shaped scenic landscape curtilage as defined by Aurecon (2016) in **Figure 4-7** was situated immediately adjacent to the study area. Within this part of the landscape there were no weirs observed and the area did not overlap with any of the three creeks. South Creek is located adjacent (west) to the study area. Badgerys Creek is located around 930 m west of the study area and Kemps Creek is located 1.2 km northeast of the study area. The area overlaps with the Fleurs Radio Telescope site listed above. Vegetation comprised grass in an open paddock environment with occasional small trees located in the vicinity of buildings associated with Fleurs Radio Telescope.  Figure 5-4 Southern section of scenic landscape, facing north.
43	Lot 21/DP 258414	Item 2: Fleurs Radio Telescope site	Surveyed by Dr Gorman (2018)	See **Annexure A** for full report.
12	Road reserve	Item 3: Luddenham Road Alignment	16 November 2017	Luddenham Road was surveyed to identify any remnant sections of original road. The road has been modified over time. No heritage items were identified.

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
				 Figure 5-5 Luddenham Road, facing south.
36 and 42	Lot 1/DP603946 Lot 51/DP811015	Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	1-2 March 2018	This heritage item is registered on the SHR and Liverpool LEP. The pipeline in both lots is located below the ground surface and was not visible during the field survey. However, one element of the pipeline, Cecil Hills Tunnel Shaft 4 was observed within the current study area in the M7 road median (Lot 1 DP603946). An interpretive sign for the shaft is located in the eastern road reserve, adjacent to the walking/bike track.  Figure 5-6 Upper Canal System, Cecil Hills Tunnel Shaft 4, located in centre of M7 road median, facing southwest.
5	Lot 21 DP 258414	Item 5: South Creek Bridge	14 November 2017	This heritage item was previously identified as having archaeological potential (Aurecon 2016). A timber structure was observed across the creek, comprising two rounded timber pillars with flat timber planks attached. Other timber features were located nearby (to the east) which contained metal bolts. Further discussion of this heritage item is provided in **Section 6.5.**

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
				 Figure 5-7 South Creek Bridge, facing north.
4	Lot 101 DP 848215	Item 6: McMaster Field Station/McMaster Farm	13-15 November 2017; 14 March 2018	Identified in a previous heritage study (Aurecon 2016) as having historical significance at a State and national level. Large property with cleared grassed paddocks and a complex of buildings. The property was surveyed by vehicle and for the purposes of the survey, divided into paddocks starting at the easternmost section: • Paddock 1 – grassed, undulating, located adjacent to creek, 0% ground surface visibility. Sandstock bricks and three earthworks; sherds of blue and white transferware; “black” bottle glass identified on top of a ridge overlooking Badgerys Creek (outside study area). • Paddock 2 – grassed, undulating, <5% ground surface visibility. One historical feature noted – concrete remnants, bricks, metal bolts and timber post within a 25 m x 5 m area. • Paddock 3 – grassed, undulating, 0% ground surface visibility. • Paddock 4 – grassed, undulating, 0% ground surface visibility. • Paddock 5 – grassed, gentle slope, <5% ground surface visibility. • Paddock 6 – grassed, gentle slope, adjacent to creek, <5% ground surface visibility. • Paddock 7 – grassed, gentle slope and undulating, <5% ground surface visibility, two concrete features noted 25 m north of the study area boundary. • Paddock 8 – grassed, gentle slope down to southern end, <5% ground surface visibility • Paddock 9 – grassed, gentle slope down to south, <5% ground surface visibility • Paddock 10 – long grass, undulating, 0% ground surface visibility • Paddock 11 – long grass and large wood heap, gentle slope, 0% ground surface visibility. • Paddock 12 – thick grass, undulating, 0% ground surface visibility.

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
				• Paddock 13 – grassed, undulating, southeast of dam, 0% ground surface visibility. Property tenant stated that there was a building previously here. No features noted during survey. • Paddock 14 – large amount of disturbance, gravel vehicle tracks, piles of building debris, trees and buildings, concrete slab. • Paddock 15 – building complex. A large number of buildings and associated infrastructure were recorded during the survey and are detailed in **Section 5.**  Figure 5-8 Paddock 1, facing north.  Figure 5-9 Paddock 1 facing south, showing sandstock bricks and earthworks.

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
				 Figure 5-10 Feature 1, paddock 2, facing east.
21	Lot 2/DP88836	Item 7: Fleurs Aerodrome	27 February 2018	Appears to be disused. Shed at south end of runway and metal structure at north end of runway. Old plans show that runway continued north but this area is now grassed and a paddock. There is a ditch beside the old runway. More detail on these structures can be found in **Section 6.7**.  Figure 5-11 Fleurs Aerodrome, facing north.
38	Lot 1/DP724970	Item 8: Cecil Park School, Post Office and Church Site	1 March 2018, 1 August 2018	See **Annexure B** for full archaeological assessment report. Thick vegetation and bushland across property, 0% visibility. Flat to gently sloping land. Several introduced garden species of plants. There is large flat levelled area close to Elizabeth Drive. However, this is not the area that was previously referenced as the location of the school. There are several wine bottles located under a tree (McWilliams Wines Pty Ltd). There are two exotic trees planted on the Elizabeth Drive frontage, as well as a platform cut out of the natural slope. A large pile of rubble, containing brick, ceramic

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
				and other items, is located in the southwestern corner of the property, close to the area referenced as the location of the school. The pile is about 10 m x 2 m in size and 1 m high and a section of intact brickwork was noted. On the eastern side of the property, in the vicinity of the St Paul's church site, a cut platform was noted adjacent to another pile of debris and a number of exotic plantings.  Figure 5-12 Cecil Park School site, pile of rubble, facing northeast.  Figure 5-13 Site of former St Pauls, Cecil Hills, looking south toward Elizabeth Drive.

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
45	Lot 6/DP629798 Lot 1/DP308358	Item 13: Former Cecil Park Public Hall ('Standing structure' previously identified by Aurecon (2016))	7 March 2019	The site of the former Cecil Park Public School is located on Lot 1/DP308358, which is located in the south east corner of Lot 6/DP629798, and is about 200 metres north east of the former Cecil Park Public School site. The ruins of the public hall were identified near the Wallgrove Road frontage, at the bottom of the embankment formed by Wallgrove Road on-ramp from Elizabeth Drive. The ruin comprised a series of *in situ* brick piers, a quantity of timber planks and a set of concrete stairs. In addition to the *in situ* remains, other material, presumably from the public hall, was strewn about the site over an area over 20 metres from the ruin. This material comprised timber planks (whole and split), bricks and brick fragments and corrugate iron. The extent of the debris field was difficult to determine, with the extensive vegetation concealing much of it. The rusted bodies of motor vehicles were also noted nearby. In addition, a former building platform was observed on Lot 6/DP629798. The area was generally flat in nature, grassed, and had sheep grazing in the vicinity. The occupier, who accompanied the survey team, was told by the previous occupier that it was the site of a large poultry shed. It is therefore possible that this relates to a structure noted on 1930 aerial, as outlined in the desktop assessment by Aurecon (2016).  Figure 5-14 *In situ* brick piers and timber planks of the former Cecil Park Public Hall, looking east.

Survey Area No.	Location	Item number and name	Date surveyed	Results of survey
				 Figure 5-15 Example of debris  Figure 5-16 Former building platform located on 6/629798.
46	Lot 26A/DP387529 Wallgrove Road, Kemps Creek	'Structure' previously identified by Aurecon (2016).	7 March 2019	Modern fibro/weatherboard dwelling on site. No potential heritage items identified

Table 5-2 Results of field survey in survey areas

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
1	2/DP529885 821-849 Luddenham Road, Luddenham	No potential heritage items identified.	13 November 2017	Currently go-kart racetrack – Luddenham Raceway. Only part of property within study area which is mostly a recently planted olive tree plantation. The land is undulating with a slope down to the eastern end of the property. Eastern end of property is a grassed paddock. Long grass throughout, 0% ground surface visibility. Foot survey.  Figure 5-17 Survey area 1, facing north.
2	1/DP235124 752-810 Luddenham Road, Luddenham	Newly identified potential heritage site: • Item 9: Karingal, 752 Luddenham Road, Luddenham	13 November 2017	Old training track for horses. Thick grass cover with small occasional areas of erosion, <5% ground surface visibility, gentle slope. Pile of building rubble in northeast corner adjacent to creek. Several buildings appear to be old: stables and sheds, slab where a sandstone building was previously located. Current tenant confirmed the buildings were built before ca. 1920. Potential heritage item. Foot survey. More detail on these buildings can be found in **Section 6.9**.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
				 Figure 5-18 Training area, survey area 2, facing northeast.  Figure 5-19 Old sheds in survey area 2, facing southeast.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
3	35/DP211842 734-750 Luddenham Road, Luddenham	No potential heritage items identified.	13 November 2017	Area contains a trotting track (currently used) and a dam, remainder is grassed. Flat land adjacent to creek. 0% ground surface visibility. Foot survey.  Figure 5-20 Survey area 3, facing east.
4	101/DP848215 1953-2109 Elizabeth Drive, Badgerys Creek	<u>Known heritage items:</u> • Forms part of McMaster Field Station (Item 6).	13-15 November 2017	This lot forms part of the McMaster Field Station. Further survey details are provided in **Table 5-1** for McMaster Field Station.
5	62/DP1087838 63/DP1087838 3/DP164242 1/DP74574 1/DP88836 21/DP258414 1793-1951 Elizabeth Drive, Badgerys Creek 124 Elizabeth Drive, Badgerys Creek	<u>Known heritage items:</u> • Item 1: McGarvie Smith Farm • Item 2: Fleurs Radio Telescope Site • Item 5: South Creek Bridge • Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	14 November 2017	These lots are part of the • McGarvie Smith Farm • Fleurs Radio Telescope Site • South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (although the lot that this heritage item is located on extends into the study area, the actual heritage item is located immediately adjacent to the study area) • South Creek Bridge. Further survey details on the four known heritage items listed above are provided in **Table 5-1**.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
		Newly identified potential heritage site: • Item 10: Exeter Farm Archaeological Site		During the field survey an area of archaeological potential was discovered, later named 'Exeter Farm Archaeological Site (Item 10)' (refer to **Figure 5-21**). Lightly grassed, ploughed fields, 50% ground surface visibility. Area of archaeological potential noted adjacent to a line of immature eucalypt trees forming a boundary with the adjacent Kemps Creek Advanced Resource Recovery Park. Handmade bricks, sandstone, glass, ceramic, metal and two musket balls were located adjacent to line of trees. Vehicle and foot survey. A hedge of bow-wood trees was also noted. Further details of this site can be found in **Section 6.10**.  Figure 5-21 Area of archaeological potential, Survey area 5, facing southwest.
6	2/DP736951 12-20 Salisbury Avenue, Kemps Creek	Newly identified potential heritage items • Item 11: Artefact Scatter, 12-20 Salisbury Ave, Kemps Creek	15 November 2017	Undulating land, grassed with patches of ground surface visibility in western section of property. Recent eucalypt plantings at eastern end. Ceramic, glass and metal identified on ground surface. Current tenant stated that it was the site of the original Kemps Creek post office which burnt down. Foot survey. Potential heritage item identified. Further discussion of the site can be found in **Section 6.11**.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
				 Figure 5-22 Survey area 6, facing northwest.
7	B/DP102214 1383-1411 Elizabeth Drive, Kemps Creek	No potential heritage items identified	15 November 2017	This property contains a known heritage item: 1918 Cottage; however, the cottage/buildings are located ca. 60 m to the south of the study area boundary. There is a horse training track located to the north of the buildings that intersects with the current study area. Mostly grassed with patches of bare ground, <5% - 100% ground surface visibility. Some old fence posts are located adjacent to the creek (northeast side of property), also some old fence posts in the centre of the training track. Vehicle survey.  Figure 5-23 Survey area 7, facing north.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
8	3/DP812284 90 Clifton Avenue, Kemps Creek	No potential heritage items identified.	15 November 2017	Property is currently used as a quarry or similar industry. Large amount of ground disturbance, apart from an area fenced off and signed as 'Environmental zone', which has some vegetation. There has been recent ploughing along the fence line. The southern section of the property has had all soil removed down to the clay. Northern section of property has gravel surface. Vehicle survey.  Figure 5-24 Survey area 8, facing southeast.
9	41/DP734584 382-393 Clifton Avenue, Kemps Creek	No potential heritage items identified.	15 November 2017	Long thick grass, 0% ground surface visibility, gently sloping land. Piles of discarded building material throughout property. Dam located in eastern end of property. Vehicle survey.  Figure 5-25 Grass cover in survey area 9, facing southeast.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
10	6/DP812284 316 Clifton Avenue, Kemps Creek	No potential heritage items identified.	15 November 2017	Half bushland, half cleared, land sloping toward creek. Cleared section has thick grass, 5% ground surface visibility. Property is intersected by power lines. Area near creek has very thick scrub. Vehicle survey.  Figure 5-26 Survey area 10, cleared section, facing west.
11	8/DP1054778 7/DP1054778 2/DP1054778 1/DP1054778 9/DP1054778 1400 Elizabeth Drive, Cecil Park	No potential heritage items identified.	16 November 2017	Mostly flat land, thick grass in western section of property, 0% ground surface visibility. Patches of bare earth in centre and eastern end of property, <5% ground surface visibility. Rubbish dispersed widely across entire property comprising large concrete blocks, bricks, building materials, metal, machinery, bottles, glass, plastic. Foot survey.  Figure 5-27 Western end of Survey area 11, facing southwest.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
				 Figure 5-28 Eastern end of Survey area 11, facing north.
12	NA	Known heritage items: • Forms part of the Luddenham Road Alignment (Item 3)	16 November 2017	This survey area is part of the Luddenham Road Alignment. Further survey details provided in **Table 5-1** for Luddenham Road Alignment.
13	30/DP30265 1373-1379 Elizabeth Drive, Kemps Creek	No potential heritage items identified.	17 November 2017	Property currently used for agricultural purposes with majority of area within study area containing agricultural buildings. Area adjacent to creek is overgrown with vegetation. 0% ground surface visibility. Vehicle and foot survey.  Figure 5-29 Survey area 12, facing northwest.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
14	18/DP30265 1247 Mamre Road, Kemps Creek	No potential heritage items identified.	17 November 2017	Long grass cover, trees located at southern end of property adjacent to creek, 0% ground surface visibility. Vehicle and foot survey.  Figure 5-30 Survey area 13, facing west.
15	2/DP812284 81 Clifton Avenue, Kemps Creek	No potential heritage items identified.	17 November 2017	Topsoil has been removed from property within the study area. Some remnant vegetation remaining along a narrow strip. New building located adjacent to study area boundary. Flat land. Foot survey.  Figure 5-31 Survey area 14, facing south.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
16	29/DP30265 1357-1371 Elizabeth Drive, Kemps Creek	No potential heritage items identified.	17 November 2017	Large number of cars and rubbish across property as well as long grass, <5% ground surface visibility. Flat land. Foot survey.  Figure 5-32 Survey area 15, facing southwest.
17	23/DP30265 1285-1291 Mamre Road, Kemps Creek	No potential heritage items identified.	17 November 2017	Gently sloping land, thick grass, some piles containing wooden crate, 0% ground surface visibility. Modern rail tracks, animal pens located at southern end of property. Foot survey.  Figure 5-33 Survey area 16, facing south.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
18	Lot 1/DP200435 The Northern Road, Luddenham	No potential heritage items identified.	26 February 2018	Modern house, horses on property, gentle slope with short grass, dam, agricultural area and shed/honey sales in south of property. 5% visibility.  Figure 5-34 Survey area 17, facing south.
19	Lot 1/DP109697 The Northern Road, Luddenham	No potential heritage items identified.	26 February 2018	Open agricultural undulating land. Market garden across some of the area. Variable visibility – 0-10%.  Figure 5-35 Survey area 18, facing west.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
20	Lot 740/DP810111 1725A Elizabeth Drive, Badgerys Creek	No potential heritage items identified.	26 February 2018	Wooded flat area beside creek with occasional swampy depressions. <5% visibility.  Figure 5-36 Survey area 19, facing east.
21	Lot 2/DP88836 949A Mamre Road, Kemps Creek	<u>Known heritage items</u> • Located within Fleurs Aerodrome (Item 7)	27 February 2018	This lot is within the Fleurs Aerodrome location. Further survey details provided in **Table 5-1** for Fleurs Aerodrome.
22	Lot 55/DP734584 203-229 Clifton Avenue, Kemps Creek	No potential heritage items identified.	27 February 2018	Grassed paddock and agricultural fields which have been ploughed. The majority of the property has been heavily disturbed through agricultural practices.  Figure 5-37 Survey area 21, facing north.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
23	Lot 7/DP812284 258 Clifton Avenue, Kemps Creek	No potential heritage items identified.	27 February 2018	Large grassed undulating paddock adjacent to creek. Long grass, 0%visibility.  Figure 5-38 Survey area 22, facing east towards creek.
24	Lot 1/DP587135 Lot 2/DP587135 146B Clifton Avenue, Kemps Creek	No potential heritage items identified.	27 February 2018	Rear of timber frame manufacturing business. The area has a gentle slope and is wooded. 50% visibility. No potential heritage items identified. Second lot is currently used for agricultural purposes – market garden.  Figure 5-39 Survey area 23, facing east.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
25	Lot 24/A/DP2566 146B Clifton Avenue, Kemps Creek	No potential heritage items identified.	27 February 2018	Agricultural property. Flat land with mounds of soil that appears to be from dam construction. 5% visibility.  Figure 5-40 Survey area 24, facing east. Mound of soil from dam construction on left.
26	Lot 1/DP981721 3 Salisbury Avenue, Kemps Creek	No potential heritage items identified.	27 February 2018	Modern houses on eastern side of property, trees on western side. Gentle slope, 20% visibility.  Figure 5-41 Survey area 25, facing west.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
27	Lot 15/DP30265 1219-1231 Mamre Road, Kemps Creek	No potential heritage items identified.	27 February 2018	Coolstore business. Gentle slope down to creek, grassed, 0% visibility.  Figure 5-42 Survey area 26, eastern section, facing north.
28	Lot 16/DP30265 1233-1237 Mamre Road, Kemps Creek	No potential heritage items identified.	27 February 2018	Property has agricultural structures across much of the property. Property was viewed from adjacent property. 0% visibility.  Figure 5-43 Survey area 27, northern section, facing southeast.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
29	Lot 1/DP1160625 1490 Elizabeth Drive, Cecil Park	No potential heritage items identified.	27 February 2018	Property is occupied by a lawn bowls club. South and eastern sections of property are asphalt car park. Remainder of property is landscaped with bowling greens and garden. Modern building located in centre.  Figure 5-44 Survey area 28, facing west across bowling green.
30	Lot B/DP416720 26-32 Salisbury Avenue, Kemps Creek	No potential heritage items identified.	27 February 2018	Property has two houses and horse yards with horses. Rear of property slopes down to creek. Visibility ranges from 5% to 80% with highest visibility in areas trampled by horses. Occasional fragments of ceramic and glass are located across property. The property owner advised that there was previously an older house in the location of modern house, which was demolished in around 1967. The rear of the property has a training track which was built by the owners. This property is located adjacent to survey area 6 which also had ceramic and glass fragments.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
				 Figure 5-45 Survey area 29, area of visibility and ceramic sherds, facing southwest.
31	Lot 25/DP30265 Lot 26/DP30265 1307-1337 Elizabeth Drive, Kemps Creek	No potential heritage items identified.	28 February 2018	Building and landscape suppliers. The easternmost lot has a large asphalt carpark and modern buildings. Ceramic and tile fragments are located in introduced fill. There are also areas of crushed rock. The westernmost lot has a modern house with grassed area adjacent to Elizabeth Drive. There are occasional concrete areas located in the grassed section and also areas of 100% visibility. The soil in the western section of this lot has been bulldozed into piles. There are ceramic and glass fragments in these piles of soil, however provenance of the fragments is unable to be determined due to the ground disturbance and introduced fill in the area. Far west of the lot is swampy and vegetated.  Figure 5-46 Survey area 30, bulldozed soil, facing west.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
32	Lot 47/DP734584 146-196 Clifton Avenue, Kemps Creek	No potential heritage items identified.	28 February 2018	Recently cleared block, sloping land. 95% visibility.  Figure 5-47 Survey area 31, facing north.
33	Lot 1/DP228498 West of Luddenham Road, Luddenham	No potential heritage items identified.	28 February 2018	Several mounds of rubble located near dam in northeast corner of property, containing bricks, metal, and concrete. Property owner stated that this was dumped illegally while he owned the property. 5% visibility.  Figure 5-48 Survey area 32, facing northeast. Mounds of rubble in background.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
34	Lot 26/DP604586 West of Luddenham Road, Luddenham	No potential heritage items identified.	28 February 2018	Steep hill and undulating land. Creek in western section. Grassed, 0% visibility.  Figure 5-49 Survey area 33, western section, facing northeast.
35	Lot 3/DP1087825 adjacent to Elizabeth Drive	No potential heritage items identified.	1 March 2018	Bushland with mountain bike trail. <5% visibility. Undulating land. Areas cleared of trees with thick and long grass.  Figure 5-50 Survey area 34, north-eastern section of survey area, facing north.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
36	Lot 51/DP811015 Elizabeth Drive, Kemps Creek	Known heritage item: • Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	1 March 2018	Further survey details provided in **Table 5-1** for Upper Canal System (Pheasants Nest Weir to Prospect Reservoir).
37	Lot 1/DP236527 Lot 2/DP236527 Lot 3/DP236527 Elizabeth Drive, Kemps Creek	No potential heritage items identified.	1 March 2018	Thick grass and weeds across property. Flat land, dam in eastern section. 0% visibility.  Figure 5-51 Survey area 35, facing west.
38	Lot 1/DP724970	Known heritage item: • Item 8: Cecil Park School	1 March 2018, 1 August 2018	Further survey details provided in **Table 5-1** for Cecil Park School and **Annexure B** for full archaeological assessment report.
39	Lot 28/DP654786 Lot 2/DP922940 Wallgrove Road, Cecil Park	No potential heritage items identified.	1 March 2018	Gentle slope, vegetated with grass and trees, 0% visibility. Swampy in centre of property. Unable to survey further north due to swampy area.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
				 Figure 5-52 Survey area 37, facing north.
40	Lot 3/DP1087825 adjacent to M7	No potential heritage items identified.	2 March 2018	Parkland area with steep slopes and undulating land. Heavily grassed and treed areas. 0% visibility.  Figure 5-53 Survey area 38, northern section, facing north.

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
41	Lot 11/DP860893 Lot 1/DP1041390 Lot3/DP2954 965 Elizabeth Drive, Abbotsbury	No potential heritage items identified.	2 March 2018	Parkland area with steep slopes and undulating land. Heavily grassed and treed areas. 0% visibility.  Figure 5-54 Survey area 39, facing east.
42	Lot 1/DP603946 Adjacent to M7	Known heritage item • Item 4: Part of the Upper Canal System (Pheasants Nest Weir to Prospect Reservoir).	2 March 2018	Lot overlaps with Upper Canal System. Further survey details provided in **Table 5-1** for Upper Canal System (Pheasants Nest Weir to Prospect Reservoir). Further survey details provided in **Table 5-1** for Upper Canal System (Pheasants Nest Weir to Prospect Reservoir).
43	Lot 21/DP 258414	Known heritage item • Item 2: Fleurs Radio Telescope site	Surveyed by Dr Gorman (2018)	See **Annexure A** for full report.
44	Lot 19/DP30265 NA	No potential heritage items identified.	30 July 2018	Lot is crossed by transmission towers.
45	Lot 6/DP629798 Lot 1/DP308358	Known heritage item • Item 13: Former Cecil Park Public Hall (Standing structure)	7 March 2019	Further survey details provided in **Table 5-1** for Former Cecil Park Public School

Survey Area No.	Location	Potential heritage item name	Date surveyed	Results of survey
46	Lot 26A/DP387529 Wallgrove Road, Kemps Creek	'Structure' previously identified by Aurecon (2016).	7 March 2019	Modern fibro/weatherboard dwelling on site. No potential heritage items identified.
47	Lot 25/DP604586 West of Luddenham Road, Luddenham	No potential heritage items were identified.	30 July 2018	Lot is owned by Mr Brindisi and located on the western side of Luddenham Road, within the proposed corridor. Comprises a modern dwelling with prefabricated outbuildings on a hill commanding views to the east, south and west.

5.1 Limitations

The field team were unable to survey the properties listed in **Table 5-3**.

Table 5-3 List of properties unable to be surveyed and reason survey unable to be completed

Reason property not accessed	Property Lot number	Address
Property access not granted	Lot 2/DP32026	2830-2844 The Northern Road, Luddenham
	Lot 1/DP981720	13-23 Salisbury Avenue, Kemps Creek
	Lot 33/DP2566	33-39 Salisbury Avenue, Kemps Creek
	Lot 402/DP812923	34-42 Salisbury Avenue, Kemps Creek
	Lot 17/DP30265	1239-1245 Mamre Road, Kemps Creek
	Lot 25/DP653888	Not in database
	Lot 5/DP812284	364-372 Clifton Avenue, Kemps Creek
	Lot 4/DP812284	373-381 Clifton Avenue, Kemps Creek
	Lot 20/DP30265	1267 Mamre Road, Kemps Creek
	Lot 8/DP737052	1349 Elizabeth Drive, Kemps Creek
	Lot 24/DP30265	1293-1297 Mamre Road, Kemps Creek
WSPT owned. Property frontage on Villiers Road (closed by Westlink/M7 gate). Access via Border Road; gates locked with “Trespassers will be prosecuted” sign. No key to gate provided.	Lot 16/DP1021940	55-57 Border Road, Horsley Park, Cecil Park
Property frontage on Villiers Road (closed by Westlink/M7 gate). Access via Border Road; gates locked with “Trespassers will be prosecuted” sign. No key to gate provided.	Lot15/DP1021940	55-57 Border Road, Horsley Park, Cecil Park
WSPT owned/privately occupied – permission granted by owner but no contact details of tenants to confirm access. However, no particular areas of potential heritage were identified during desk top investigations.	Lot 25/DP2954	Wallgrove Road, Cecil Park
	Lot 24/DP1152887	151 Wallgrove Road, Cecil Park
	Lot 14/DP1021940	144 Wallgrove Road, Cecil Park
Properties were unable to be accessed on 2 March 2018 due to the presence of thick blackberries and a swamp	Lot 10/DP1021940	84 Wallgrove Road, Cecil Park
	Lot 11/DP1021940	84 Wallgrove Road, Cecil Park
	Lot 12/DP1021940	84 Wallgrove Road, Cecil Park
Properties located to the east of Kemps Creek are within the study area. However, the properties were not surveyed as not considered to be affected by the project.	Lot 10/DP812284	258 Clifton Avenue, Kemps Creek
	Lot 1/DP30265	1097-1099 Mamre Road, Kemps Creek
	Lot 2/DP30265	1101-1105 Mamre Road, Kemps Creek
	Lot 5/DP30265	1127-1133 Mamre Road, Kemps Creek
	Lot 6/DP30265	1135-1141 Mamre Road, Kemps Creek

Reason property not accessed	Property Lot number	Address
	Lot 7/DP30265	1143-1147 Mamre Road, Kemps Creek
	Lot 8/DP30265	1149-1155 Mamre Road, Kemps Creek
	Lot 9/DP30265	1157-1161 Mamre Road, Kemps Creek
	Lot 10/DP30265	1163-1167 Mamre Road, Kemps Creek
	Lot 11/DP30265	1169-1177 Mamre Road, Kemps Creek
	Lot 12/DP30265	1179-1189 Mamre Road, Kemps Creek

5.2 Summary

Three potential archaeological sites were identified during the field survey, these are:

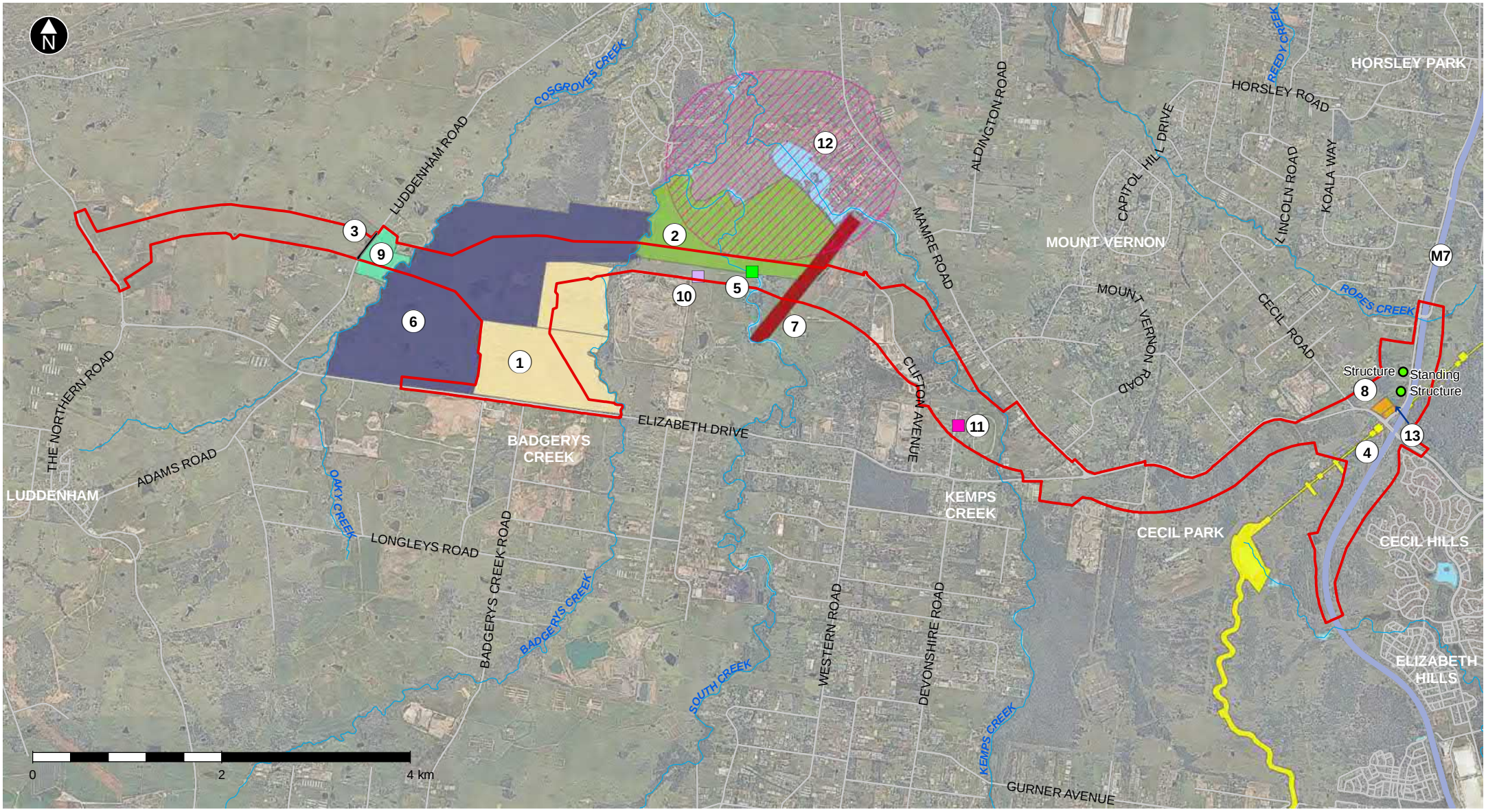
- Karingal
- Exeter Farm archaeological site
- Artefact scatter.

Following the field survey, 12 registered or potential heritage sites were considered to occur within the study area and one heritage site is located immediately adjacent to the study area. These are:

- Item 1: McGarvie Smith Farm
- Item 2: Fleurs Radio Telescope
- Item 3: Luddenham Road Alignment
- Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
- Item 5: South Creek Bridge
- Item 6: McMaster Field Station/McMaster Farm
- Item 7: Fleurs Aerodrome
- Item 8: Cecil Park School, Post Office and School Church
- Item 9: Karingal
- Item 10: Exeter Farm Archaeological Site
- Item 11: Artefact Scatter
- Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (adjacent to study area)
- Item 13: Former Cecil Park Public Hall

The location of the 13 potential heritage sites are demonstrated in **Figure 5-55.**

More detailed information and significance assessment for above-listed heritage items are provided in **Section 6**.



Study area
Waterways
Motorway
Main roads
Potential heritage item

Non-Aboriginal registered and potential heritage items

1: McGarvie Smith Farm
2: Fleurs Radio Telescope site
3: Luddenham Road Alignment
4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
5: South Creek Bridge
6: McMaster Field Station
7: Fleurs aerodrome
8: Cecil Park School, Post Office and Church site
9: Karingal
10: Exeter Farm Archaeological site
11: Artefact Scatter Salisbury Ave
12: South, Kemps and Badgerys Creek confluence weirs scenic landscape
13: Former Cecil Park Pubic Hall

Figure 5-55 Registered and potential heritage items within the study area following field survey

Date: 5/07/2019 Path: J:\IE\Projects\04_Eastern\IA145100\08 Spatial\GIS\Directory\Templates\MXDs\Figures\EIS\SpecialistReports\NonAbHeritage\FinalEIS\JAJV_EIS_NonAbHeritage_F005_PotHerItems_r4v1.mxd
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6. Assessment of significance

The 13 registered and potential heritage items within the study area (mapped in **Figure 5-55**) have been subject to assessments of heritage significance. The findings for each of the 13 items are provided in the following sections.

6.1 Item 1: McGarvie Smith Farm (Penrith LEP 857)

6.1.1 Description and history

McGarvie Smith Farm is registered on the Penrith LEP (857). It has previously been nominated for the NHL, however, its status is Nomination now ineligible for Proposed Priority Assessment List (PPAL) and is therefore not protected by the EPBC Act.[1]

The McGarvie Smith Farm overlaps with the study area on Lot 62 DP 1087838 and Lot 63 DP 1087838. The heritage item is located inside the project's construction footprint. It was surveyed on 14 November 2017 (Survey Area No. 5). During the field survey, a number of buildings, dams, earth ditches and other features were noted.

The following information is replicated from RPS (2016):

> *The property first comprised a 500 acre grant by Lachlan Macquarie to William Lawson Johnston on 31 August 1819 (Portion 63). William Lawson Johnston was a free settler who was granted 500 acres at Emu Plains in 1807. As will all land grants made by the rebel government between the deposing of Governor Bligh following the Rum Rebellion and the next Governorship, being that of Lachlan Macquarie, his grant was cancelled by Macquarie. An alternative grant was made for the same amount at South Creek in 1819. As with common practice in the area, it is likely that Johnson did not live on the property, preferring instead to place tenant farmers on the property to work the land.*
>
> *Separated by Badgerys Creek from James Badgery's Exeter Farm, Johnson's farm was leased and released to John Piper in 1830, the grantee of the adjoining property to the west (Portion 62). John Piper sold his property to William Cox in 1831. From then until 1859 the land stayed with at least one member of the Cox family before passing through the various hands until taken up by the CSIRO.*
>
> *In 1936 the Veterinary Department of the University of Sydney, in association with the McGarvie Smith Institute, purchased and developed a 160 hectare property at Badgerys Creek for the training of veterinary students in animal husbandry.*

The McGarvie Institute, which funded the farm, was founded by Sir John McGarvie the developer of the first 'long' living anthrax vaccine (Australian Heritage Database 2018).

The following information is replicated from Aurecon (2016:139-141):

> *McGarvie Smith Farm began in 1936 as an experimental farm for the development of veterinary studies by the University of Sydney. The YMCA building for the Liverpool Army camp during the First World War was relocated to the site of the farm and was utilised as one of the farm's first buildings.*
>
> *Largely funded by the McGarvie Institute, the farm was a practical training ground for students and operated in close association with the CSIRO farm (McMaster Animal Health Research Farm) situated to the west of the farm].*
>
> *This association expanded the function from veterinary purposes to also include pasture improvement. By 1938, student accommodation had been erected, along with milking sheds and dairy stables.*
>
> *Dams were constructed and the land was also used to sow crops. A film from 1956 highlighted the dams as part of a documentary on the work of the McGarvie Smith Farm in managing water. The construction of these dams and tanks formed part of a project to study water harvesting for the Australian environment that extended into the 1950s.*

[1] Under the EPBC Act, the Australian Heritage Council (AHC) can only assess places for the National Heritage List if the places are on the AHC's assessment work plan (known as the 'priority assessment list'). The Minister sets this work plan each financial year. A nomination become ineligible if it has been considered for two consecutive work plans but not included. However, a nominated place ruled ineligible in this way can be re-nominated, thereupon becoming eligible again for consideration.

The oldest surviving structures appear to be those located in the western portion of the farm on the crest of a hill. Two structures (McGarvie Smith Farm 1 and 2) have the same fabric and are similar in architectural design which suggests a 1930s to 1950s origin. Of composite construction, these timber framed buildings have a foundation of brickwork, followed by a weatherboard cladding, and then an upper section of fibro-cement sheeting.

On 14 July 1938, the *Farmer and Settler* newspaper (Sydney, NSW: 1906-1955) reported that student barracks had been built at the farm and that students at Sydney University would attend classes there during the vacation. They were to also stay there on weekends during semesters. The report also stated that dams, milking sheds and dairy stables had been constructed, and paddocks had been subdivided, crops grown and fodder conserved. The farm had a Jersey cattle herd as well as pigs.

For the purposes of this assessment the same numbering of buildings has been retained as those outlined in the previous assessment (Aurecon 2016). The descriptions outlined in **Table 6-1** are replicated from Aurecon (2016) with additions or updates from this assessment added in bold type. A review of 1947 aerial imagery was undertaken as outlined below and this information is included in **Table 6-1**, as well as a grading of significance for each building as a component for the site. The gradings are based on those outlined in the *NSW Guidelines for Assessing Heritage Significance* (NSW Heritage Office 2001: 11).

Table 6-1 Features recorded at McGarvie Smith Farm

Building Number	Description	1947 Aerial imagery results	Contribution heritage grading
McGarvie Smith Farm 1	The structure identified as McGarvie Smith Farm 1 appears to be a barracks or building utilised for accommodation and is in an L shape. Its roof style is skillion and is clad in what appears to be a corrugated fibro sheeting. The building, while still standing, is in poor condition with missing cladding, broken windows, overgrown with vegetation and animal infestation. **The building is constructed from weatherboard on the lower section and cement sheeting on the upper sections. The building is built on a brick elevated base** (**Figure 6-1**).	Visible in photograph, and building is either attached to McGarvie Smith Farm 2, or the area between the buildings is covered by roofing. The building originally extended further west. Tank visible to west of this building.	High
McGarvie Smith Farm 2	McGarvie Smith Farm 2 appears to be a small residential cottage or office. Its roofing style is a combination of hip and gable, with a portico at the entrance to the structure. The building, while still standing, is in poor condition with missing cladding, broken windows, overgrown with vegetation and animal infestation. **The building has been built on stumps, is timber framed, has double-sash windows, a timber verandah and timber doors. There is an entrance hall on the south side with double glass doors** (**Figure 6-2**).	Visible in photograph, and building is either attached to McGarvie Smith Farm 1, or the area between the buildings is covered by roofing.	High
McGarvie Smith Farm 3	A rectangular shaped corrugated iron clad shed with a steel girder frame set into a platform cut into the shape of the fill. The building is in poor condition with broken windows	Not present	Moderate

Building Number	Description	1947 Aerial imagery results	Contribution heritage grading
	and is heavily corroded. **The shed has an opening at one end with a large doorway. There are four paned metal window frames. The floor has two levels.**		
McGarvie Smith Farm 6	A medium sized weatherboard dwelling with corrugated iron hipped roof, has been fenced in with star picket and wire with chicken wire mesh around it. This house is in good condition as well as being occupied.	Visible in photograph	Moderate
McGarvie Smith Farm 7	A small shed of fibro-cement sheeting and gabled corrugated fibro roof located behind McGarvie Smith Farm 6. There are introduced plants and a grove of eucalypts around the dwelling. These dwellings could date to post-second world war.	Unclear if building in photograph is this building or it has been replaced	Moderate
McGarvie Smith Farm 8	Further south are two brown brick dairy sheds with corrugated iron skillion roofs. They are associated with yards and fencing for livestock. These structures may date from 1960s to 1980s. **The dairy has peeling paint and is overgrown with weeds and grass. There is a large round concrete holding yard with a moveable gate** (**Figure 6-4**).	Not present	Moderate
McGarvie Smith Farm 10	A small post-second world war weatherboard building with corrugated iron gabled roof, unoccupied. **Building is in poor condition with asbestos, missing windows, rotting timber. Building has louvre windows, timber framed windows and sills, wooden floorboards.**	Not present	Moderate
McGarvie Smith Farm 11	Orange/brown brick building with a brown tiled gable roof. The style of this dwelling is 1980s-1990s and is in good condition. **The building is occupied.**	Not present	Little
McGarvie Smith Farm 12	Small post-second world war weatherboard building with brown roof tiles. **Louvre windows at rear of building. Recent addition of metal framed verandah roof. Unoccupied and in deteriorating condition.**	Not present	Moderate

Other features

Additional features were identified during the field survey for this assessment. A concrete silo is located directly east of McGarvie Smith Farm 1 and 2. The silo (**Figure 6-3**) has a timber and corrugated iron roof. Surrounding the silo are large piles of concrete rubble, timber posts and low concrete structures (**Figure 6-3**). There is a large amount of vegetation growing over the features on the ground around the silo. Scattered north of the silo are further concrete structures and concrete slabs indicating previous buildings. Some of the concrete features have metal objects and

pipes on the surface. A review of 1947 aerial imagery indicated that the silo had been built and there was a larger building to the north and immediately adjacent to the silo. There was also another large building located further north of the silo which is no longer there.

There are two sheds (**Figure 6-5** and **Figure 6-6**) to the northwest of the silo. Shed 11 is corrugated iron with a timber A-frame roof, overhanging eaves, timber framed window and concrete slab. The inside of the building contains old farm refuse and there is cement sheet lining on the interior upper walls. Shed 22, further north, is a large more modern looking building with corrugated iron walls and roof. The shed is open on one side. Neither of the sheds are present on 1947 aerial imagery.

A series of earthworks exists across the property, including mounds and semi-circular embankments, dams and canals/ditches. Several dams are located across the property: adjacent to Elizabeth Drive, in the western half of the property and in the north. The canals/ditches are located just north of McGarvie Smith Farm 88 (**Figure 6-7**), and continue to the northern boundary of the property (**Figure 6-8**).

6.1.2 Curtilage information

The curtilage of the McGarvie Smith Farm includes houses, buildings, sheds, dams and earth works as described above and shown in **Figure 5-55**. A map showing the location and number of each building is shown in **Figure 6-10**.

6.1.3 Comparative analysis

6.1.3.1 Introduction

Farms associated with Sydney University include JB Pye, Coates Park, and Wolverton Farms in the Bringelly area, and the following farms in the Camden-Cobbity area: Westwood Farm, Corstorphine Farm, May Farm, Mount Hunter Farm, Karalee, and Lansdowne. The University's landholdings are used for a wide range of teaching, research and economic purposes, including broad scale cattle grazing, intensive food production, education and training, cutting edge research, and student accommodation. These farms are not listed on any heritage register or database. For the purposes of the comparative analysis, a series of heritage listed Agricultural Research and Advisory Stations, that were established from the 1890s across NSW by the Department of Agriculture have been compared. These experimental farms and research stations made major contributions to the development and introduction of new technologies in NSW agriculture in the first half of the twentieth century. The following farms and research and advisory stations are registered on the s.170 NSW Stage Agency heritage register by the Department of Agriculture.

6.1.3.2 Experimental farms (NSW Department of Planning, Industry and Environment (Regions, Industry, Agriculture & Resources))

Bathurst Experiment Farm

Research Drive, Bathurst
s.170 NSW State agency heritage register #3040004

This farm was the third experiment farm to be established by NSW Department of Agriculture. The farm undertook research on breeding and selection of improved varieties of farm crops and the raising of stud stock. The farm also had a farm school which operated between 1897 and 1941. The farm still contains the original buildings, comprising stables, cannery/packing shed, workshop, cottage, haysheds, seed store and woolshed. The buildings are constructed of weatherboards, galvanised iron and brickwork.

The farm is significant for the turn of the century farm buildings which have had little alteration over time and characteristic of farming in the Central Tablelands of NSW during this time. It is significant for its intactness of one of the Department's experiment farms of the 1890s which made major contributions to the development and introduction of new technologies into NSW Agriculture. The buildings have been the focus of some of the most important agricultural research to have been carried out in NSW in the first half of the twentieth century.

Condobolin Agricultural Research and Advisory Station

Trundle Road, Condobolin
s.170 NSW State agency heritage register #3040012

This farm was established in 1912 as a demonstration farm to assess the potential for cropping in the region. Merino sheep were introduced to the farm in 1917. In the 1920s experimental work expanded to hay, grain, fertiliser, seeding rates and cultivation trials. In the 1970s research was undertaken on sheep and beef cattle which decreased over time. Work on feral goats was undertaken between the 1970s and 1990s. The farm still contains a collection of

several buildings and associated structures such as office/admin building, stables and cottage. The buildings are constructed of timber, corrugated iron and brick.

The research and advisory station is significant for serving as the centre of agricultural research for over 90 years and has been instrumental in the introduction of significant technological and cultural change to the agricultural industries of the Central Wheat Belt of NSW. The buildings retain considerable fabric of life and technology of the early 1900s. it is both representative of the evolution of many rural industry technologies and a rare example of a type of place which has few intact survivors.

Cowra Agricultural Research and Advisory Station

Binni Creek Road, Cowra
s.170 NSW State agency heritage register #3040017

This farm was established in 1903 initially to research wheat growing. The station was also a practical agricultural training centre with accommodation onsite. After World War I the station was involved with the 'Dreadnought Farm Scheme' and during World War II, with the 'Women's Land Army'. In 1913, the station was used to evaluate breeds and crosses of sheep. The farm contains a collection of farm, research and administrative buildings and structures as well as a contour bank layout.

The research and advisory station is significant for its associations with significant figures and events in the history of NSW. The buildings retain considerable fabric of life and technology of the early 1900s. It is both representative of the evolution of many rural industrial technologies and a rare example of a type of place which has few intact survivors.

Glen Innes Agricultural Research and Advisory Station

Wellingrove Road, Glen Innes
s.170 NSW State agency heritage register #3040035

This farm was used for education and training in advancement and efficiency of agricultural production in the Northern Tablelands of NSW. The station was also linked to the 'Dreadnaught Farm Scheme'. The areas of contribution included fruit and vegetables, broadacre crops, pastures and livestock. The buildings were constructed in 1911 for accommodation. The farm contains a collection of buildings, infrastructure and plantings. The farm buildings are constructed of timber and corrugated iron while the main administration/accommodation buildings are constructed of brick.

The research and advisory station was significant for its contribution made by NSW Agriculture to the advancement and efficiency of agricultural production in the Northern Tablelands of NSW and its instrumental role in developing advanced technologies and introduction of improved genetic material to increase agricultural productivity. The research and advisory station is significant for their role in education and training.

Grafton Agricultural Research and Advisory Station

Trenayr Road, Trenayr
Copmanhurst Shire Council LEP #3040051

This farm was established in 1910 to develop advanced technologies and introduction of new genetic material to increase the productivity of agriculture in the region. Contributions included dairy cattle, beef cattle, pigs, maize and tropical pastures. The station was a practical agricultural training centre and was also linked to the 'Dreadnought Farm Scheme' after World War I. The farm contains a wide range of farm buildings such as office/laboratory, cottages, and other research related buildings. There is also rainforest remnant and a wetland.

The research and advisory station is significant at a regional level as one of a group of agricultural stations established throughout NSW by the Government during the period 1892-1916. It is also socially significant to the local Clarence Valley farming community, former staff and Dreadnought scheme boys.

Wagga Wagga Agricultural Institute

Pine Gully Road, Wagga Wagga
s.170 State agency heritage register #3040087

This farm was established as the Wagga Wagga Experiment Farm in 1892. The institute focused on advancement and efficiency of agriculture production in Southern NSW over a 100 year period. In 1948 the Wagga Agriculture

College was established at the institute. The institute provided first class laboratory and field facilities for research. In 1998 staff included extension, veterinary and regulatory staff.

The institute is significant as it was at the centre of focus of the contribution made by NSW Agriculture to the advancement and efficiency of agricultural production in Southern NSW over a period of in excess of 100 years. It was instrumental in the development of new plant varieties.

Wollongbar Agricultural Institute

Bruxner Highway, Wollongbar
s.170 NSW State agency heritage register #3040088

This farm was established in 1894 to develop advanced technologies and introduction of new genetic material to increase productivity of agriculture in the region. Features of the institute include buildings, infrastructure and plantings. The station was a practical agricultural training centre and was also associated with the 'Deadnought Farm Scheme' after World War I. Buildings on the site include administration and advisory buildings, library, research and chemistry laboratories, animal health building, veterinary laboratory, glasshouses, dairy and workshops.

The institute is significant as it was at the centre of focus of the contribution made by NSW Agriculture and was instrumental in developing advanced technologies and the introduction of new genetic material. The buildings, infrastructure and plantings form a significant fabric of the history of the activities on NSW Agriculture and are significant also for education and training. The property also includes individual buildings and plantings possessing significance in their own right.

6.1.3.3 Summary of comparative analysis

The comparative analysis indicates that heritage listed experimental farms associated with universities in NSW during the first half of the twentieth century are not common as there are limited listings on NSW heritage databases. A series of research and advisory stations across NSW which were established in the late nineteenth century by the Department of Agriculture played a large role in training and research in agriculture. A common theme of the stations was that building additions and farm elements were added over time, as well as demolished, as is the case with the McGarvie Smith Farm. Like the McGarvie Smith Farm, the stations played an important role in development and introduction of new agricultural technologies.

The comparative analysis indicates that many experimental farms, particularly those established by the Department of Agriculture, were established early with additions and modifications over time. In contrast, McGarvie Smith Farm was not established as an experimental farm until 1936. It appears the McGarvie Smith Farm focused specifically on veterinary training for Sydney University, whereas, the experimental farms and research stations outlined above in the comparative analysis and listed on heritage registers had a variety of functions. There are other Sydney University farms in existence but no assessment of their nature or significance has been undertaken to date. There are also likely university related farms and facilities located elsewhere in Australia. Therefore, while McGarvie Smith Farm had a different specific purpose to the other experimental farms, it contributes to the broader theme of the development of agriculture, pastoralism and farming in Australia in a similar way.

6.1.4 Significance assessment

The following significance assessment is based on the assessments prepared by Aurecon (2016:125-126) in standard text, RPS (2016: 165-166) in italics, with updates (bold or struck-out text) as determined during a comparative analysis undertaken for this assessment.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	The farm's educational purposes for animal husbandry and pastoral experimentation for students from across the Commonwealth as well as the University of Sydney makes it a historically significant site in the history of these industries~~, both State and nationally~~.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	McGarvie Smith Farm is associated with a number of leading researchers such as HJ Geddes who, as officer in charge to the farm, was responsible for pioneering water harvesting methods for Australian environments in the middle of the twentieth century. The farm is also associated with Sir John McGarvie, the developer of the first long living anthrax vaccine and the McGarvie Institute. The farm is associated with the University of Sydney. *It is also associated with Sir Frederick Tout, who was a director of the McGarvie Institute and assisted in its running.*

NSW Criterion	Assessment
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. McGarvie Smith Farm does not have any particular aesthetic qualities.
D – Strong or special associations with a particular community or cultural group	~~Without further research, it is not known to what degree the farm has social significance. However, its association with agricultural, pastoral and animal husbandry groups over the length of its history, may indicate potential significance.~~ **The McGarvie Smith Farm is one of a number of farms associated with former Sydney University veterinary students who would have spent some time here, including staying in the student accommodation on site, during operation of the farm as a training facility. Without further consultation or research with the relevant group, this criterion cannot be confirmed.**
E – Potential to yield information	The pioneering and experimental nature of McGarvie Smith Farm lends itself to technical/research significance. Its original function for educational purposes could also extend into the future, albeit from a heritage or historical perspective.
F – Uncommon or rare	McGarvie Smith Farm is a relatively intact example of an experimental farm from the 1930s and into mid twentieth century. It is facing endangerment not just to its built environment, but to the modified landscape in the form of innovative water harvesting practices constructed for its time.
G – Principal characteristics of a class	McGarvie Smith Farm was the leading state institution in pioneering experiments and educations in agricultural and pastoral methods. **Other agricultural institutes which contributed to research were established by the Department of Agriculture.**

6.1.5 Statement of significance

The following statement of significance is replicated from Aurecon (2016:124) with updates (bold or struck-out text) as determined after comparative analysis undertaken for this assessment.

> *The McGarvie Smith Farm has a chronology of structures and infrastructure dating from the 1930s through until recent times.* **All the buildings contribute to the significance of use of the site over time, and the two oldest buildings on the complex are McGarvie Smith Farm 1 and McGarvie Smith Farm 2.** *The farm's educational purposes for animal husbandry and pastoral experimentation for students from across the Commonwealth as well as the University of Sydney makes it a significant site in the history of these industries~~, both State and nationally~~. It is an innovative complex,* **linked closely to the history of Sydney University as an agricultural research institution. As such, it differs from other experimental farms of that era, which were established by the Department of Agriculture, as it contributes more broadly to the story of the development and innovation of Australia's agricultural and pastoral industries. The farm** *was a leader in the way in finding solutions to the agricultural and pastoral industries of the mid twentieth century.* **The farm is assessed as being of State significance.**

Figure 6-1 Farm 1, facing northwest.

Figure 6-2 Farm 2, facing southwest.

Figure 6-3 Silo and concrete remnants, facing west.

Figure 6-4 Farm 8, facing north.

Figure 6-5 Shed 1, facing west.

Figure 6-6 Shed 2, in background, facing south.

Figure 6-7 Visible ditch in western section of the property, facing northwest.

Figure 6-8 Earthen ditch in northern section near Badgerys Creek, facing southeast.

Figure 6-9 Dam in northern section of property, facing northeast.

6.2 Item 2: Fleurs Radio Telescope Site (Penrith LEP 832)

The following information has been summarised from A Heritage Survey of the Fleurs Radio Telescope Field Site (Gorman 2018). A full version of this report is provided in **Annexure A**.

6.2.1 Description and history

The Fleurs Radio Telescope site is listed on the Penrith LEP (832). Australian Government et al. (2016:31) identified Fleurs scientific and educational values and assessed the property as having local significance.

The Fleurs Radio Telescope intersects with the study area on Lot 21 DP 258414. The South Creek 1 and 2 heritage items are about 80 metres north of the construction footprint. The site was surveyed on the 20 and 21 October 2017 by Wallis Heritage Consulting (Gorman 2018). During the field survey a number of buildings, remains of antennas, antenna footing trenches, concrete plinths, cabling, signal boxes, and demolition material were noted.

The area around the Fleurs site is predominantly grazing and farmhouses and the land is zoned low lying rural/commercial (Figure 3-11 in Australian Government et al. 2016:72).

Fleurs was originally part of Bayly Park, established in the early 1800s by Rum Corps officer Nicholas Bayly, who cleared the property of vegetation (Stacker 2002). In 1823, part of the original property was sold to merchant Richard Jones, who named it Fleurs. A full historical background of the Fleurs site is given in Australian Govt et al. (Australian Government et al. 2016:21-23).

In World War II the Royal Australian Air Force (RAAF) Station Fleurs aerodrome was constructed at the southern end of the area. Between 1949 and1956 the aerodrome was used by the NSW Gliding Association.

In 1954 the Commonwealth Scientific and Industrial Research Organisation (CSIRO; formerly the Council for Scientific and Industrial Research (CSIR) acquired the Fleurs property as a scientific field site for radioastronomy. Fleurs was the leading field station of the CSIRO's Division of Radiophysics, utilising three innovative cross-type radio telescopes, the Mills Cross, Shain Cross and the Chris Cross (Australian Government et al. 2016) (**Figure 6-11**). The Chris Cross was the world's first cross-grating interferometer and the first radio telescope to provide a two-dimensional daily map of the Sun (Orchiston 2004). The property was purchased by the University of Sydney in 1963.

The project
M12 study area
The project construction footprint
McGarvie Smith Farm
Ancillary facilities

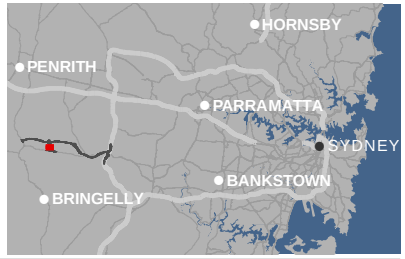


Figure 6-10 Map showing location of building numbers and features at McGarvie Smith Farm

Date: 5/07/2019 Path: J:\IE\Projects\04_Eastern\IA145100\08 Spatial\GIS\Directory\Templates\MXDs\Figures\EIS\SpecialistReports\NonAbHeritage\FinalEIS\JAJV_EIS_NonAbHeritage_F007_McGarvieSmithFarmBldngs_r6v1.mxd
Created by : AA | QA by : TC

Features recorded at Fleurs Radio Telescope site can be found in **Table 6-2**.

Figure 6-11 Shain Cross, with Mills and Chris Cross in background, from Gorman (2018) (image courtesy of ATNF).

6.2.2 Curtilage information

The curtilage of the Fleurs includes buildings, the remains of three antennas, radio dishes, switch boxes, fencing, and earth works as described in Gorman (2018). A map showing the location of each building and structure is shown in Figure 18 in Gorman (2018) and is reproduced as **Figure 6-12**. The heritage curtilage for this heritage item is shown **Figure 5-55.** Significance assessment

The following information has been summarised from A Heritage Survey of the Fleurs Radio Telescope Field Site Gorman (2018:68-71).

NSW Criterion	Assessment
A – Important in the pattern of NSW's history	***Assessment by Australian Govt et al. (2016)*** Fleurs was 'historically important at periods of the State's history—in the development of radiophysics during the 1950s and 1960s'. It has potential historical significance at a local or State level. However, the low to moderate intactness of the site may reduce it to local significance (Australian Govt et al. 2016:77). ***Revised 2018 Assessment*** While radioastronomy has been practiced at other scientific sites in Australia the CSIRO field sites around Sydney were the location of the major developments in the field of radioastronomy following WWII. These were the places where Mills, Christiansen, Payne-Scott, Pawsey and others established some of the fundamental principles of radioastronomy. This work established the CSIRO as a world leader, as evidenced by the 1952 URSI conference taking place here. Fleurs was significant as the field site which hosted the mature technologies of the interferometer, Mills Cross and cross grating antennas. Hence it can be argued that Fleurs represents a period, prior to the development of the ATNF, where state-based research was leading the way. Tangible elements relating to state significance are standing elements of the Shain Cross and the FST, and the materials of Mills Cross, Chris Cross and FST located in rubbish mounds scattered across the site. While the telescopes are not in good condition and are completely dismantled in some cases, intactness is not a reason for exclusion (OEH 2001:12). At the local level, Fleurs is one site of a number of research stations in the area, including the University of Sydney McGarvie Smith Farm, established in 1936 for veterinarian studies (Australian Govt et al. 2016:139–146), and the CSIRO McMaster Animal Health Research Farm (M12 H4; Australian Govt et al. 2016:124–127). It forms one component of a wider

NSW Criterion	Assessment
	landscape of institutional research facilities interspersed with small scale pastoral and horticultural industries— science at local scale. Intrusive values are associated with agricultural activities such as pasture, fencing, and ploughing, which have contributed to the erasure of the original ground reflecting surfaces and obscured the visibility of the Shain Cross.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's history	Fleurs is associated with pioneering radioastronomers Bernard Mills, Bruce Slee, Alex Shain, Chris Christiansen, Charlie Higgins and J.L. Pawsey. It represents a significant chapter in the history of the CSIRO's Division of Radiophysics, which was the foundation of the CSIRO's continuing work in radioastronomy. The ground-breaking scientific contributions of these astronomers has been extensively researched by scholars such as Orchiston (see References). Both Mills and Christiansen became professors at the University of Sydney, which supported Christiansen's continued work on the Chris Cross and FST. As a school of radioastronomy, these men were technological innovators, dedicated teachers and pioneers of Australian science with international reputations, who launched Australian science onto a world stage. Mills, Shain and Christiansen were each primarily responsible for the design, construction and operation of the antenna which bears their name, although there was clearly also much cross-fertilisation of ideas. The final configuration of the arrays indicates both individual achievement and the impacts of working in a close-knit research group which fostered innovation and experimentation. The astronomers of Fleurs are associated with State, National and International networks of scientists. Their integration into, or participation in, the local community is not known.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	The antennas demonstrate a high degree of both creative and technical achievement by prominent NSW scientists and technicians. Radioastronomy is now an integral part of astronomy, with a multitude of telescopes worldwide. However, in the 1940s and 1950s, it required true creativity and imagination to devise innovative instruments and visualise their signals to portray a 'vision' of the universe which barely existed before. These antennas were integral to the global effort to map the radio universe and understand its relationship to the optical universe. The surveys carried out at Fleurs from the 1950s to the 1980s resolved many of these disparate data sources, enabling us to more fully understand the structure of the universe. The construction and design of the antennas is directly related to a way of perceiving the universe. While scientific instruments are not always associated with aesthetic values, there are some themes that emerge from Fleurs (Table 5 in Gorman 2018). The selection of Fleurs for the siting of the arrays was due to the availability of a sufficiently large area of flat ground in a radio-quiet area, thus relating to local topography. The repetition of modular elements in all three crosses also lends a distinctive appearance, although this is now only evident in the remaining Shain Cross elements. The individual elements of the telescopes are in various states of decay. Further elements have been dismantled and are stockpiled in the rubbish mounds. As noted for the management of heritage values at Mt Stromlo following the 2003 fires, in recent years such decay and destruction are being recognised as having social and aesthetic value in their own right. While nothing as dramatic as a firestorm occurred at Fleurs, there was nonetheless at least two moments of destruction, in the 1990s and in 2005 when the bulk of the site was bulldozed and the materials stockpiled. The demolition created dis-array of the arrays, disrupting the careful geometry that listened to the sky. The antennas have not entirely left the site: they are simply deconstructed, re-arranged from an organic assemblage forming a complete unit, into a bricolage of body parts and groupings defined by material and form. With the exception of the two FST dishes, the remainder of the antenna parts are not sufficiently different from average rural construction materials to be immediately identifiable as scientific instruments. The dishes are an unusual and uncommon feature in the local landscape, where nothing else like them exists; however, due to the flat topography and degree of vegetation along the creek lines, they are not easily visible from surrounding roads and properties.

NSW Criterion	Assessment
	Unlike many dish antennas at major astronomical and satellites tracking stations in Australia, which imported their antennas from the USA, the Fleurs antennas were all manufactured in NSW. Further research could identify how distinctive their style is in comparison to imported antennas.
D – Strong or special associations with a particular community or cultural group	The associations with the site for the local community at the present time would require further consultation. However, it is clear that there has been an interest in Fleurs in the past. For example, local historian Stacker (2002) included the Fleurs antennas in her 2002 pictorial history of Penrith and St Mary's. The 2005 demolition of the Mills Cross and Chris Cross antennas were, as reported by Orchiston et al. (2005:68), a result of concerns about children playing in the structures. This implies it was frequent enough an activity to warrant concern, and speaks to the re-purposing of the antennas into an informal playground for local children—a charming (albeit alarming from the safety perspective) image. The feelings of the children deprived of their cosmic playground are unknown. However, the ease with which the process of demolition was suggested and approved suggests that the local adult community did not have strong associations with the science or aesthetic qualities of the Fleurs infrastructure. The site has very strong associations for the NSW, national and international astronomy community, including people who worked on the various antennas, former students at the University of Sydney and University of Western Sydney, and historians of astronomy. Numerous works by Orchiston and others, and the continued concern of the IAU radioastronomy working group, emphasise that the physical infrastructure of antennas is meaningful for them, as demonstrated in this quote from Orchiston (2004b:68) prior to the final destruction of the Chris Cross: *… a visit to Fleurs reveals that the novel Mills Cross and Shain Cross antennas are no more, having long ago rotted, rusted and disintegrated. Thus, to track Slee's initial exploits in radio astronomy is to explore the early history of these Radiophysics field stations and to mourn the loss of so much of our pioneering radio astronomical heritage. We can but hope that reason will prevail and that those early radio telescopes that have survived, including the 18 m Kennedy parabola at Parkes, parts of the Chris Cross and the Fleurs Synthesis Telescope at Fleurs, and the Radioheliograph and Radiospectrograph at Culgoora, will be restored and preserved for posterity.* With increased interest in the life and work of Ruby Payne-Scott and Australian women scientists generally, the community of women involved with the Fleurs site should not be forgotten. A footnote in a published research paper acknowledges the work of two women who performed calculations for the antennas before computers were installed. The work of women 'computers' is increasingly being highlighted at places like the Defence space launch site of Woomera, and further research would undoubtedly lead to the identification of more women involved with science at Fleurs.
E – Potential to yield information	***Assessment by Australian Govt et al. (2016:78)*** 'Inherent to most of the sites inspected as part of the March 2016 survey, is a level of research significance. This is largely attributable to the moderate intactness of most of these items. Ranging from the nature of historical community social hubs such as those at Cecil Park, through to the experimental undertakings of institutions in the twentieth century across domains as diverse as radiophysics, animal husbandry, and military defence.' Australian Govt et al. (2016:78) concluded that Fleurs has research potential, despite compromised intactness. ***Revised 2018 Assessment*** The site has the potential to contribute to the understanding of the manufacture, and hence the science and technology 2018, behind the construction of early radiotelescopes. These materials are still present on the site, although the Mills Cross and Chris Cross are mainly represented in the rubbish mounds. As the controversy over the 2C catalogue demonstrates, the nature of the instruments was integrally bound up with what was perceived, and hence the theories the data supported. The antennas and their remains are tangible evidence of two intangibles: the radio waves they were designed to pick up, and the cultural context of how the universe was understood in the 1950s and 1960s. The

NSW Criterion	Assessment
	changing configurations of the antennas reflect a positive feedback loop whereby data from one iteration led to the refining of hypotheses and redesigning of the antenna configurations to validate new theories. Without the (admittedly compromised) physical remains at the site, it would not be possible to pursue research into the social context of the technology. Subterranean evidence of cable infrastructure may reveal successive phases of development such as automation, the move from employing women 'computers' to electronic computers, and increased power demands as the sophistication of the capacity of instruments increased.
F – Uncommon or rare	***Assessment by Australian Govt et al. (2016:78)*** The Fleurs Radio Telescopes are rare examples of early radiophysics technology in Australia, providing the lead in this field during a narrow window of innovation between 1954 and 1963. Further historical and archaeological research is required to determine whether significance is at State or local level due to various compromises to the site's integrity. ***Revised 2018 Assessment*** There are few extant remains at other Division of Radiophysics field sites around Sydney. An antenna footing survives at Dover Heights along with a replica antenna created as a memorial. Orchiston notes that of all these significant sites, including Badgerys Creek and Penrith (Figure 4), only the 12 Chris Cross antennas survived in 2004 (Orchiston 2004a:161); four were removed to unknown locations, and none now survive at the site. Fleurs appears to be all that remains as physical fabric in its original location. In the Australian context, the only comparable antenna arrays were built by Grote Reber in Tasmania; his square kilometre dipole array at Bothwell and other non-dish antennas no longer exist. The Molonglo Mills Cross, the technological successor of the Fleurs Mills Cross, is still in operation using one arm. Gorman 2018 (**Annexure A**) shows that there are no other cross antennas or low frequency arrays surviving nationally. Original Mills Cross antennas are rare globally, as the parabolic reflector has superseded cross, horn and other configurations as the most common form of antenna. For example, the Seneca Mills Cross, influential for its role in the discovery of Jovian radio emissions, was destroyed at some point between 1955 and 2005 (however, it is on the Maryland SHR). The Stanford University (California, USA) Mills Cross antenna at Site 515 was destroyed in 2010, much to the dismay of the IAU's Working Group on Historic Radio Astronomy (Orchiston and Kellerman 2010:246). Orchiston (2004) pointed to the rapidly disappearing infrastructure of radio astronomy in Australia and the central significance of Fleurs in this history. Hence the remaining Shain Cross and FST antennas, based on Mills' principles, are both rare and endangered.
G – Principal characteristics of a class	***Assessment by Australian Govt et al. (2016:78)*** Australian Govt et al. (2016:79) stated that 'In nearly all cases, further historical and/or archaeological research is required to fully assess both the significance and intactness of both the sites identified during this project, and those identified from previous studies.' ***Revised 2018 Assessment*** The current survey indicates that Fleurs retains portions of the fabric of a scientific field site, in the topography required for the construction of long antenna arrays, and the remnants of the arrays which partially show the original layout in the distinctive cross shape. It demonstrates the characteristics of an early radioastronomy field site, the only one which retains archaeological evidence of the early development of radioastronomy in NSW and nationally.

Table 6-2 Fleurs antenna and infrastructure elements and grading

Site Element Grading Justification	Site Element Grading Justification	Site Element Grading Justification	Site Element Grading Justification
South Creek 1 Antenna Complex	Overall	Low	Good condition. The antenna has been removed. However, the 'signal box' is intact and in good condition. The plinths have been moved from original location and cables are exposed.
	Signal box	High	In excellent condition; demonstrates a key part of antenna operation.
	3 x plinths	Little	Function unknown, position disturbed.
	Cable trench	Moderate	This is the only location at the site where cables are exposed, with the potential for further research on the operation of the FST antennas.
	Antenna footing trench	Little	The trench indicates where an antenna has been removed from the site but provides no further information about its operation or configuration.
South Creek 2 Antenna	Overall	High	Poor condition. This is one of two FST elements remaining on site, and despite having collapsed, the structure is in better condition than the North antenna, (which would not be impacted).
	FST	Exceptional	One of only two extant antennas remaining on the site. Demonstrates how the Chris Cross was augmented to become the FST. Although collapsed, the dish is sufficiently intact to allow recording of its configuration and allow comparison with the North Antenna and FST antennas located at CSIRO Marsfield and Parkes.
	Signal box	Moderate	Mostly identical to Signal Box 1 but in poorer condition.
	Power structure	Little	The purpose of the structure is unclear.
	Fenced enclosure	Little	A later addition to protect the antenna and signal box from stock and other damage; unrelated to original function.
North Antenna Complex	FST	Exceptional	One of only two extant antennas remaining on the site. Demonstrates how the Chris Cross was augmented to become the FST and the aesthetic impact of the height and texture of the structure within its setting. The antenna is standing although damaged by rust and in a precarious position.
	3 x plinths	Little	Intact position, but function unknown.
	Fenced enclosure	Little	A later addition to protect the antenna and signal box from stock and other damage; unrelated to original function.
Shain Cross	SC01	Exceptional	Intact but deteriorating. One of seven intact elements of the Shain Cross array in its original location, demonstrating Shain's technological innovation as well as Slee's alterations which continued the active life of the array after Shain's death. Demonstrates an unusual radio telescope type as used in the early decades of the international development of radioastronomy. This is the terminal element of the N-S arm of the Shain Cross, aligned with several further elements at the northern end of the site.
	SC02	Exceptional	As above. SC02-SC07 show how the Shain Cross poles were aligned in offset pairs.
	SC03	Exceptional	As above.

Site Element Grading Justification	Site Element Grading Justification	Site Element Grading Justification	Site Element Grading Justification
	SC04	Exceptional	As above.
	SC05	Exceptional	As above.
	SC06	Exceptional	As above.
	SC07	Exceptional	As above.
Central Mound Complex	Chris Cross artefact scatter	Little	Demolition debris heavily disturbed by ploughing and other agricultural activities.
	Instrumentation complex 1	Moderate	Buildings in poor condition with asbestos contamination issues. Demonstrate data processing aspect of antenna operation and working conditions of Fleurs staff.
	RB1	Moderate	Mills Cross and/or Chris Cross fabric; only extant remains of these arrays. Demonstrates the manufacture and construction of the arrays.
	RB2	Moderate	Mills Cross fabric.
	RB3	Moderate	Mills Cross fabric.
	Instrumentation building 2	Moderate	In poor condition with asbestos contamination. Original instrumentation building for the Mills Cross array. Demonstrate data processing aspect of antenna operation and working conditions of Fleurs staff. Some processing/computing units and documents inside.
	RB4	High	Contains turnstile antenna, which demonstrates additional astronomical activity at the site at a different level to the crosses, perhaps relating to a specialist experiment.
	RB5	Moderate	Possibly related to Mills Cross.
	RB6	High	Counterweights from the original Chris Cross array; the most intact component present on the site; demonstrates the pre-automation configuration of the antennas.
	RB7	Moderate	Not clear which instrument it is related to.
	RB8	High	Includes Shain Cross elements.
	RB9 rubbish mound complex	High	Includes Shain Cross antenna elements and Chris Cross infrastructure elements.
Kemps Creek artefact scatter	Kemps Creek artefact scatter	Little	Low possibility of antenna components; most likely related to non-astronomical activities at the site.

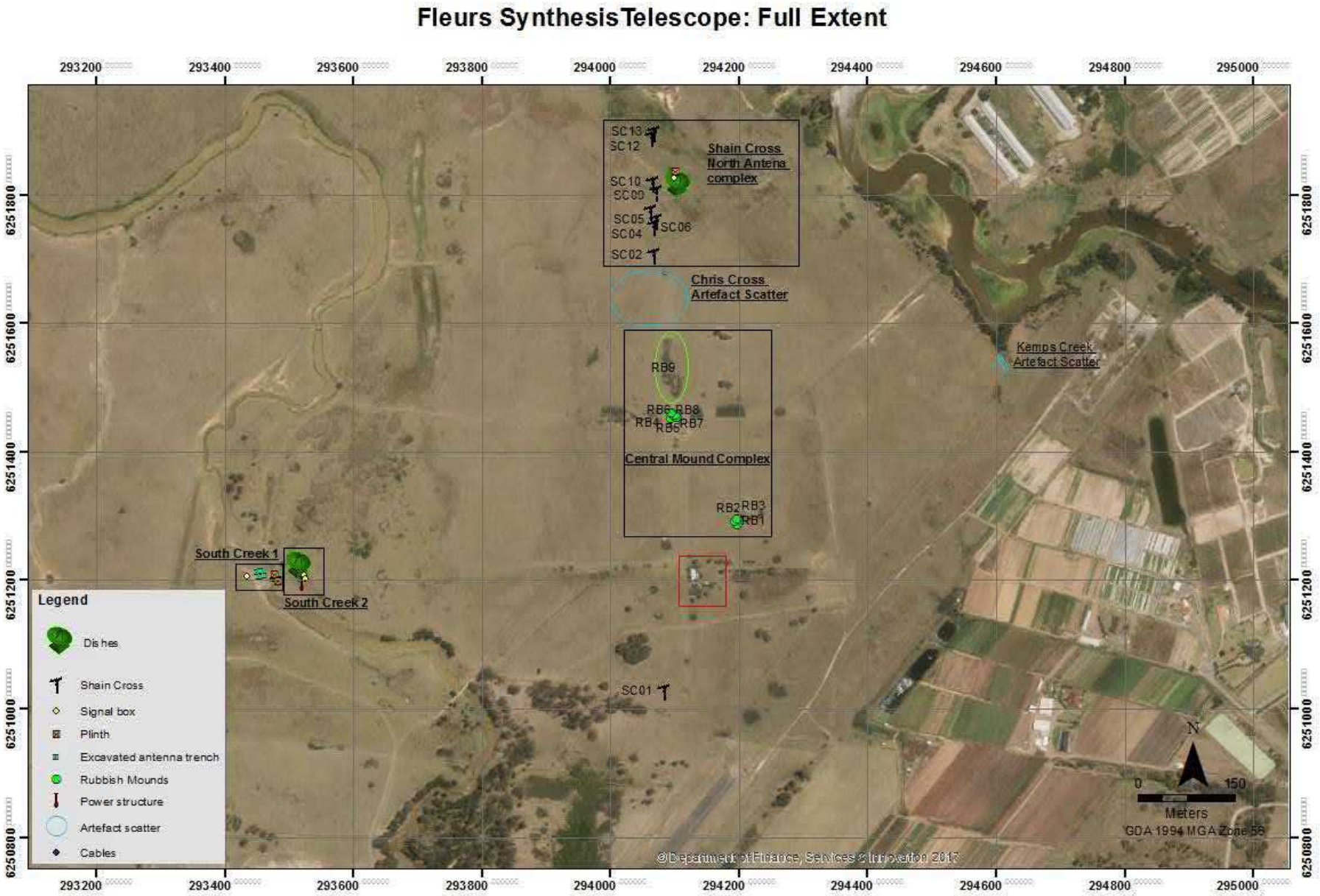


Figure 6-12 Map showing the buildings and structures identified by Gorman (2018) at Fleurs Telescope site.

6.2.3 Statement of significance

The following information has been summarised from A Heritage Survey of the Fleurs Radio Telescope Field Site (Gorman 2018).

The Fleurs Radio Telescope Site was a CSIRO facility established in the 1950s for radioastronomy research. Three innovative antenna arrays were designed and built in order to pick up low frequency radio signals from galaxies, the Sun and Jupiter. Radioastronomy was a new area of research emerging from WWII radar technology, and through these antennas, Australia became a world leader, a position it still holds today. The astronomers Bernard Mills, Chris Christiansen, Alex Shain, Bruce Slee and others used the antenna arrays to map the non-visible part of the universe, made 'visible' for the first time through this technology. The data they gathered contributed to cosmological theories of the origin of the universe, particularly in the Steady State vs Big Bang debate. As a school of radioastronomy, these men were technological innovators, dedicated teachers and pioneers of Australian science with international reputations.

The antennas demonstrate a high degree of both creative and technical achievement by prominent NSW scientists and technicians. In the 1940s and 1950s, it required true creativity and imagination to devise innovative instruments and visualise their signals to portray a 'vision' of the universe which barely existed before. The construction and design of the antennas is directly related to a new way of perceiving the universe.

The Chris Cross, Mills Cross and Shain Cross were composed of identical antenna elements in long lines forming a symmetrical cross shape. The cross formation created an artificial 'dish' the length of the cross arms. While many antenna types can be grouped together to form arrays, the cross formation was devised and tested by Bernard Mills and is associated with him. The Chris Cross comprised 64 traditional 'dish' antennas.

The Mills Cross was made of 'hurdle'- shaped supports covered in chicken wire which collected the radiowaves. The Shain Cross used wire dipole antennas strung between power poles. In the 1960s, the Chris Cross was extended by adding new dish antennas and became the Fleurs Synthesis Telescope. The Fleurs site was selected because it was both large and flat enough to encompass the long arms of the arrays. As the Shain Cross used the ground as a reflector, the landscape itself can be regarded as a component of the antennas.

The antenna arrays at Fleurs were actively used to gather data about the solar system and distant galaxies until the 1990s, by which time they had been superseded by high-frequency dish antennas. In 2005 large parts of the infrastructure were demolished or removed. Remaining telescope infrastructure at the site is two 13.7 metres dishes from the Fleurs Synthesis Telescope, seven intact power poles from the Shain Cross, and elements of the Mills Cross and Chris Cross scattered between stockpiles of demolition material.

The aesthetic qualities of the site contrast high science with a typical rural landscape. The dishes of two remaining Fleurs Synthesis Telescope dish antennas, one of which has fallen, retain their original chicken wire mesh reflecting surfaces and reveal the geometric structure of the dishes. The position of the dishes and several remaining Shain Cross poles show the extent of the original cross arrays placed across the landscape.

The state of decay, while diminishing the integrity of the elements, conveys a distinct aura of the passing of time and the integration of the telescopes into the natural environment.

The site has very strong associations for the NSW, national and international astronomy community, including people who worked on the various antennas, former students at the University of Sydney and University of Western Sydney, and historians of astronomy.

The site has the potential to contribute to the understanding of the manufacture, and hence the science and technology, behind the construction of early radiotelescopes. These materials are still present on the site, although the Mills Cross and Chris Cross are mainly represented in the rubbish mounds. The antennas and their remains are tangible evidence of the radio waves they were designed to receive, and the cultural context of how the universe was understood in the 1950s and 60s. Subterranean evidence of cable infrastructure may reveal successive phases of development such as automation, the move from employing women as 'computers' to electronic computers, and increased power demands as the sophistication of the capacity of instruments increased.

There are few extant remains at other CSIRO radioastronomy field sites around Sydney. Fleurs appears to be all that remains as physical fabric in its original location. Nationally, no other cross antennas or low frequency arrays survive. Original Mills Cross antennas are rare globally, as the parabolic reflector has superseded cross, horn and other configurations. Hence the remaining Shain Cross and FST antennas, based on Mills' principles, are both rare and endangered.

Fleurs retains portions of the fabric of a scientific field site, in the topography required for the construction of long antenna arrays, and the remnants of the arrays which partially show the original layout in the distinctive cross shape. It demonstrates the characteristics of an early radioastronomy field site, the only one which retains archaeological evidence of the early development of radioastronomy in NSW and nationally.

These antennas were integral to the global effort to map the radio universe and understand its relationship to the optical universe. The surveys carried out at Fleurs from the 1950s to the 1980s enabled us to more fully understand the structure of the universe. The CSIRO's field sites, including Fleurs, were the focal point of radioastronomy research in Australia.

The site is considered to have State and potentially National significance as evidence of ground breaking scientific discoveries, leading to revisions of our understanding of the origins of the universe, and as evidence of Australia's pre-eminence in the international development of radioastronomy. There is renewed interest in the history of radioastronomy due to Australia's key role in the Square Kilometre Array, to which the Fleurs antennas can be considered historical precursors. The elements are considered to have outstanding interpretive potential.

6.3 Item 3: Luddenham Road Alignment (Penrith LEP 843)

6.3.1 Description and history

Luddenham Road is registered on the Penrith LEP (843) and bisects the study area for about 347 metres. It was surveyed on 16 November 2017 (Survey Area No. 12). The heritage item is located inside the construction footprint.

The following information is replicated from Aurecon (2016:160):

> *An early unnumbered edition of the parish map for Claremont in the County of Cumberland shows a red double dashed line on a north easterly alignment running parallel with Cosgroves Creek to the east. [***Figure 6-1***]. Titled 'Govt. Road', this road infrastructure is the site of the Luddenham Road alignment. This road easement has been previously identified in earlier heritage studies as a significant early cadastral feature of the area and has been included in the Penrith LEP 2010. Absent from the earliest parish maps for Claremont, its ill-defined nature in the parish map is replaced by a more permanently depicted road easement in later maps. The road easement of Elizabeth Drive (formerly School Road), forms a T intersection with, and defines the southern extent of Luddenham Road.*
>
> *In 1894, the Nepean Times reported that parliamentarian TR Smith had been successful in his term of office in getting the Luddenham Road approved and established. In 1890 it was described as a 'principal road' in connecting the townships of Liverpool, Luddenham and St. Mary's. The condition of the road appears to have been a topic of discussion for a number of decades. By the 1920s, a time of great innovation in road building techniques, wood carters were blamed for creating ruts along the route and plans were being made to metal its surface. Further conditioning of the road continued into the 1930s.*

After a field inspection, Aurecon concluded that the original cadastral reserve and road alignment survives, however modification of the original road fabric and associated features suggests that it has low historical significance at a local level. Aurecon indicated that impact by any future development would minimally affect the integrity of the whole alignment.

A site inspection for this project supports the conclusion outlined above. Within the study area, Luddenham Road comprises modern asphalt with no remnants of the original road visible. The road is located within the original cadastral location with road reserve either side.

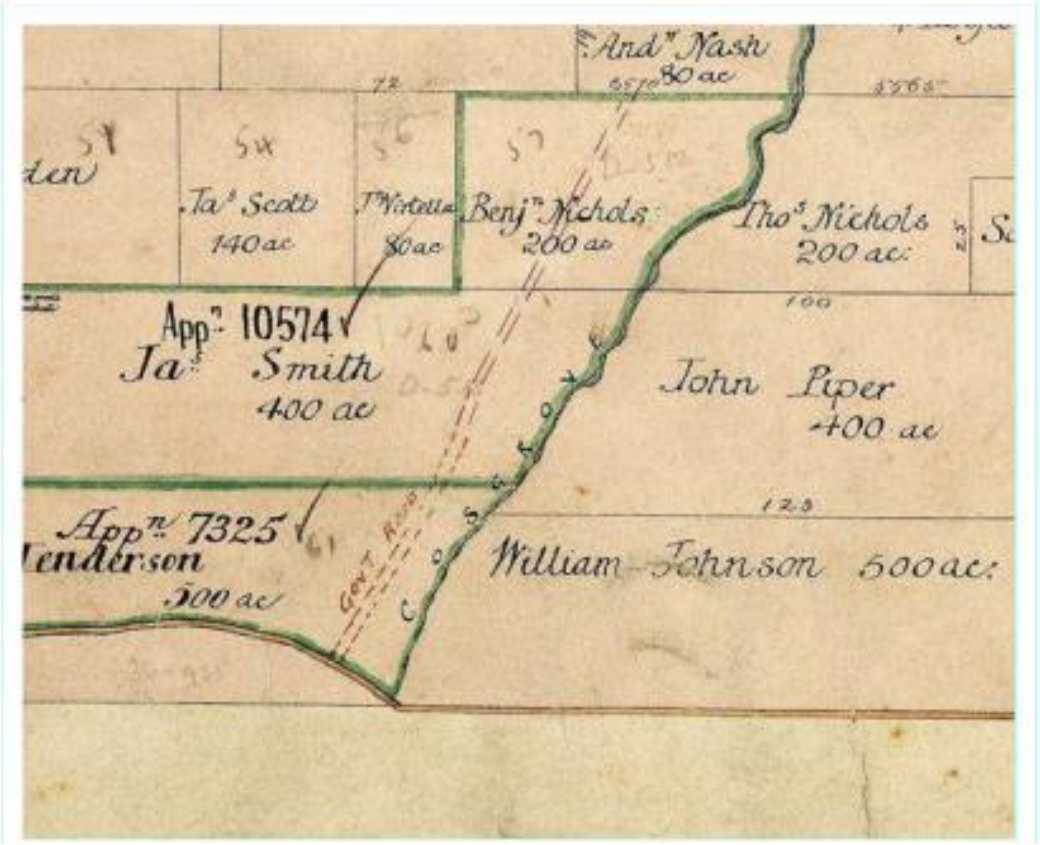


Figure 6-13 Extract from an early (unnumbered) edition of the Parish Map of Claremont, showing Luddenham Road as the 'Govt. Road'

Source: Aurecon 2016

6.3.2 Curtilage information

The curtilage of Luddenham Road within the study area is shown in **Figure 5-55**.

6.3.3 Significance assessment

The following significance assessment applies only to the section of Luddenham Road within the study area. The remaining sections of Luddenham Road were not assessed.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	The Luddenham Road Alignment has historical significance as a late nineteenth century road connecting the western settlements of Luddenham and St Marys as part of the growing development in this part of western Sydney and the need for infrastructure to support economic development in the area.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. The Luddenham Road Alignment within the study area has no known historical association significance.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. The Luddenham Road Alignment within the study area has no aesthetic significance.
D – Strong or special associations with a particular community or cultural group	Does not meet this criterion. The road is only important to the local community for amenity reasons.
E – Potential to yield information	Does not meet this criterion. As no physical evidence of the original road remains due to modifications over time the item has little or no research or archaeological potential.

NSW Criterion	Assessment
F – Uncommon or rare	Does not meet this criterion. The Luddenham Road Alignment is not the only colonial road example within NSW and there are better examples with some original features and physical evidence, including the Great North Road and Old Windsor Road.
G – Principal characteristics of a class	Does not meet this criterion. The Luddenham Road Alignment within the study area is a poor example of early historical NSW roads. Modifications and upgrades within this section of the road have resulted in the loss of a range of characteristics.

6.3.4 Statement of significance

The item is considered to have local historical significance as an early road. While the section of Luddenham Road within the study area is located within the original cadastral location of the early road, original fabric associated with the early road no longer exists due to modifications and renewal of the road surface over time.

Figure 6-14 Luddenham Road, western road reserve, facing north.

Figure 6-15 Luddenham Road, eastern road reserve, facing south.

6.4 Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (SHR 01373, Liverpool LEP)

6.4.1 Description and history

The Upper Canal System bisects the study area in the southwestern and northeast corner of the Elizabeth Drive and M7 interchange on Lot 1/DP 603946 and Lot 51/DP811015. The heritage item is partly located inside the M12 Motorway construction footprint. It was surveyed on 1-2 March 2018 (Survey Area Nos. 36 and 42) (**Figure 6-17**, **Figure 6-20**). A map showing the curtilage of the Upper Canal System is provided in **Figure 8-3**.

The Upper Canal System within the study area is in tunnel 32 metres below the ground surface, which is part of the section of canal referred to as the Cecil Hills Tunnel. There is an interpretive sign located in the eastern road reserve, within the study area (**Figure 6-19**). The sign states that the Cecil Hills Tunnel, built between 1880 and 1888, was one of eight in the Upper Canal System that carried water from the Upper Nepean to Prospect Reservoir and Sydney. **Figure 6-16** shows a schematic diagram of the relevant section of the tunnel and its depth beneath the ground surface. The tunnel is a fine example of nineteenth century hydraulic engineering and many of the original control installations are still in use.

The brick-lined Tunnel Shaft 4 is located within the study area and projects above the current central traffic median of the M7 Motorway. The shaft is 33.8 metres deep and was one of seven shafts along the Cecil Hills Tunnel. During construction the shafts were used to remove stone and provide ventilation. Tunnel Shaft 4 was observed from the M7 eastern road reserve (**Figure 6-18**).

No other areas of archaeological potential were identified during the field survey of this heritage item.

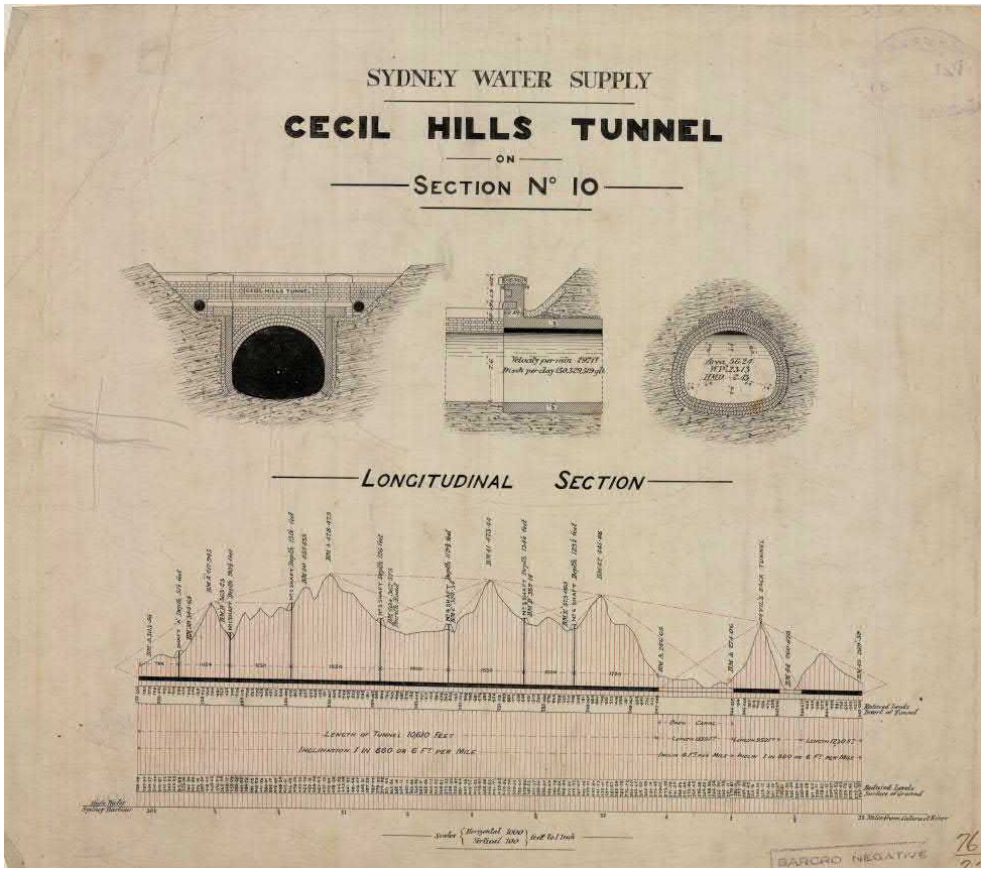


Figure 6-16 Schematic diagram of the Cecil Hills tunnel portion of the Upper Canal System
Courtesy: Arcadis

The following section is replicated from the NSW heritage database.

In 1867, the Governor of NSW appointed a Commission to recommend a scheme for Sydney's water supply, and by 1869 it was recommended that construction commence on the Upper Nepean Scheme. This consisted of two diversion weirs, located at Pheasant's Nest and Broughton's Pass, in the Upper Nepean River catchment, with water feeding into a series of tunnels, canals and aqueducts known as the Upper Canal. It was intended that water be fed by gravity from the catchment into a reservoir at Prospect. This scheme was to be Sydney's fourth water supply system, following the Tank Stream, Busby's Bore and the Botany (Lachlan) Swamps.

Designed and constructed by the Public Works Department of NSW, Prospect Reservoir was built during the 1880s and completed in 1888. Credit for the Upper Nepean Scheme is largely given to Edward Orpen Moriarty, the Engineer in Chief of the Harbours and Rivers Branch of the Public Works Department from 1858-88 (B Cubed Sustainability, 2005, 7).

The Upper Canal System is an integral element of the Upper Nepean Scheme which collects water from the four major dams on Cataract, Cordeaux, Nepean and Avon Rivers. The 64km long Upper Canal is the man-made section of the Scheme between Pheasant's Nest Weir and Prospect Reservoir and still operates as a gravity supply.

The Upper Canal was commissioned into use in 1888, along with Prospect Reservoir. The Canal was built using a variety of materials and structure types to suit the nature of the countryside through which it was passing. Above ground the water was channelled in open canal sections. Where the ground was soft the Canal was Vshaped and lined with shale or sandstone. In other sections, it was U-shaped and lined with sandstone masonry or left unlined where the Canal cut through solid rock. Where the water had to pass through hills or rises, tunnels were excavated and left unlined where they passed through rock and lined with brick where they cut through softer material. Over creeks and other deep depressions, the water moved through wrought iron aqueducts.

Other original design features included: stop boards to allow sections of the Canal to be closed for cleaning and repair; flumes to ensure that stormwater from surrounding lands did not enter the Canal to pollute; bridges to carry major roads; and 'occupation bridges' to allow access for property owners.

A Conservation Management Plan (CMP) (NSW Public Works Government Architect's Office 2016) was prepared for the Upper Canal. The report included heritage significance for the canal, outlined conservation policies and guidelines for conservation works, maintenance works and schedule of exemptions. The CMP is discussed further in **Section 8.3**.

6.4.2 Curtilage information

The section of the Upper Canal System within the study area relates to Lot 1/DP603946 and Lot 51/DP811015 as shown in **Table 5-1** and **Figure 5-55**.

6.4.3 Significance assessment

The following significance assessment is replicated from the NSW heritage database.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	The Upper Nepean Scheme has functioned as part of the main water supply system for Sydney since 1888. Apart from the augmentation and development in supply and other improvements, the Upper Canal and Prospect Reservoir portions of the Scheme have changed little and in most cases operate in essentially the same way as was originally envisaged.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	The construction of the Upper Nepean Scheme made the big advance from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it to the city by means of major canals and pipelines.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. The system is not a major work by an important designer or artist and does not demonstrate any particular degree of technical achievement.
D – Strong or special associations with a particular community or cultural group	Does not meet this criterion. The system is only important to the local community for amenity reasons.
E – Potential to yield information	The Upper Nepean Scheme provides detailed and varied evidence of engineering construction techniques prior to the revolution inspired by reinforced concrete construction. Although concrete was later used to improve the durability of the System, much of the earlier technology is still evident along the canal. It also provides extensive evidence of the evolution of engineering practice, such as the replacement of timber flumes by wrought iron flumes to be followed by concrete flumes. The early utilisation of concrete for many engineering purposes in the System, also demonstrates the growing emergence of an engineering technology based upon man-made materials. Many of the original control installations such as the 'Stoney gates', stop logs, penstocks, gate valves are still in service and continue to illustrate the technology of the time.
F – Uncommon or rare	The Upper Nepean Scheme is unique in NSW, being the only extensive canal, reservoir and dam network to supply a large city and its population with fresh water from a distant source in the hinterland. This type of water supply system is also rare in Australia and only has major comparative examples in other countries.
G – Principal characteristics of a class	Does not meet this criterion. The System does not demonstrate principal characteristics of a class.

6.4.4 Statement of significance

The following statement of significance is replicated from the NSW heritage database:

> *The Upper Canal System is significant as a major component of the Upper Nepean Scheme. As an element of this Scheme, the Canal has functioned as part of Sydney's main water supply system since 1888. Apart from maintenance and other improvements, the Upper Canal has changed little.*
>
> *As part of this System, the Canal is associated with Edward Moriarty, Head of the Harbours and Rivers Branch of the NSW Public Works Department.*
>
> *The Canal is aesthetically significant, running in a serpentine route through a rural bushland setting as an impressive landscape element with sandstone and concrete-lined edges,*
>
> *The Canal is significant as it demonstrates the techniques of canal building, and evidence of engineering practice. The Canal as a whole is an excellent example of 19th century hydraulic engineering, including the use of gravity to feed water along the canal.*
>
> *The Upper Nepean Scheme is significant because:*

- In its scope and execution, it is a unique and excellent example of the ingenuity of late 19th century hydraulic engineering in Australia, in particular for its design as a gravity-fed water supply system.
- It has functioned as a unique part of the main water supply system for Sydney for over 100 years, and has changed little in its basic principles since the day it was completed.
- It represented the major engineering advance from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it the city by means of major canals and pipelines.
- It provides detailed and varied evidence of the engineering construction techniques prior to the revolution inspired by reinforced concrete construction, of the evolution of these techniques (such as the replacement of timber flumes with wrought iron and then concrete flumes), and of the early use of concrete for many engineering purposes in the system.
- The scheme possesses many elements of infrastructure which are of world and national renown in technological and engineering terms.
- Many of the structural elements are unique to the Upper Nepean Scheme.

Figure 6-17 Northeast section of the Pipeline, facing northeast.

Figure 6-18 Tunnel Shaft 4 as viewed from eastern road reserve, facing southwest.

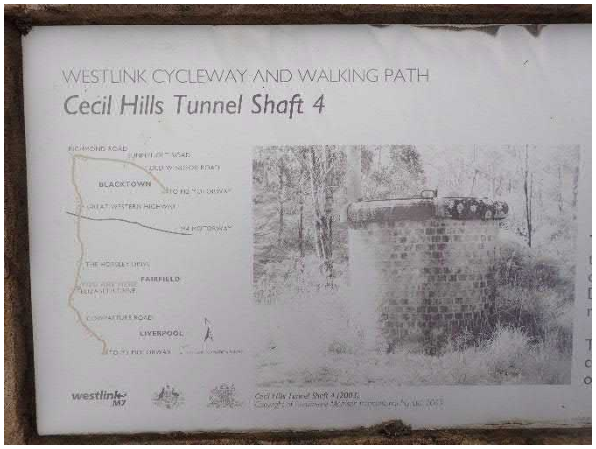


Figure 6-19 Interpretive sign showing Tunnel Shaft 4.

Figure 6-20 Southwestern section of pipeline, facing north.

6.5 Item 5: South Creek Bridge

6.5.1 Description and history

The South Creek Bridge is located in Lot 21 DP258414 and was surveyed on 14 November 2017 (Survey Area No. 5). The potential heritage item is located inside the project's construction footprint. This lot was originally part of a 680-acre land grant in 18 December 1805 to Nicholas Bayly called King's Down (Paul Davies Pty Ltd 2007:12).

During the field survey it was noted that there were remnants of a timber bridge located about 60 metres northwest of the existing modern bridge which leads to the Fleurs Radio Telescope site (**Figure 6-22**, **Figure 6-23**). The bridge would have connected a lower flat area south of the creek with a higher bank on the north side. The bridge would have comprised of round timber beams with flat planks attached to the top. Some of the timber still has metal bolts attached on the south side (**Figure 6-24**). Currently at the site, there is a timber structure located across the creek, comprising two rounded timber pillars with flat timber planks attached. Other timber features were located nearby (to the east) which contained metal bolts.

Background research indicated that there were no early roads marked on parish maps; however, a road easement was marked on a Parish of Melville map in 1962 and located about 16 metres south of the bridge. The note indicates that a road was included in original cert. Vol. 912 fol. 55. Neither a review of historical aerial imagery nor the field survey indicates that there was originally a road at this location. In addition, the road easement is located at right angles (west/east) to the direction of the bridge (north/south).

The following information is replicated from Aurecon (2016:104):

> *The bridge could have been an earlier version of the modern bridge that now spans the creek and was relocated further upstream. It could also be the location of the original bridge crossing that has fallen into disrepair on site.*
>
> *There are no dates able to be directly associated with the structure. However, a series of concrete bridges or crossings further north on South Creek appear sometime around the mid-2000s. the timber bridges or crossings, of which two have been identified between the substantial modern bridge in the south and the substantial timber bridge in the north, predate these more recent structures. Their condition and the material used might suggest a construction date sometime between early and late twentieth century.*
>
> *If the substantial timber bridge at the far north is associated with the timber structures to the south along South Creek, there may be a significantly early date for their original construction or placement. The substantial timber bridge crosses South Creek at the western end of an old boundary easement for a road, as shown on early parish maps.*

A review of aerial imagery from 1947 is inconclusive as to whether the bridge existed prior to 1947 due to the lack of clarity of the image in this area. However, the image clearly shows a creek crossing to the east (where the current creek crossing is located) and also one to the northwest.

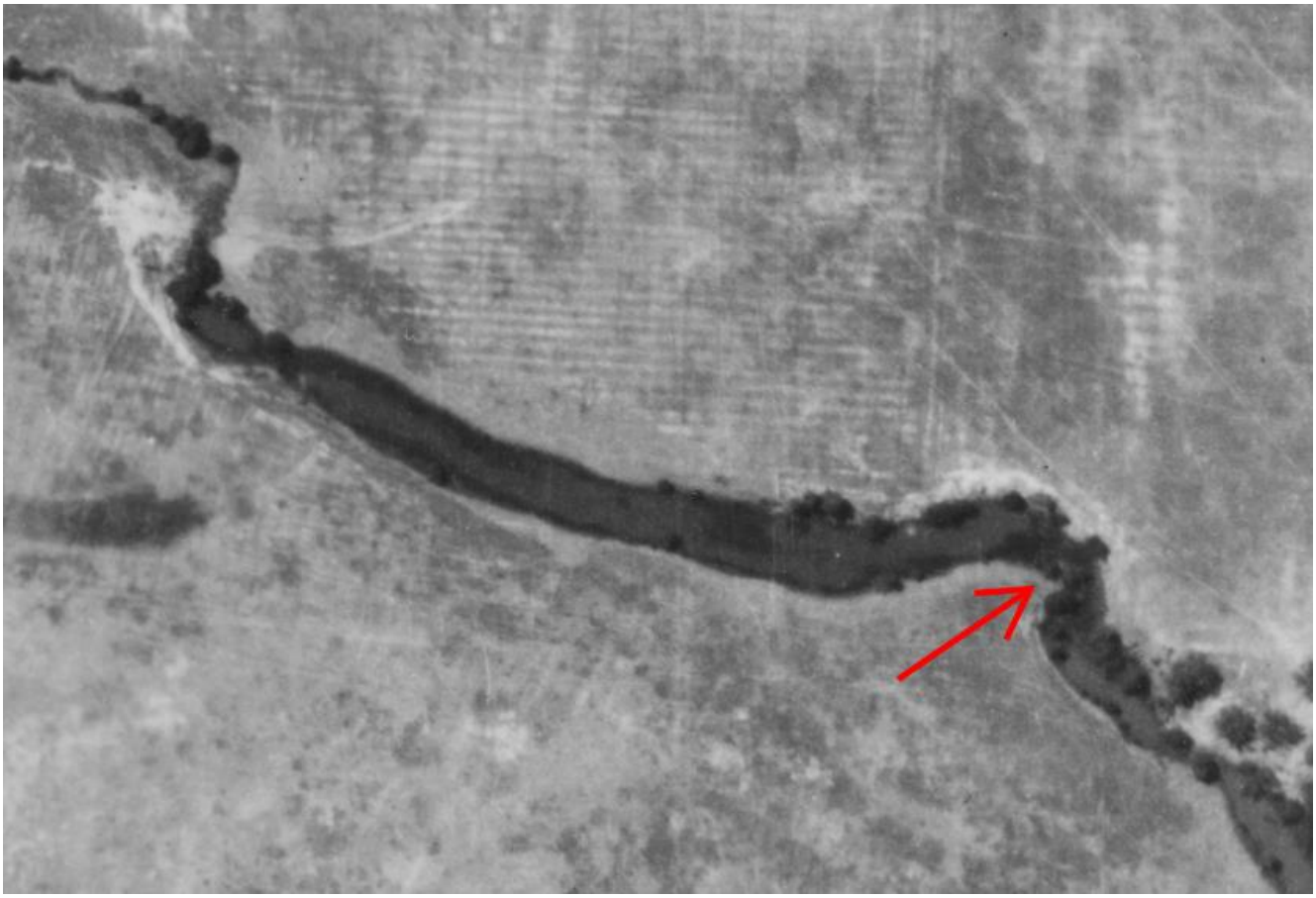


Figure 6-21 Aerial image from 1947 showing the location of South Creek bridge
Courtesy: NSW Department of Finance, Services and Innovation.

6.5.2 Curtilage information

The curtilage of South Creek Bridge is shown in **Figure 5-55**.

6.5.3 Significance assessment

The following significance assessment is replicated from Aurecon (2016:105).

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	Does not meet this criterion. The South Creek Bridge has historical significance, as it represents an early means of fording the waterways separating properties. Its condition, however, renders it minimal to low in its value.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. The South Creek Bridge has no strong or special associations.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. The South Creek Bridge has no aesthetic significance, due to its disrepair and inoperability.
D – Strong or special associations with a particular community or cultural group	Does not meet this criterion. The South Creek Bridge has no known social significance associated with it.
E – Potential to yield information	Does not meet this criterion. Due to the poor condition of the bridge, there is little research significance attached to this site.
F – Uncommon or rare	Does not meet this criterion. The timber bridge at South Creek was the only one of its kind encountered in the survey carried out by Navin Officer Heritage

NSW Criterion	Assessment
	Consultants on behalf of Aurecon on March 2016. However, a desktop survey identified other similar structures at points along South Creek to the north.
G – Principal characteristics of a class	Does not meet this criterion. The South Creek Bridge located downstream of the road crossing on Elizabeth Road, the main thoroughfare, indicates a means of crossing between properties over the creek away from the main transport infrastructure. It is not the only example of this kind of crossing along South Creek.

6.5.4 Statement of significance

There is little evidence to indicate that South Creek Bridge formed part of an early route through this area. The item is considered to have insufficient significance to fulfil the criteria for State or local listing.

Figure 6-22 South Creek Bridge, facing north.

Figure 6-23 South Creek Bridge detail, facing east.

Figure 6-24 Detail, South Creek Bridge.

6.6 Item 6: McMaster Field Station

6.6.1 Description and history

The McMaster Farm also known as 'McMaster Field Station', is located on Lot 101 DP848215 and was surveyed between 13 and 15 November 2017 (Survey area no. 4). The heritage item is located inside the project's construction footprint.

The property has been previously identified as having potential to hold historical significance at a State and national level for the contribution it made to the development of farming in Australia. The property was also previously identified as a potential heritage landscape by Aurecon (2016) and the South Creek Heritage Study (Perumal Murphy 1990). The listing describes the area as:

> *A pastoral landscape with lake-like water bodies, native vegetation and a backdrop of green hills. Of regional significance. Lack of intrusive transmission wires is important.*

The South Creek Study noted that ''The best local example of scenic landscapes are those featuring lake-like dams' (Perumal Murphy 1990:24), while the statement of significance did not assess individual elements of the McMaster Farm is assessed the South Creek Valley as a whole:

> *The original landscape has been substantially modified. Nevertheless, those areas spared from recent subdivision retain a traditional rural landscape of considerable value. The primary elements of significance are: the remnant stands of natural vegetation along creeks and roadsides; the aesthetic cultural landscapes associated with early homesteads; and the many fine scenic landscapes, both natural and cultural (Perumal Murphy 1990:26).*

The Penrith Heritage Study (Paul Davies Pty Ltd 2007) noted that the former McMaster Field Station is of historical interest as an important centre for CSIRO animal research from 1936 to c1990 and is the only known example of a CSIRO rural research institute in the Penrith LGA.

Frederick Duncan McMaster was a successful grazier and sheep breeder who formed a relationship with the Council for Scientific and Industrial Research (CSIR) and its successor, the CSIRO. McMaster was appointed as a founding member of the CSIR in 1926, and he gifted the organisation £20,000 in 1926 to build a new veterinary research laboratory for CSIRO at the University of Sydney. The private gift was the largest that the CSIR had ever received and led to a new era of veterinary research in Australia which resulted in new ideas and technologies. The aim of the laboratory was to research diseases and parasites affecting the pastoral industry, particularly sheep. In 1936 the CSIR bought a property at Badgerys Creek with the intention of setting up a field station. It named the property the FD McMaster Field Station (CSIRO 2018).

Aurecon (2016:125) noted:

> *This experimental farm worked collaboratively with McGarvie Smith and cultivated fields, built dams, livestock yards, dwellings, farm buildings and other infrastructure such as sheep dips. On the eastern boundary a number of telegraph or telephone poles were identified, some complete with their glass or ceramic insulators. One of these insulators, a purple glass, dates from the 1930s and is contemporaneous with the establishment of the farm. It was noted that the landscape was culturally modified for the purposes of CSIRO research: cultivated fields, fence lines, dams and groves of trees.*

The features listed in **Table 6-3** were recorded during the field survey. The buildings are numbered as they were recorded in the field. Where buildings had been physically numbered and which were visible to the field team, these have been included in a column in the table as an original building number. The buildings and field survey building numbers are shown in **Figure 6-26**.

Aerial imagery

Aerial imagery from 1947 indicates there was previously a building located to the north of the cluster of buildings noted during the field survey (**Figure 6-25**). This building has now been demolished.

A review of aerial imagery from 1947 indicates that some of the buildings currently on the property had not been built by 1947. As the aerial imagery is of low resolution and clarity it is uncertain whether other buildings were present in 1947. It is possible that Buildings 9, 10, 11 or 12, are visible in the aerial photo. There was a building located north of the current building complex which has since been demolished. The grove of trees currently on the property is visible, however it appears the plantings were extended further south. Numerous dams are also visible. The concrete pillar

feature located in the east of the property is not visible in the 1947 aerial photo. The information about whether the buildings were present or absent in the aerial photography is included below in **Table 6-3**.

Table 6-3 Features recorded at McMaster Field Station

Building number	Original building number	Description and condition	Contribution heritage grading
Building 1	-	White modern besser block building with gabled roof. Currently occupied. Good condition. Not present in 1947.	Moderate
Building 2	-	Shed with corrugated iron A-frame roof. Fair condition. Not present in 1947.	Moderate
Building 3	17	Small square timber and corrugated iron shed with sloping corrugated iron roof, large verandah at front, sliding door. Fair condition (**Figure 6-27**). Not present in 1947.	Moderate
Building 4	3	Timber and corrugated iron shed with A-frame roof. Sliding timber double doors on western side (**Figure 6-28**). Not present in 1947.	Moderate
Building 5	6	Timber and corrugated iron shed with hinged small timber shutters (**Figure 6-29**). Some small windows have glass. Also some timber doors. There was a crate of small glass bottles in a corner of the shed inside. Not present in 1947.	Moderate
Building 6	-	Timber and corrugated iron shed with gable roof. Not present in 1947.	Moderate
Building 7	-	Timber and corrugated iron shed, flat roof, open at one side, currently used as chicken shed. Unclear if present in 1947.	Moderate
Building 8	4	Modern besser brick building, currently occupied. Good condition. Not present in 1947.	Little
Building 9	20	Timber and corrugated iron building. Large round timber posts, open on one side, gable roof, floorless, timber beams inside, large doorway on eastern side (**Figure 6-30**). Unclear if present in 1947.	Moderate
Building 10	-	Small rectangular timber and corrugated iron building with timber floor, timber door on north side, small timber framed windows (**Figure 6-31**). Unclear if present in 1947.	Moderate
Building 11	21	Large corrugated iron and timber building with metal roof trusses, open on west side, cement floor. Interior has remnants of animal pens (**Figure 6-32**). Building is in poor state. Large peppercorn tree at rear of building. Toilet and laundry attached to north side of building. Unclear if present in 1947.	Moderate
Building 12	22	Timber and corrugated iron building. Large timber round poles with a flat roof on timber beams on north side, metal poles on south side, concrete slab on floor. Building is open on east and west sides. One wall is of corrugated iron. Unclear if present in 1947.	Moderate
Building 13	-	Occupied modern house in good condition, cladding. Unclear if present in 1947.	Moderate
Silo 1	-	Located next to Building 4 and constructed of corrugated iron. This silo is quite large and has horizontal metal bands on the outside (**Figure 6-33**). Not present in 1947.	Moderate
Silo 2	-	Silo 2 is smaller than Silo 1 and is constructed of corrugated iron. Silo 2 is located north of Building 9. Unclear if present in 1947.	Moderate
Animal pens and stockyards	-	Numerous small animal pens and stockyards located within the main buildings. One of the stockyards has a corrugated iron building built over the top labelled building 37. Unclear if present in 1947.	Moderate
Grove of trees	-	There is a grove of trees in the western section of the property **Figure 6-34**). The grove measures about 700 m x 45 m although	Moderate

Building number	Original building number	Description and condition	Contribution heritage grading
		only the northern 260 m are located within the study area. Partly present in 1947.	
Dams and ditches	-	There are numerous dams across the property, some of which are large. There are also some man-made ditches within the property. Present in 1947.	Moderate
Concrete pillar remnants	-	In the eastern section of the property, located adjacent to the northern boundary of the McGarvie Smith Farm is an area with concrete pillar remnants, bricks, metal bolts and a wooden post (**Figure 6-35**, **Figure 6-36**). The size is the area is 25 m x 5 m. A ditch in the neighbouring McGarvie Smith property appears to lead to this area (**Figure 6-34**). The concrete remnants are similar in appearance to those recorded on the nearby Fleurs Telescope site in Area RB 7, located 2.1 kilometres east (Gorman 2018, Figure 48). It is possible that these remnants are related to the Fleurs Telescope site.	Moderate
Archaeological site in Paddock 1	-	Paddock 1 Features –Sandstock bricks and three earthworks; sherds of blue and white transferware; “black” bottle glass identified on top of a ridge overlooking Badgerys Creek. It is located outside of the construction footprint.	Moderate

Figure 6-25 1947 aerial image of part of McMaster Field Station, showing demolished building in north, and Building 9 in the south
Courtesy: NSW Department of Finance, Services and Innovation

6.6.2 Curtilage information

The curtilage of the McMaster Field Station includes houses, buildings, sheds, dams and earth works as described above and shown in **Figure 5-55**. A map showing the numbers of individual buildings is shown in **Figure 6-26**.

6.6.3 Comparative analysis

6.6.3.1 Introduction

The McMaster Farm was previously a CSIRO rural research institute. A background history on the CSIRO is replicated from the Victorian Heritage Database (Victorian Heritage Database 2012):

> *The CSIRO is Australia's premier research organisation, with a long history associated with research into agriculture and the natural environment.*
>
> *The origins of the CSIRO lie in the Advisory Council of Science and Industry established by the Australian Government in 1916 to advise on the establishment of a Commonwealth Institute of Science and Industry. However it was poorly funded and most research was carried out by state governments, universities or industry.*
>
> *A report into the organisation of Australian science in order to coordinate scientific research nationally resulted in 1926 in the establishment of the Council for Scientific and Industrial Research (CSIR). Its aim was to carry out scientific research to assist primary and secondary industries in Australia - in farming, mining and manufacture - but it was primarily oriented towards agricultural research. In its first year the CSIR had 41 scientists working in rented rooms at a technical college in Brunswick, Melbourne.*
>
> *During the 1930s and 1940s CSIR's research focused on animal and plant pests and diseases, fuel problems and food preservation. The organisation's activities have always been aimed towards areas of national need. During World War II research shifted to projects related to military areas, such as radar. In the post-war period, activities expanded to include areas such as building materials, wool, coal, atmospheric physics, metallurgy and assessment of land resources such as soils.*
>
> *In 1949 the organisation was renamed the Commonwealth Scientific and Industrial Research Organisation (CSIRO). It grew rapidly during the 1950s and 1960s and consolidated its pre-eminent position in Australia's scientific research.*

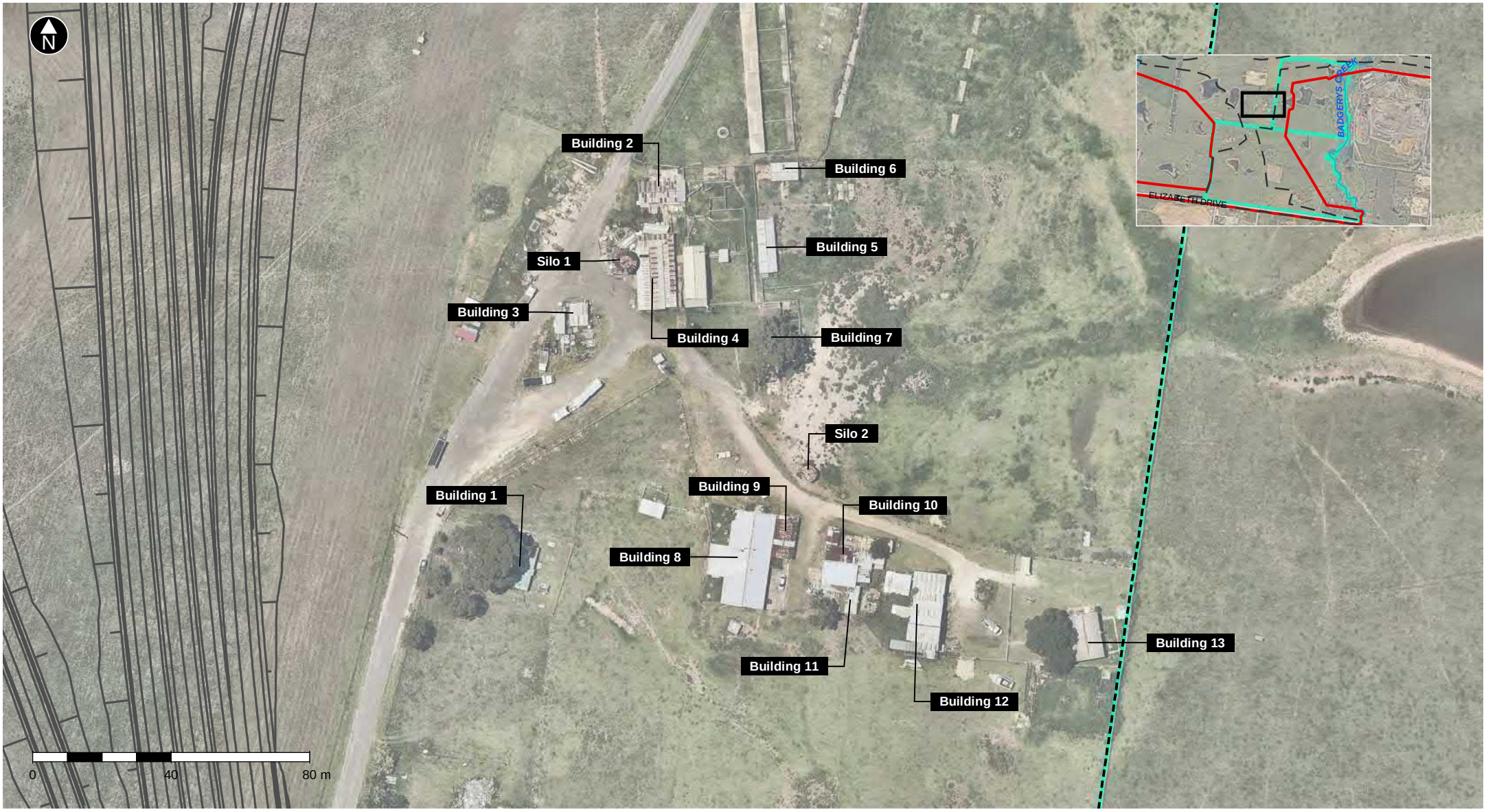
6.6.3.2 Research stations and farms

Three experimental farms were examined for the comparative analysis. As there are limited CSIRO farms in NSW, an experimental farm run by the CSIRO in Victoria is also compared. Two of the farms in the comparative analysis were owned by the CSIRO (Prospect Hill in NSW and Merbein in Victoria). The third farm was State government owned, and located in Grantham, NSW.

Prospect Hill

Clunies Ross Street, Prospect, NSW
SHR #01662)

Prospect Hill is a CSIRO complex which was acquired by the Commonwealth in 1946. It is registered on the SHR as a historic landscape. In the early 1950s the site was established and research on sheep began. Since then 40 buildings and sheds have been constructed. There have been various modifications, extensions and refurbishment of the CSIRO buildings at the site. The site is important for its contribution to research and is significant to employees who have worked at the research facility over 40 years.



The project
M12 study area
The project construction footprint
McMaster Field Station

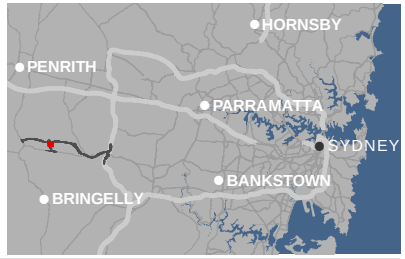


Figure 6-26 Map showing location of building numbers and features at McMaster Farm

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Grantham Poultry Research Station (former)

71 Seven Hills Road, Seven Hills, NSW
SHR #01382)

The Grantham Poultry Research Station (former) is registered as a cultural landscape on the SHR (01382). The site is also registered on the NT (7810) and RNE (101037). The residences at the station are also listed on the LEP. The station was one of the six leading poultry research stations in the world and is presumed to be the only poultry research station in NSW. The station was constructed between 1897 and 1939 and operated under the NSW Government. There are six structures which include two residences with outbuildings and an administration building, sheds, workshops, old feed shed, switchboard and cleaner store. After 1991 the site was subdivided, and the farm area was sold for housing, resulting in the demolition of buildings related to farm activities. The site contains foundations, ground slabs and footings of most of the demolished buildings, roads, drainage systems, former entry gates foundations and former wells. The experimental farm phase of the property began after 1917 when breeding sheds and runs, crop plantings and dams were constructed. In 1927-39 new buildings were added to the site, in the 1940s there were some upgrades to the research facilities including laying house and pens, and breeding pens. In the 1950s additional land was acquired as the station expanded and became internationally known. In 1958 new laboratories and offices were added, as well as a new poultry range house, broiler house and silos. The site use declined in the 1980s. The research station has historic and social significance as the focus of the poultry industry in NSW for over 70 years.

Former Horticulture Research Station

571-585 River Avenue, Merbein South, Mildura VIC
Victorian Heritage Register # H2316; Mildura Rural City Heritage Overlay #181)

The Former Horticulture Research Station in Merbein, Victoria, was developed in 1919. The development included a concrete laboratory which was used as an experimental laboratory, office and library. The experimental farm focussed on grape growing. In 1926 the CSIR took over the research station. Research continued to be undertaken in the original laboratory until the 1937 when a new laboratory was built. During the 1930s the focus of research at the station was soils, salinity and drainage. Research continued at the station until 2008 when CSIRO funding was cut and the station was identified for closure. The research station is significant for its operation as one of Victoria's early agricultural research establishments which was important in the development of the viticulture industry in Victoria and other states. The laboratories are significant for the involvement of local growers, the Commonwealth government and the CSIRO in agricultural research in Victoria.

6.6.3.3 University-based farms and facilities

In NSW several experimental farms were associated with Sydney University, such as McGarvie Smith Farm (Section 6.1) adjacent to McMaster Field Station. McGarvie Smith Farm operated in close association with the McMaster Farm. Other Sydney University farms included JB Pye, Coates Park, and Wolverton Farms in the Bringelly area, and the following farms in the Camden-Cobbity area: Westwood Farm, Corstorphine Farm, May Farm, Mount Hunter Farm, Karalee, and Lansdowne. These farms were not included in the comparative analysis as they are not listed on any heritage register or database. While the Sydney University farms had a different specific purpose, all of these farms contribute broadly to the development and innovation of Australia's agricultural and pastoral industries.

6.6.3.4 Comparative analysis

There are few CSIRO experimental farms listed on heritage registers within NSW. Prospect Hill was established by CSIRO around 15 years after McMaster Farm was established. CSIRO took over an experimental farm in Merbein, Victoria around a decade earlier than McMaster Farm. Grantham Poultry Research Station was established earlier than McMaster Farm but operated over a long period of time, with additional buildings added at the time McMaster Farm was established. Prospect Hill was the only other station that also undertook research on livestock similar to McMaster Farm. Both Prospect Hill and Grantham are registered as either historic or cultural landscapes, which relates to modified landscapes such as is evident at McMaster Farm. Both Prospect Hill and McMaster Farm operated for a similar period of time under CSIRO (40-50 years). The Grantham Poultry Research Station shares characteristics with McMaster Farm, such as livestock pens as well as buildings.

The comparative analysis indicates that experimental farms, such as the McMaster Farm developed over time, with both additions and demolitions of buildings occurring across the properties. Modification of the landscape for purposes such as drainage occurred commonly and often remains visible in the landscape. There are limited examples of research farms operated by the CSIRO listed on heritage registers in NSW, and in that respect, the McMaster Farm is a rare example as it contains both buildings and landscape modifications.

6.6.4 Significance assessment

The following significance assessment is based on the assessment prepared by Aurecon (2016:125-5), with updates (bold or struck-out text) as determined during a comparative analysis undertaken for this assessment.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	The McMaster Farm ~~potentially~~ holds historical significance at a State level ~~and national level~~ for the contribution it made to the development of farming in Australia, **and in particular in NSW.**
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	The McMaster Farm is associated with a number of leading researchers such as the University of Sydney's Sir Frederick Duncan McMaster. His original gift to CSIRO in 1929, for the construction of the Division of Animal Health's first laboratory, located at Sydney University, marked the beginning of a new era of veterinary research.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	There is no aesthetic significance associated with McMaster Farm.
D – Strong or special associations with a particular community or cultural group	~~Without further research, it is not known to what degree the farm has social significance. However, its association with agricultural, pastoral and animal husbandry groups over the length of its history, may indicate potential significance.~~ **The McMaster Farm does not meet this criterion. There is little evidence to suggest that the farm has strong or special associations with a particular community or cultural group.**
E – Potential to yield information	There is potential technical/research significance for McMaster Farm, similar to that for McGarvie Smith Farm due to its pioneering methods and practices.
F – Uncommon or rare	McMaster Farm is a relatively intact example of an experimental farm developed and managed by the Commonwealth from the 1930s and into mid twentieth century. It is facing potential endangerment to its archaeological heritage, including its modified landscape.
G – Principal characteristics of a class	McMaster Farm was a leading Commonwealth institution in pioneering experiments and education in agricultural and pastoral methods.

6.6.5 Statement of significance

The following statement of significance is replicated from Aurecon (2016:124):

> *The McMaster Farm, an experimental enterprise by CSIRO in the 1930s, is associated with the University of Sydney's FD McMaster Building (a State heritage listed building), both named in honour of Sir Frederick Duncan McMaster. His original gift to CSIRO in 1929, for the construction of the Division of Animal Health's first laboratory, located at Sydney University, marked the beginning of a new era of veterinary research in Australia that saw Australia forge an international reputation for excellence in veterinary research. The landscape has been culturally modified for the purposes of CSIRO research: cultivated fields, fence lines, dams and groves of trees. The potential archaeology and intactness of this landscape rates it as moderately significant at a ~~local or~~ State level.* **The McMaster Farm ~~potentially~~ holds historical significance at a State level for the contribution it made to the development of farming in Australia, and in particular in NSW.**

Figure 6-27 Building 3, facing south.

Figure 6-28 Building 4, facing northeast.

Figure 6-29 Building 5, facing north.

Figure 6-30 Building 9, facing south.

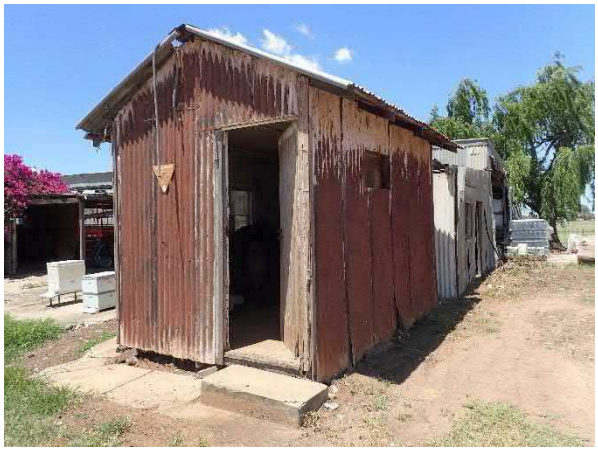

Figure 6-31 Building 10, facing southeast.

Figure 6-32 Building 11, interior, including ceiling.

Figure 6-33 Silo 1, facing southeast.

Figure 6-34 Constructed ditch with grove of trees in background, facing east.

Figure 6-35 Concrete feature, facing east.

Figure 6-36 Detail of metal and concrete feature.

6.7 Item 7: Fleurs Aerodrome

6.7.1 Description and history

The Fleurs Aerodrome is located on Lot 2 DP88836 and was surveyed on 27 February 2018 (Survey area no. 21). The heritage item is partially located inside the construction footprint.

Fleurs Aerodrome is located on the lands of a colonial family mansion and grounds under cultivation which was renamed from Bayly Park to Fleurs in 1826, following its sale by Nicholas Bayly to Richard Jones. Jones retained ownership of the grounds until he sold it to land speculators in 1883. It was sold again to land speculators in 1887 before being re-subdivided in 20-acre allotments. The homestead of Fleurs was auctioned again in 1930, and remained in the same ownership until a diversionary airstrip was built at Fleurs and used by the RAAF at Richmond. The homestead was located elsewhere on the estate and is still occupied today (Penrith City Local History, n.d.).

The following information is replicated from Aurecon (2016:120):

> *Fleurs Aerodrome was a parent aerodrome built on behalf of the Royal Australian Air Force near Penrith, NSW during the Second World War. This indicates it was a major operational aerodrome. A 'parent' may have a number of satellite aerodromes or landing grounds, or it may just be a major base. Satellite aerodromes were normally associated with a major operational airfield, and used to relieve the congestion in the circuit area. Dispersal airfields were attached to an Aircraft Depot, Aircraft Park or Operational Base, and consisted of landing ground with revetted areas for open storage of aircraft against possible air attack, and with the minimum of services and no permanent hangars or buildings.*
>
> *Construction started on the aerodrome in 1942 and was still under construction in 1944 as part of a proposal to base a United States Navy Fleet Air Wing in Sydney should the need arise. As Australia needed the help of the US with its extensive defence assets, the government considered it appropriate to provide any necessary infrastructure from which the US fleet could base itself in the southern hemisphere. It was an objective of the US Navy to have one 'parent' and a number of dispersal airfields in the Sydney region and Fleur met this requirement. The presence of the US in the State and at its aerodromes is obviously significant due to their success in the South-West Pacific Area campaign.*
>
> *The main runway which is still visible today, was set at a 40 degree angle* [Figure 6-37 and Figure 6-38]. *The second runway, which intersected the main, was at a 104 degree angle.*
>
> *Construction started on the aerodrome in 1942 and was still under construction in 1944 as part of a proposal to base a United States Navy Fleet Air Wing in Sydney if required. Initially planned with three runways, No. 1 (5000ft) and No. 3 (6000ft) runways were serviceable, however construction of No. 2 runway (5000ft) was abandoned. A total of eight aircraft dispersal hideouts were constructed and accommodation was a farm house and a former Civil Constructional Corps camp* [Figure 6-39].
>
> *Fleurs Aerodrome is situated on a flat area of land between South Creek and Kemps Creek, north of Elizabeth Drive. The aerodrome reserve transect allocated to the main landing strip runs on a north east to south west axis for about 1.6 kilometres (1 mile). The reserve is about 120 metres wide with the landing strip just off centre to the north, running down the middle. The existing strip itself on the bituminised portion is about 25 metres wide and nearly 300 metres in length, with the rest of its sections grassed.*
>
> *The reserve set aside for the aerodrome is the most intact of the site's elements, with only a minor incursion from a fence line on the northern side. The northern section of the existing landing strip has been cultivated over the years, the middle section has gone to grass, and the lower section containing the bituminized strip appears to be of later construction over an original footprint. It is unsure as to whether a number of rudimentary structures overgrown with vegetation in the area are associated with the aerodrome or the radio telescopes site to the north[2]. A number of modern buildings have been built on the reserve over the years (and removed). There are a small number of tracks that cross through the landing strips path.*
>
> *While the original footprint of the main landing strip reserve has been maintained, the archaeological integrity has been compromised by cultivation and construction along its path. The construction of sites such as the radio telescopes to the north and agricultural development to the south have also contributed to weakening the entire intactness of this area. Comparatively speaking, however, Fleurs may be of greater intactness than other parent aerodromes developed during the Second World War in Sydney.*

Aurecon (2016:136) recommended that further historical and archaeological investigation be completed ahead of any planned development in order to fully assess this site, which may have local to State significance due to its relatively intact nature and historical significance. They noted that a recommendation in a thematic history of World War 2 aerodromes (Brew 2001) was that all parent aerodromes be listed on the SHR. To address these recommendations, a comparative analysis has been undertaken for this heritage item for this assessment and is outlined in **Section 6.7.2**.

[2] These 'rudimentary structures' may be outside the study area, as they were not noted during the field survey. Aerial imagery indicates footings located at the far northern end of the original airstrip.

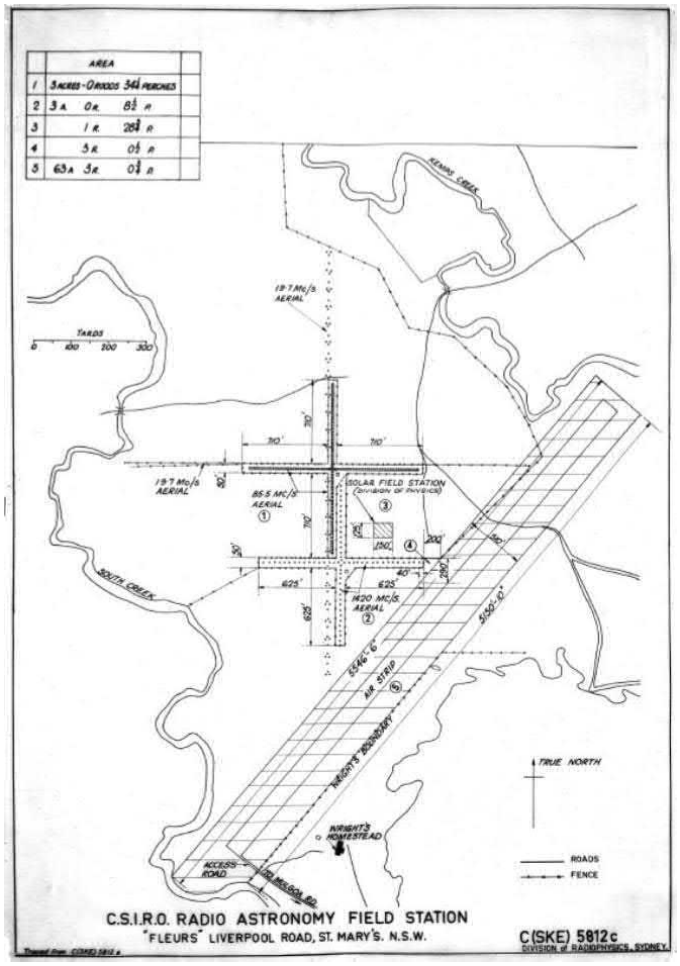

Figure 6-37 CSIRO radio astronomy field station map showing location of original airstrip
Courtesy: Australian Telescope National Facility, date unknown.

Figure 6-38 Fleurs Aerodrome.
Source: Aurecon (2016:137). Originally from State Library of NSW, Government Printing Office 1 – 23753. Main Roads. 'Fleurs Aerodrome – Pan of 2 St25318 to St25319, from south west end 40 degrees runway 50 foot from end 5000 foot peg' date unknown.

Figure 6-39 Fleurs Aerodrome in 1942
Source: Aurecon (2016:38). Originally via PeaceLoveScoobie, Flickr
http://www.flickriver.com/photos/peacelovescoobie/sets/72157626505704696/

Currently at the property there are three sections of the former airstrip: a short airstrip of bitumen that appears to be disused and more recent than the original airstrip, a grassed area south and north of the existing airstrip, and north of this a grassed area outside the M12 study area that likely contains building remnants observed by Aurecon (2016). A modern shed is located at the southern end of the airstrip and a large metal structure is located at the northern end of the current bitumen airstrip. It is unknown if the metal structure is connected with the original aerodrome.

A map showing these features is provided in **Figure 6-40**.

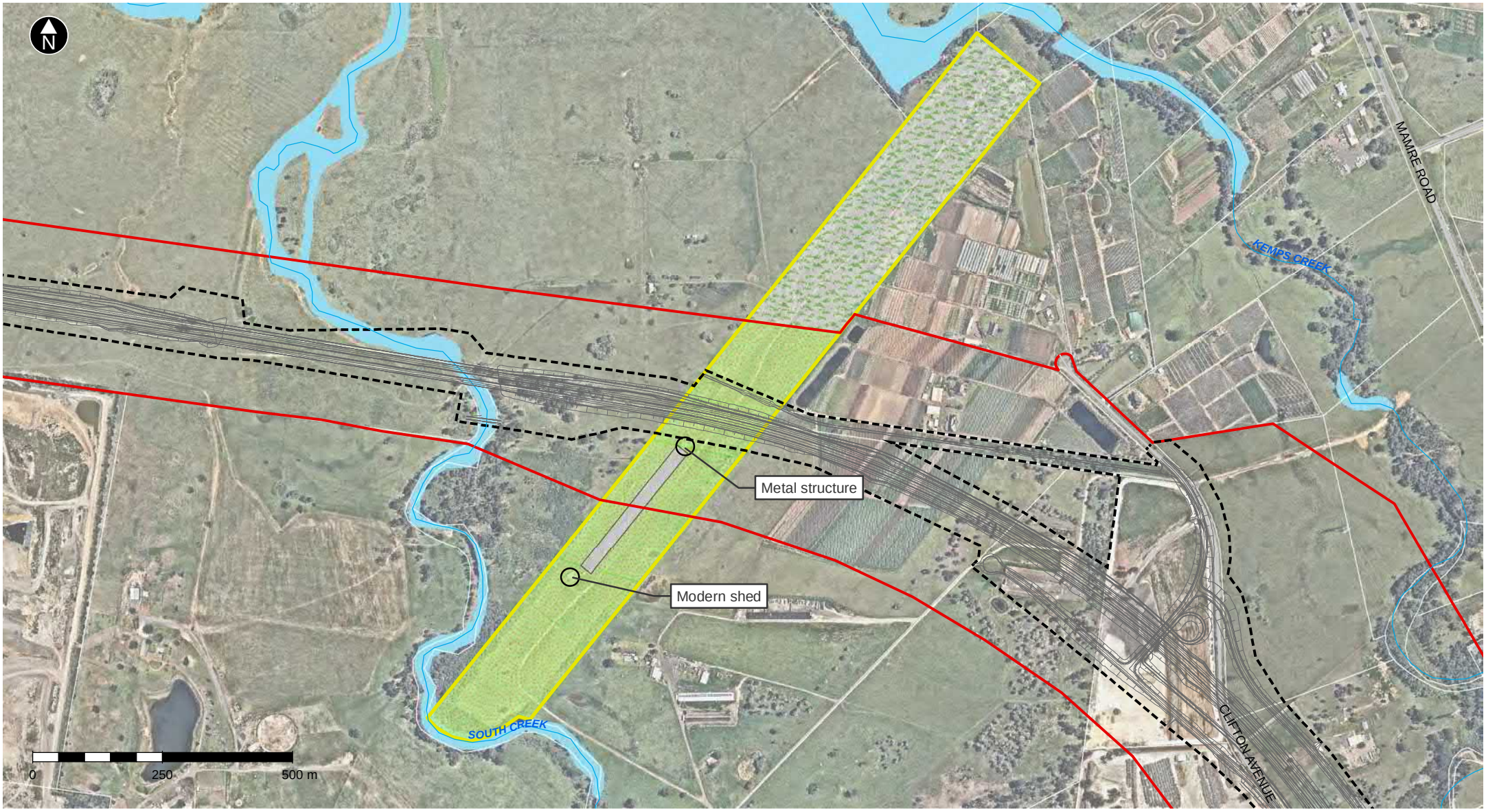

Figure 6-40 Map showing areas of Fleurs Aerodrome observed during field survey

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Created by : AA | QA by : TC

6.7.2 Comparative analysis

6.7.2.1 Introduction

In 1921, Australia formed the Royal Australian Air Force (RAAF) in Melbourne due to its commitment to imperial defence. The program included headquarters, squadrons, training school recruit depot, non-technical training centre and stores depot (Brew 2001:17). Inefficient and delayed by the Great Depression, the RAAF languished somewhat until a rebuilding of the defence forces began in 1934.

At the time of the attack on Pearl Harbour in 1941, the Australian Imperial Forces (AIF) had no combat experience, and the Royal Australian Navy (RAN) was under-resourced. In light of the strength of the Japanese forces and the proximity of the war to Australia, a number of contingency plans were established in case of an invasion. A build-up of defences in Australia's southeast included a number of large aerodromes from which to launch bombing attacks and reconnaissance flights on the presumed future Japanese position in northern Australia (Brew 2001:20). Additionally, Australia provided an ideal location for the United States (US) to plan counterattacks against the Japanese, accommodating a build-up of American troops and air force from December 1941 and becoming the military responsibility of the US by mid-February 1942.

The construction of multiple aerodromes and landing fields in NSW began as a direct result of WWII, however a number of the aerodromes used by the RAAF were originally civil or private airfields, occupied by the RAAF and acquired under National Security (General) Regulations. Post-war, it was proposed that when the war effort ended and/or Regulations were repealed, that a large proportion of acquired land would either be reverted to the original owners, or purchased or leased by the RAAF. The Department of Air was interested in the strategic location of aerodromes for future defence, with air routes, civil aviation requirements, and post-war training key concerns (Brew 2001:32) in determining future management. Fleur Aerodrome was listed for retention, but without maintenance.

6.7.2.2 WWII Aerodromes

Evans Head Memorial Aerodrome

Memorial Airport Drive, Evans Head, NSW 2473
SHR #01649, Richmond Valley LEP 2012 #I-131
Also known as: 'RAAF No. 1 Bombing and Gunnery School' and 'NSW and RAAF Air Observers School'

In 1936 the site was an Emergency Landing Ground, but resumed by the Commonwealth for defence purposes, it underwent development in 1940 under the Unemployment Relief Works Grants Scheme. It was one of 10 Australian air bases designated under the Empire Air Training Scheme (EATS), a Commonwealth effort to ensure sufficient trained aircrews to support the allied war effort (GHD 2009).

In 1941, Sir Valston Hancock (Director of Works and Buildings for the RAAF) became the first commanding officer of the No. 1 Bombing and Gunnery School (BAGS) based at Evans Head, reportedly the largest RAAF training facility in the Southern Hemisphere under the EATS during WWII. More than 5000 air force personnel passed through its training programs, and at its height, No. 1 BAGS had 70 battle aircraft with extensive bombing and gunnery ranges to the north and south of the Evans Head village. The base itself contained a complex of buildings and structures. Notable figures who spent time at No. 1 BAGS included Australian actor 'Chips' Rafferty and flying hero Leonard Fuller, DFC (Heritage Division 2005).

Following WWII, the aerodrome was used for commercial airline services, which were later transferred to Casino in the mid-1950s, and the Department of Defence handed the facility to the Department of Transport in 1952. Queen Elizabeth II flew into Evans Head during her Royal visit in 1954. Since then, it has been used for a variety of purposes including, but not limited to, an emergency landing facility, aircraft storage facility, ordnance depot and staging base for relief work supplies. Passed to the Richmond River Shire Council in 1992, the Council has downgraded the flying status of the aerodrome, though it is still in use today (Heritage Division 2005).

There are significant written historical records on the Evans Head Aerodrome, most of which are held in the National and State Archives, and the site plays a significant role in the living oral histories of those who served at the base from 1939-1945 (Heritage Division 2007). It was accordingly added to the SHR on 22 November 2002.

As of 2002, the primary physical remains of the aerodrome are its runways, surrounded by grass and low heath scrub with views to the Great Dividing Range, Broadwater Sugar Mill and the Evans Head Headlands. Only one building or facility related to WWII remains on site, a modified Bellman Hangar (originally one of 17 hangars), situated on the apron adjacent to the main north-south landing strip. The hangar is in fair condition. Three of the four runways are sealed, though the northeast-southeast runway has been shortened by later subdivisions, and grass is showing

through some areas. Other built elements related to the aerodrome are located outside of the heritage curtilage of the site. These include a gun pit, bomb store, various timber huts and store rooms, and archaeological sites at the location of observation towers and dispersal areas (Heritage Division 2007).

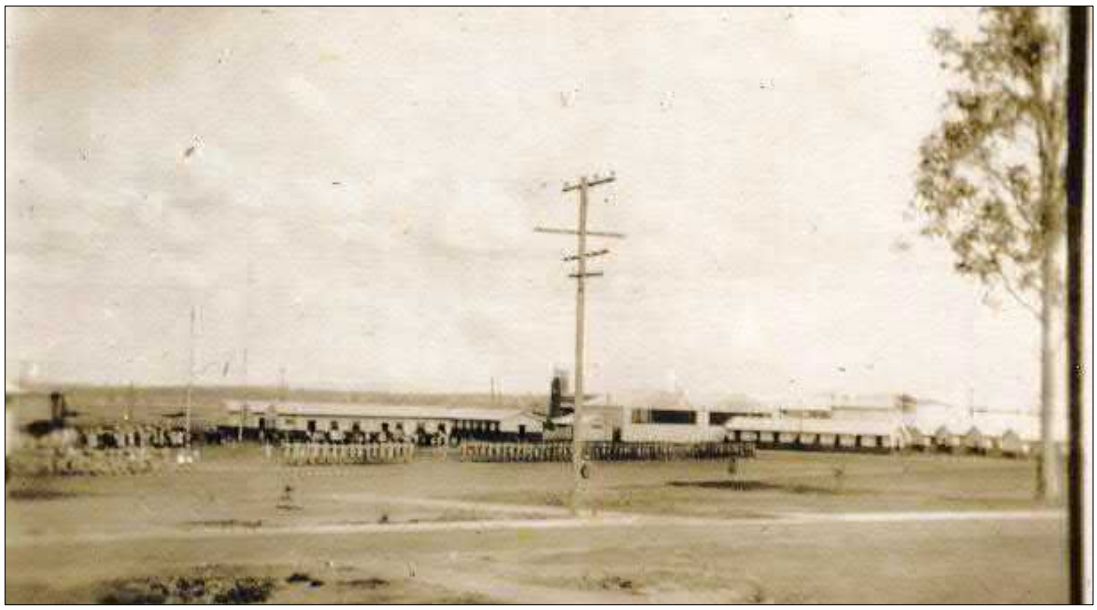


Figure 6-41 Evans Head Training School WWII, 22 Squadron RAAF,
Photo taken by H W (Bill) HALL at 1 B A G S at Evans Head - W/Op Air Gunner course June/July 1942.
Source: (jahjahau n.d.))

Figure 6-42 Evans Head Memorial Aerodrome looking west
Source: Heritage Division 2005, photo by Andrea Brew

Figure 6-43 Memorial Aerodrome – runways
Source: Heritage Division 2007, image by Jane Gardiner, on behalf of Richmond Valley Council

Bankstown Aerodrome

345 Marion Street, Georges Hall, NSW 2198
Bankstown LEP 2015 #i18
Also known as: 'No. 2 Aircraft Park' (1940), 'RAAF Bankstown' (1940-1944), 'HMS Nabberley' (1944-1946), 'RAAF No. 2 Stores Depot' (1946-1948)

Earmarked as a second or training aerodrome for Sydney in 1929, Bankstown aerodrome did not develop until WWII, with the land formally resumed on 5 August 1940. Originally intended as a training facility, fears of a Japanese invasion prompted its elevation to operational status for defence purposes, and fighter squadrons were based there from 1941. One of 22 RAAF units associated with the aerodrome, the No. 101 Fighter Control Unit (formed in 1941) became the No. 1 Fighter Sector Headquarters and operated at Bankstown until January 1945. The first Women's Auxiliary Australian Air Force intake took place at Bankstown in September 1941 (Heritage Division 2001).

The operational section of the base consisted of unsealed airstrips, headquarters, parade ground, hangars, control towers and other technical structure, as well as residential buildings, barracks and messes. Plane parks (hideouts) were set up around the perimeter of the airfield in random locations to prevent destruction of aircraft by enemy forces (Heritage Division 2001).

A local hospital was established to augment the RAAF presence and De Havilland established an aircraft assembly at the airport in 1942 (the first Australian-built Mosquito was completed in July 1943). The Bankstown facility became more important as Australia's war effort against Japan increased and Hoxton Park was selected as a dispersal airfield for Bankstown, with the 41st USAF Fighter Squadron based at Bankstown from March 1942. At the end of 1944, the Royal Navy moved onto the airport and commissioned it as a Mobile Naval Air Base, which was officially known as HMS Nabberley (National Archives of Australia 1943).

The No. 2 Aircraft Park was disbanded in March 1945, having provided a major economic influence on the Bankstown area through industrial investment and infrastructure (which were maintained and expanded post-war). The Department of Civil Aviation assumed responsibility for the airport in 1948 in an effort to relieve pressure at Mascot Airport, though the RAAF retained a presence on-site until 1977.

A gravel runway was constructed in 1952, with three intersecting runways and taxiways added in 1962. Runway lighting was installed in 1965 followed by a control tower during 1970. By this time, Bankstown Airport was reputedly the largest general aviation airport in the southern hemisphere (National Archives of Australia 1943).

Bankstown Airport exists today as a large complex, east of the Georges River. Largely open, it has three parallel runways which are crossed by a single runway at their western end. The control tower is located at the western end of the site, with buildings and car parks situated to the northeast. The existing airport retains elements of the site's original purpose, including: the road network, timber headquarters building, parade ground, a sawtooth-roofed structure, a gable-roofed hangar, six Bellman hangars, two Royal Navy hangars, two Singapore hangars, two timber latrine huts and an office, a brick power station, Clyde Engineering hangar and a number of buildings associated with the Harker de Havilland factory (Heritage Division 2001).

Figure 6-44 Aerial of Bankstown Aerodrome in 1943
Source: National Archives of Australia 1943

Figure 6-45 WWII RAAF Bankstown Aerodrome 41st Fighter Squadron USAAC
Source: PeaceLoveScoobie 1942

Figure 6-46 Bankstown Aerodrome
Source: SHR, Heritage Division 2001, image by C. Macarthur on behalf of Bankstown City Council

Narromine Aerodrome and RAAF Base

Mitchell Highway, Narromine, NSW 2821
Narromine LEP 2011 #I14

The Narromine aero club (now Australia's oldest regional aero club) was formed in 1929 after approval for an aerodrome by Civil Aviation, and during the 1920s and 1930s, hosted visitors of the likes of Sir Keith and Sir Ross Smith, Sir Charles Kingsford Smith, Charles Ulm, Sir Alan Cobham, Arthur Butler, Jean Batten and Sir Francis Chichester. It was also a regular stop for pilot Arthur Butler, who operated an air mail service at Narromine from 1934 to 1938.

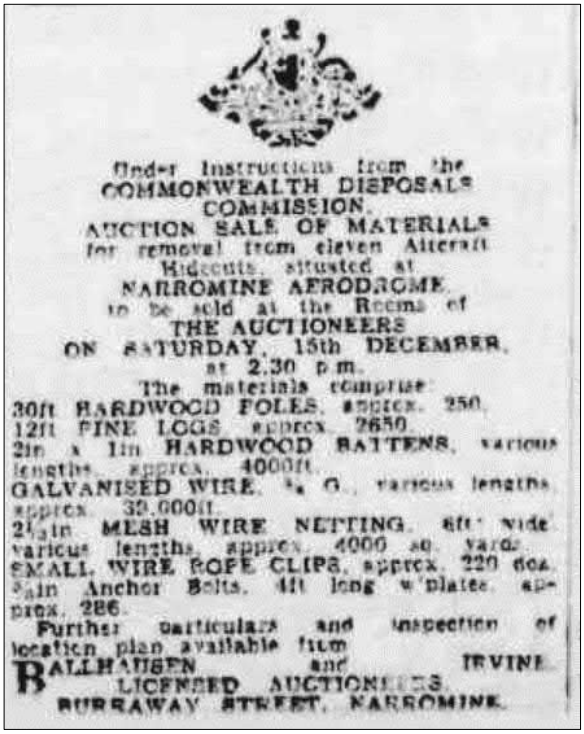
Narromine Aerodrome was acquired by the RAAF in July 1940 for the establishment of an Elementary Flying Training School (EFTS) (No. 5 EFTS). One of a dozen schools established as part of the EATS, the school had 2,850 graduates in its four years of operation (Narromine Aviation Museum 2017). It also served as parent aerodrome to at least four satellite airfields at Burroway, Woodlands, Milford and Willydah (and potentially three others). By 1941 it boasted badminton courts, two tennis courts and a cricket pitch, and by 1942 two sealed cross-strips were in operation.

As RAAF pilot training requirements changed, it was decided to progressively disband all of the EFTS, with Narromine closing in 1944. A large proportion of its personnel were relocated to the new No.8 Operational Training Unit at Parkes. The RAAF retained a presence at Narromine until the last Care and Maintenance Unit was disbanded in 1947 (following the divestiture of surplus assets and buildings).

The airfield building is no longer used and has been relocated to accommodate a new Aeroclub and Museum building. The vast majority of the WWII-era buildings were progressively sold off (see Figure 6-49), with many relocating to local properties. In 2002 its physical condition was listed as 'poor'.

Figure 6-47 Tiger Moth trainers of No. 5 Elementary Flying Training School at Narromine, NSW
Source: Anon. circa 1940

Figure 6-48 Narromine Aerodrome and RAAF Base
Source: Heritage Division 2002obtained from Narromine Shire Council.



Under Instructions from the
COMMONWEALTH DISPOSALS
COMMISSION.
AUCTION SALE OF MATERIALS
for removal from eleven Aircraft
Hideouts, situated at
NARROMINE AERODROME,
to be sold at the Rooms of
THE AUCTIONEERS
ON SATURDAY, 15th DECEMBER,
at 2.30 p.m.
The materials comprise:
30ft HARDWOOD POLES, approx. 250.
12ft PINE LOGS, approx. 2650.
2in x 1in HARDWOOD BATTENS, various lengths, approx. 4000ft.
GALVANISED WIRE, 8 G., various lengths, approx. 30,000ft.
2½in MESH WIRE NETTING, 6ft wide, various lengths, approx. 4000 sq. yards.
SMALL WIRE ROPE CLIPS, approx. 220 doz.
¾in Anchor Bolts, 4ft long w/plates, approx. 286.
Further particulars and inspection of location plan available from
BALHAUSEN and IRVINE
LICENSED AUCTIONEERS,
BURRAWAY STREET, NARROMINE.

Figure 6-49 For Sale advertisement for Narromine aerodrome materials
Source: Anon. 1945

The Oaks Airfield

955 Burragorang Road, The Oaks, NSW 2570
Wollondilly LEP 2011 #I238

Constructed in 1942 as a satellite landing field of Camden Airport (a major operational RAAF base), The Oaks was built with one 5,000 ft (1.5 kilometres) by 150 ft (46 metres) sealed landing strip, and was designed to be used as a dispersal base if the major bases of Sydney came under attack (Heritage Division 2011b). Following the construction of Warragamba Dam, the runway was cut by Burragorang Road (the main access road to the dam, with gates to stop cars from entering the airfield), with only the southern end of the original strip still used today. Deemed unnecessary in the post-war review, it was offered for sale in 1946. The original runway was removed sometime after the sale (Russell 2010).

The Oaks Airfield is listed on the Wollondilly LEP as a rare item of local historical significance and representative of a typical WWII emergency landing strip, one of multiple developed by the Department of Defence throughout NSW.

Figure 6-50 The Oaks Airfield in 2007
Source: Heritage Division 2011b, photo taken by Peter Kabaila on behalf of Wollondilly Shire Council

6.7.2.3 Civil Aerodromes

Old Bar Airfield – Greater Taree

Old Bar Reserve, 0.5 kilometres off Old Bar Road, Old Bar, NSW 2430
SHR #01304, Greater Taree LEP 2010 #I46

The airfield was constructed in 1925, to tender for Commonwealth Government contracts for air mail and aerial passenger services. By 1926, 44 aerodromes and 90 emergency landing grounds had been established as part of the scheme, with Old Bar being the main refuelling stop between Sydney and Brisbane (Heritage Division 1998).

Designated an 'aerodrome' by the Department of Defence in November 1930, the airfield was the refuelling point for Kingsford-Smith and Ulm's Australian National Airways until mid-1931, after which New England Airways operated a bi-weekly service between Sydney and Brisbane, which stopped at Lismore, Grafton, Coffs Harbour and Old Bar (SHR). It also saw constant visits by key pioneering figures in Australian aviation, including Sir Charles Kingsford-Smith, Captain C.T.P. Ulm, Jean Batten and Nancy Bird Walton (Heritage Division 1998).

The RAAF used the airstrip as a refuelling stop during the mid to late-1930s, and based a coastal surveying and mapping expedition there for 12 months in 1939/1940. It was then designated an emergency landing field for the RAAF during WWII (Heritage Division 1998).

The airstrip is grass over compacted clay, north-south aligned and is about 675 metres by 60 metres. Various heritage elements have been removed over time, including runway markers, the fuel shed and windsock, though the windsock and runway markers (removed in 1995) are stored at Taree Airport. A concrete slab at the southeast end of the runway may be the foundation slab for a 1940s fuel pump. At the time of the 1999 SHR listing, the physical condition was listed as excellent, with moderate archaeological potential. This is primarily due to the possibility of an intact, underground fuel tank and fuel pump remains. It was gazetted to the SHR in 2000.

Figure 6-51 Aerial view of Old Bar Airfield
Source: Heritage Division 1998

Figure 6-52 SHR Plan 1887
Source: Heritage Division 1998

Arthur Butler Memorial Aerodrome

Tooraweenah Aerodrome Road, Tooraweenah, NSW 2831
Gilgandra LEP 2011 #I65
Also known as: 'Yeo Airport Terminal' and 'Tooraweenah Aerodrome'

The village of Tooraweenah was the site of Australia's first registered regional airport, developed by solo aviator Arthur Butler. Trading under the name Butler Air Transport Company, in 1938 Butler developed a 5,000 ft gravel and grass airstrip on land acquired from local grazier Alf Yeo. The original hangar was a converted shearing shed, and

operated an air transport service for passengers and mail to Sydney via Cunnamulla, Bourke, Coonamble, and Tooraweenah, continuing to operate its commercial routes throughout WWII (Heritage Division 2008).

Post-WWII, Butler Air Transport Pty Ltd was registered as a public company, and the airport facilities (then called the Yeo Airport) included a small terminal building, hangar and workshops. By the early 1950s Butler Airlines provided regular passenger services from Yeo Airport with 300 passengers each week. Taken over by Ansett Transport Industries Ltd in 1957, Arthur Butler was forced out in a bitter shareholding battle. At one time recognised as the only village in the world (with a population of less than 200) to possess a privately-operated airport, the hangar and workshop buildings were removed to the Gilgandra Shire Council depot (Heritage Division 2008).

The site currently consists of a grassed runway with vehicle access form Tooraweenah Aerodrome Road. Two former Butler Airlines Terminal buildings (circa late 1940s or early 1950s) are located within the publicly-accessible area of the aerodrome: a small, skillion-roofed booking office and waiting room, and a separate pit toilet. The area is in very good condition (as of 2008) and is considered to have low archaeological potential (Heritage Division 2008).

Figure 6-53 Waiting terminal and booking office of Tooraweenah Aerodrome
Source: Heritage Division 2008, photo taken by Ray Christison

Figure 6-54 Arthur Butler in flying gear
Source: Goodall 2016

Aerodrome (Former) (Council Depot)

1610 Forest Road, Warrendine, NSW 2800
Orange LEP 2011 #I172
Also known as: 'Bloomfield Airport'

Construction of the Orange Aerodrome started at Bloomfield in May 1935, with clearing of the site being part of a subsidised unemployment relief program. Opened in 1938 by the Minister for Defence, it operated as a private airport for the area and a new hangar was installed in 1946. Changing aircraft design and steadily decreasing condition pushed the Orange Chamber of Commerce in conjunction with the Orange City Council and the Department of Civil Aviation to build a new 'A-class' aerodrome at Springfield, with the Bloomfield Aerodrome retained for use by short intra-regional flights by light aircraft and trainers (Anon. 1952). Opened in 1961, the Springfield Aerodrome remains the main Orange airport today (Heritage Division 2011a).

The only surviving remnant of the former aerodrome is a large ground sign spelling out the word 'ORANGE'. Considered a modern innovation in aerodrome construction, the sign could be read from an altitude of up to 20,000 ft, with the letters 12 ft 6 in by 10 ft and in 2010 the local Council management plan provided funds to conserve the ground sign in recognition of its historic significance (Orange City Council 2010).The site remains as a landscaped area (about 60 metres by 30 metres) divided by a cyclone fence (which encloses a Council depot). It also includes mature trees which have been allowed to grow though the area previously dedicated as an aerial identification sign (Heritage Division 2011a).

Figure 6-55 Old Aerodrome (Council Depot)
Source: Heritage Division 2011a, photo taken by David Scobie on behalf of Orange City Council

Figure 6-56 Old Aerodrome (Council Depot)
Source: Heritage Division 2011a, image by Davide Scobie on behalf of Orange City Council

6.7.2.4 Summary of comparative analysis

From this comparative review of aerodromes, airstrips, and airports that were established around the same time as Fleurs Aerodrome, a number of patterns emerge. These can assist with benchmarking the significance of the site as a whole, when measured against the legislative criteria and other similar or comparative heritage-listed sites.

An aerodrome designated a 'parent' was considered a major operational aerodrome, and may or may not have had satellite aerodromes or landing grounds. Satellite aerodromes were used to relieve some of the circuit congestion of major airfields, and the number of satellites can indicate the degree of congestion at the parent aerodrome. As an operational station for the Fleet Air Arm of the United States Navy Fleet, Fleurs Aerodrome was intended to have six dispersal airfields (Wallgrove, Bringelly, Bargo, Mittagong, Tuggerah, with the intended sixth – Ravenswood –not constructed) to provide the US fleet with the necessary infrastructure to establish a southern hemisphere base (Brew 2001:40). Fleurs Aerodrome had one of the highest numbers of satellite facilities, comparable to Narromine RAAF Base (seven satellites to cover the Darling Plains). Satellite airfields could be comprised of a landing strip and associated building complexes (a smaller aerodrome), or simply an emergency landing strip (such as the dispersal base at The Oaks, a satellite of Camden Aerodrome).

The WWII Aerodromes thematic study (Brew 2001) has compiled a list of 77 aerodromes and landing grounds in NSW, which it groups into three categories – Operational, Training and Maintenance. Operational Aerodromes were mostly created from unused civilian airfields with pre-existing infrastructure and resources. Training Aerodromes are those that conducted one of the many training schools of the RAAF, including Initial Training Schools (ITS), EFTS, Service Flying Schools (SFTS), Air Observers' Schools (AOS), BAGS and Women's Air Training Corps (WATC) amongst others (Brew 2001:23-27). Examples of these include Bankstown (Aircraft Park), Evans Head (BAGS), and Narromine (EFTS) RAAF Bases. Maintenance Aerodromes were attached to either a stores depot or a Repair and Salvage Unit. Although few in number, they provided an essential support role to the other RAAF bases (the two parent Maintenance Aerodromes were located at Dubbo and Mt Druitt).

Operational aerodromes generally did not have permanent RAAF ground crew, but housed squadrons on a rotating basis dependant on the circumstances and requirement of the RAAF and the War. Designated as a RAAF Station in the NSW Heritage Office thematic study (Brew 2001), Fleurs Aerodrome is one such aerodrome. An assessment of the map of Parent Operational Bases in the same study shows a general pattern, that Operational Bases do not appear within obvious town centres (Brew 2001:39). These discrete locations likely served as an additional dispersal technique to protect Australia's aviation resources.

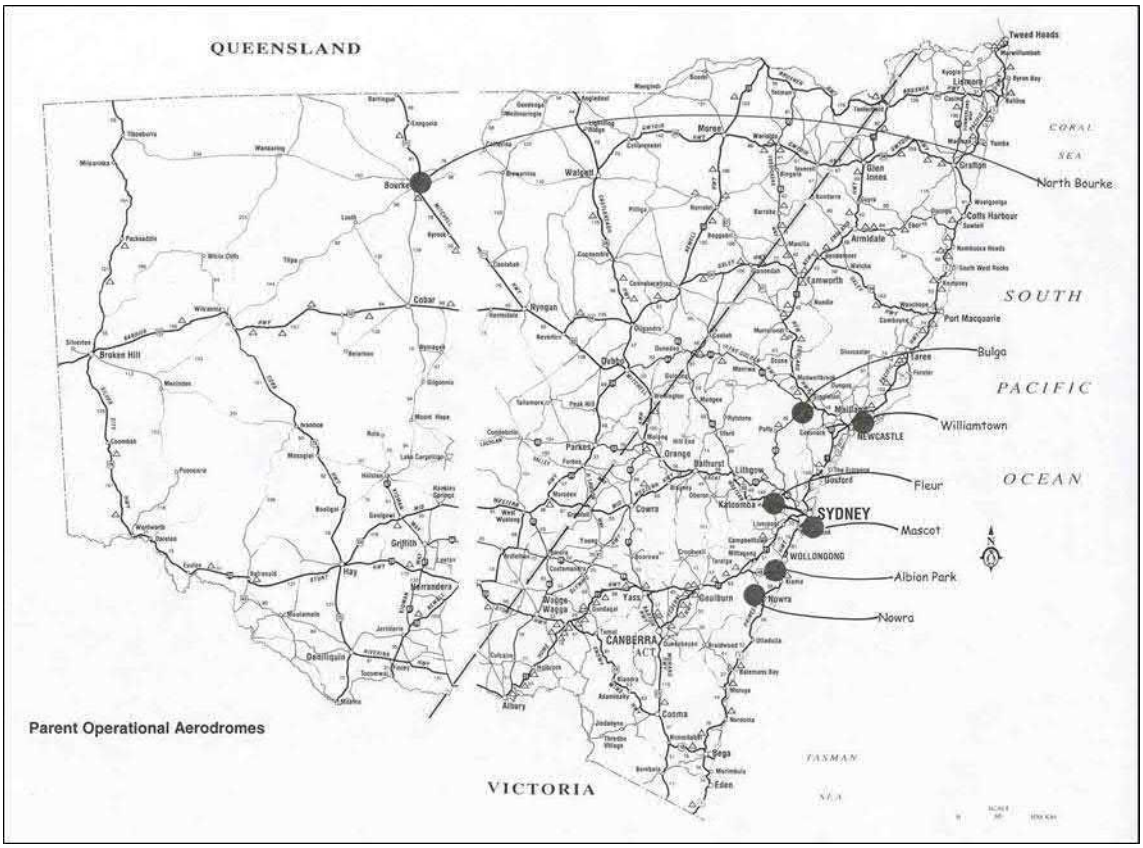


Figure 6-57 Parent Operational Aerodromes
Source: Brew 2001: Annexure H

According to the thematic study, 'the importance of an aerodrome during wartime can be determined by the number, length and design of the runways'. The Evans Head aerodrome was constructed with four intersecting runways to allow aircraft landings regardless of wind direction, and many of the larger aerodromes of Sydney, and other regions are supported by a design of three or more runways eg Nabiac (four runways), Narromine (three runways), Temora (four runways) and Tocumwal (three runways). Assumptions can be drawn from this information as to the relative importance and/or changing fortunes of the Fleurs Aerodrome site as, although central to the US Navy presence in the Sydney region, its intended third runway was abandoned prior to construction.

As a seemingly mundane element in many of their original locations, wartime aerodromes and airstrips have suffered considerable dilapidation once their military purpose was served. Either through initial discard, or subsequent adaptation and/or neglect, a large number of prior aerodromes and airstrips no longer exist in a recognisable way. Often, the WWII buildings and structures of an aerodrome or airstrip were recycled or sold-off (such as at Evans Head and Tooraweenah) and this removal of fabric can significantly impact the integrity and intactness of the site. Subsequent cultivation of those sites returned to pastoral uses can further compromise archaeological or historical remnants. The Oaks (satellite Operational) and Bankstown (parent Training) aerodromes are considered to be representative examples of air bases constructed during World War II, however of the seven parent Operational Aerodromes established, Fleurs Aerodrome is one of the most intact and representative of its WWII scale. Many of the others have since been overdeveloped to the point that they now show little resemblance to their wartime form (eg Mascot and Williamtown have both been substantially developed over time).

6.7.3 Curtilage information

The curtilage of the Fleurs Aerodrome as described above including runway and features is outlined in **Figure 5-55** and **Figure 6-40**.

6.7.4 Significance assessment

The following significance assessment is based on the assessment prepared by Aurecon (2016:121), with updates (bold or struck-out text) as determined during a comparative analysis undertaken for this assessment .

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	Fleurs Aerodrome is an example of the strategic placement of airfields in the Greater Sydney area to accommodate the planes of the various defence arms of the Australian and US contingents during the war in the Pacific during the Second World War. It was one of the biggest sub-networks within a hierarchy that spanned most of western Sydney, and was only stalled in its growth (a third runway was planned for construction) with the cessation of conflict in 1945. The preference for Fleurs by the US naval wing suggests its significance as a key strategic element. **Review of other defence aerodrome examples confirms that Fleurs Aerodrome was constructed as part of the series of strategic aerodromes for the RAAF and further developed for use by the US Navy Fleet Air Wing.** **For NSW, Fleurs Aerodrome was an operational base and serviced multiple squadrons depending on the deployment needs. It provided a strategic base in NSW for the US Navy and the RAAF.**
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. Fleurs Aerodrome has presently no known historical associations. **Further research confirms, no known historical associations are apparent.**
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. There is no aesthetic significance associated with the Fleurs Aerodrome. **Fleurs Aerodrome still has its primary runway in a grass reserve, which is similar to its original form and layout. However, the loss of its second runway has reduced its integrity and associated aesthetic values.**
D – Strong or special associations with a particular community or cultural group	The Fleurs Aerodrome has been associated with the US navy air wing during its operational life in the Second World War, as well as the RAAF. Further research is required to determine the extent of social significance for this site. **As an Operational Aerodrome, Fleurs would have housed a number of RAAF and US Navy squadrons during its operation.**

NSW Criterion	Assessment
E – Potential to yield information	When compared with other parent aerodromes (Bankstown, Richmond, Camden and Mt Druitt), Fleurs Aerodrome is relatively intact. ~~The question over where the second airstrip is could be resolved by gaining more information on the site from further architectural, archaeological and historical research. The site offers a high level of research and educational significance towards understanding the strategies employed during the war in the Pacific.~~ **The second airstrip was oriented at a bearing of 104 degrees (as opposed to the 40-degree bearing of the main runway) and would have occupied an area of 5,000 feet by 150 feet (1.6 kilometres x 46 metres). These dimensions in conjunction with archival photos held by the National Archives enable the location of the second airstrip to be roughly located at the site. Given that the aerodrome was retained by the RAAF without maintenance after the war, it is likely that archaeological evidence of the second runway remains *in situ*, where subsequent development has not disturbed it. Archaeological evidence relating at the location of observation towers and dispersal areas may also be present.** **Despite this possibility for archaeological evidence, their investigation is unlikely to reveal any further insights into the operation and layout of the Fleurs Aerodrome that could not be obtained through documentary evidence.**
F – Uncommon or rare	Fleurs Aerodrome is one of the five parent aerodromes still in existence. The other parent sites – Bankstown, Richmond, Camden and Mt Druitt – are in various states of intactness and therefore similar in nature to Fleurs. Schofields is no longer extant, and Mascot has been developed beyond its original purpose. Fleurs, however, was the parent aerodrome to the most satellite strips. Only one of which never got further than planning stage, and another in Bargo whose location remains unidentified at the time of this statement of significance. The other three satellite strips are still extant, albeit in various states of intactness. **Further research confirms that Fleurs Aerodrome had the most satellites of any Operational parent Aerodrome in NSW. It was also one of only two Operational parent aerodromes in the greater Sydney region.** **Narromine in the Darling Plains had seven active satellites, however Narromine was a Training aerodrome rather than an Operational one.**
G – Principal characteristics of a class	Fleurs Aerodrome is an example of a parent aerodrome utilised during the Second World War. Bankstown Parent Aerodrome has been listed as significant at a local level. Neither Fleurs or any of its satellite landing strips has been listed. **As with Evans Head, Narromine and Bankstown Aerodromes, Fleurs Aerodrome is representative of a parent aerodrome used during WWII.** **Evans Head Aerodrome, Narromine Aerodrome, and Bankstown Aerodrome have been listed as significant at a local level. Bankstown and Evans Head have both also been listed as State significant due to their greater level of integrity. Fleurs Aerodrome is representative of parent operational aerodromes, being one of only seven in NSW.**
Integrity/intactness	The reserve set aside for the aerodrome is the most intact of the site's elements, with only a minor incursion from a fence line on the northern side. While the original footprint of the main landing strip reserve has been maintained, the archaeological integrity has been compromised by cultivation and construction along its path. The construction of sites such as the radio telescopes to the north and agricultural development to the south have also contributed to weakening the entire intactness of this area. Comparatively speaking, however, Fleurs may be of greater intactness than other parent aerodromes developed during the Second World War in Sydney. **A number of other parent Aerodromes survive with some level of intactness; however, they are primarily training aerodromes outside of the Sydney area, and some (eg Bankstown) have been updated through time to show little resemblance to their wartime form.** **Although not a complex site, and despite having suffered through subdivision and development (primarily agricultural and scientific) Fleurs Aerodrome retains sufficient integrity and retains enough general features to allow interpretation of its original usage.**

6.7.5 Statement of significance

Fleurs Aerodrome has local significance based on its historical and social significance, rarity, and representativeness.

Fleurs Aerodrome represents an integral part of the RAAF defence of Australia and the larger US military strategy in the Asia-Pacific. An operational aerodrome, Fleurs housed and serviced multiple flight squadrons throughout the war, dependant on the deployment needs of the group.

Fleurs Aerodrome is not unique but one of the few operational parent aerodromes built or established by the RAAF in WWII. Better preserved examples of WWII aerodromes survive at Bankstown and Evans Head, but these were training bases rather than operational ones, serving a different function in the wartime effort. Fleurs aerodrome was one of only two parent Operational aerodromes in the greater Sydney region, and had the largest number of satellite airfields of any of the Operational aerodromes. It represents a rare surviving example of such an airfield in both the Sydney region and greater NSW, as operational airfields are typically of importance to Defence.

Although situated in a large grass reserve, and similar in form to its original surfacing, the loss of the greater lands and second runway of the aerodrome has reduced its integrity, with only a portion of its original layout and infrastructure remaining. This has reduced its heritage value accordingly. Fleurs Aerodrome retains some integrity, despite subdivision and development (primarily agricultural and scientific) and enough general features remain to allow interpretation of its original usage.

Figure 6-58 Existing bitumen runway (disused) facing north.

Figure 6-59 Metal feature at northern end of bitumen runway, facing southwest.

Figure 6-60 Area north of bitumen runway, facing south.

6.8 Item 8: Cecil Park School, Post Office and Church Site

6.8.1 Description and history

Cecil Park Public School, Post Office and Church Site is located on Lot 1 DP724970 and was surveyed on 1 March 2018 (Survey area no. 38) and again on 1 August 2018. The heritage item is located inside the construction footprint. Aurecon (2016) identified this potential heritage item in its report as a result of a 1906 reconnaissance map (**Figure 6-63**) which depicted three buildings on the site, and recommended that further historical and archaeological

investigation be undertaken in order to fully assess the site. The report identified the potential for intact subsurface archaeological deposits to be present at the site, although no extant buildings remain on site.

Subsequent historical research has confirmed three separate buildings were formerly built on the property, forming the nucleus of the Cecil Park village. These buildings were Cecil Park Public School, Cecil Park Post Office and the School Church of St Paul, Cecil Park (later known simply as “St Paul’s Cecil Park”). There is historical evidence indicating that a residence for the school master also existed on the site.

The following features have been identified in the c1947 aerial (**Figure 6-61**):

- Area A: Cecil Park School
- Area B: Teacher’s Residence
- Area C: Cecil Park Post Office
- Area D :School Church of St Paul.

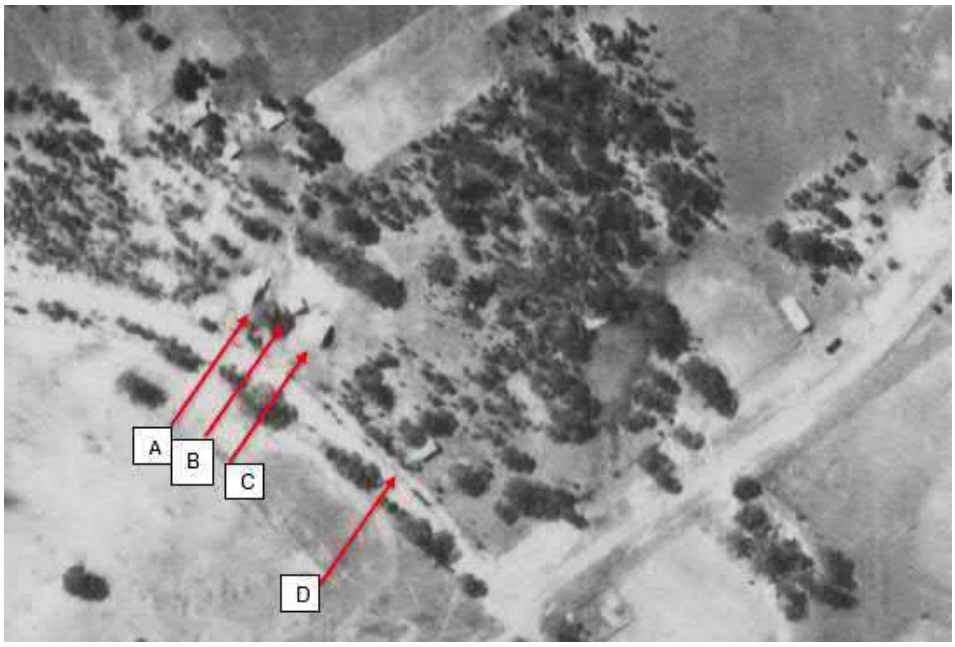


Figure 6-61 1947 aerial imagery of the Cecil School site
Courtesy: NSW Department of Finance, Services and Innovation.
Note: Area A: Cecil Park School; Area B: Teacher’s Residence; Area C: Cecil Park Post Office; Area D :School Church of St Paul.

Following the field survey, archaeological test excavation was undertaken at the site between 1 and 5 July 2019 . A separate archaeological assessment, research design and subsequent test excavation report for the former Cecil Park School, Post Office and Church Site is included as **Annexure B**. The information from this report has been summarised below in **Section 6.8.3**.

Cecil Park Public School

Cecil Park Public School was identified by Aurecon (2016) as a potential heritage item.

The following information is replicated from Aurecon (2016: 111):

> *Historical records show that there was a school from 1895 to 1940. There was also a school residence for the school master, who, in the early days, was also the post master. The first teacher was Mr William Flood.*
>
> *In 1921, Mr Michael Joseph Kenniff retired as a teacher from Cecil Park Public School.*
>
> *An image of the post office from the 1950s shows that it was a wooden building. A tender put out for the construction of the school shows that it was meant to be brick. The school grounds were cleared for the purpose of creating playgrounds and to allow the construction of buildings and fencing. Dorothy Cook was appointed to the Post Office at Cecil Park in 1956.*

In 1895, McDermott and Murphy builders were engaged to build the Cecil Park Public School for a sum of £89. A tender for the erection of a wooden teacher's residence was put out in 1896. However, in 1898, the NSW government sought tenders for the erection of a brick school, implying the previous entity was wooden or of less substantial construction. This was awarded to HA Baglee for £330.

The Cecil Park public school in 1899 had been enclosed by a two-rail fence, at the same time as a tender was sought for 'extra work' to the school by the NSW Department of Public Instruction. The playground, which comprised about six acres, was also being attended to, with grubbing and clearing operations occurring.

In 1905, tenders were sought for improvements to both the school and the teacher's residence. This would entail repairs and painting.

Aurecon recommended that further historical and archaeological investigation be completed in order to fully assess this site which may have local significance due to the potentially intact nature of subsurface deposits.

Cecil Park Post Office

Little historical information is available regarding the post office. The post office appears on a 1906 reconnaissance map of Liverpool (**Figure 6-63**). An image of the post office from 1950 shows that by the time of the photograph the post office was made up of a cluster of weatherboard buildings with a public telephone box outside (**Figure 6-62**).

Figure 6-62 Cecil Park Post Office, 1950
Courtesy: National Archives of Australia

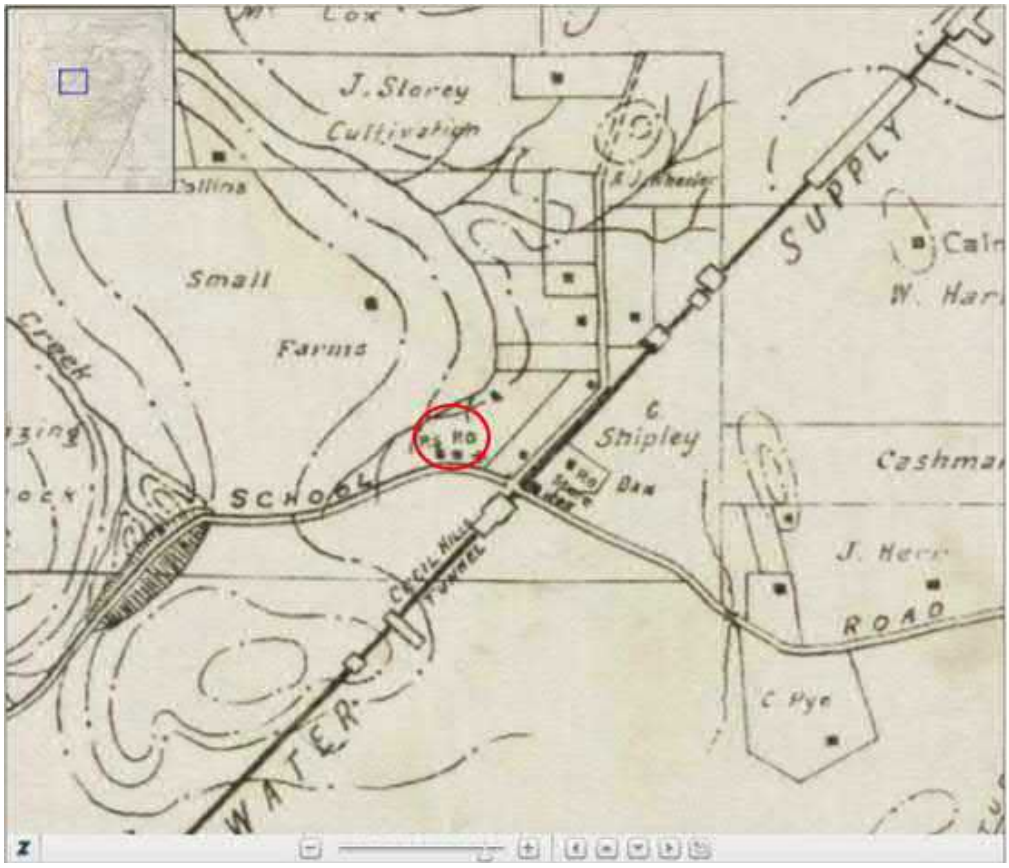


Figure 6-63 Extract from 1906 reconnaissance map for Liverpool Army Camp showing site for Cecil Park Public School and Post Office and St Paul's church (later community hall)
Source: Aurecon (2016:116).

School Church of St Paul, Cecil Park

In 1903 a church was constructed to the east of the school and post office (**Figure 6-63**). Anglican religious services were held at the house of the Shipleys, whose property was to the immediate east of the church, school and post office, on the opposite side of Wallgrove Road. The new church was opened by the Archbishop of Sydney, Dr William Saumarez Smith, on 17 October 1903 and dedicated to St Paul. The cost of construction was funded partially by the church Society, but mostly by residents. According to newspaper reports of the time, the church was constructed of weatherboard with an iron roof, internally lined with timber. The capacity of the church was estimated to be for 100 people, and as with other nearby localities, such as the first Methodist Church at Badgerys Creek, doubled as a community hall (Liverpool Herald 1903:3) (RPS Manidis Roberts 2015:118). The church was formally named the "School Church of St Paul, Cecil Park" at the dedication ceremony, although later publications refer to the church as "St Paul's, Cecil Park".

No historical information was found regarding the exact dates of the closure of the church. The church celebrated its Golden Jubilee in 1953, however appears to have closed shortly thereafter.

6.8.2 Archaeological potential

Expected archaeological deposits are of building footings and would be most likely found in the area at the front of the block, where historical mapping and aerial imagery have indicated there were school and/or post office buildings previously (**Figure 6-61** and **Figure 6-63**).

As noted above, the school was open until the 1940s, the church until the 1950s and the post office until the 1960s. It is assessed that owing to the relatively undisturbed nature of the Cecil Park Public School, Post Office and Church Site and presence of surface material consistent with that expected for institutional buildings of the time period, the site has potential to contain archaeological deposits.

Other types of archaeological deposits consistent with this type of site but not observed may include cess pits and/or material culture relating to the site's use. There is no known cemetery attached to the site of the church. The archaeological remains have the potential to yield information about the past relating to development of education,

religious buildings in rural Sydney and postal and telecommunications infrastructure in the late 19th century and early 20th century.

Features identified during field survey included (**Figure 6-64**):

- A large flat area close to Elizabeth Drive at the east of the property, a 10 metres x 2 metres x 1 metres pile of rubble including bricks and ceramics at the south west of the property
- A platform in the centre of the property at the Elizabeth Drive frontage was noted to be cut from the natural slope
- A level clearing was found to the west of the former teacher's residence
- A rubbish pile chiefly comprising sections of intact brickwork and glass. The vacant block had clearly been used for the dumping of refuse and recreational activity.

A detailed archaeological assessment, methodology and research design for the Cecil Park School, Post Office and Church Site is provided in the Archaeological Assessment, Research Design and Test Excavation Report (**Annexure B**).

Figure 6-64 Aerial photograph showing the approximate location of various features identified during the site inspection

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Created by : AA | QA by : TC

6.8.3 Archaeological test excavation

The following section is summarised from the Archaeological Assessment, Research Design and Test Excavation Report provided in **Annexure B**.

Archaeological test excavation results

The archaeological test excavation was conducted over a five day period from 1 to 5 July 2019 by a small team of archaeologists, including the Excavation Director (Fiona Leslie, Jacobs Principal Archaeologist), two assistant archaeologists (Deborah Farina, Jacobs Senior Archaeologist; Clare Leevers, Jacobs Archaeologist) and an experienced site planner (Kerry Platt, Jacobs).

The investigation involved the excavation of five strip trenches, measuring 1.5 metres wide by 5 metres long, placed in strategic locations across the subject site (**Figure 6-65**).

In summary, the following archaeological relics were identified during the test excavation:

- Intact brick footings of the former c1898 Cecil Park school in Test Trench 1. The footings appear to be associated with an annex attached to the main school building and include a former brick and mortar base, possibly for a stove. The footings were found below and in association with demolition fill and a number of artefacts, including ceramic, glass and metal pieces, were collected as part of the process of exposing the *in situ* structural remains. Of particular note was the presence of buttons, animal bone pieces with cut marks and a marble. Given the integrity of the footings, it is likely that some *in situ* deposits associated with occupation of the school would survive within the broader building footprint
- An artefact and charcoal rich deposit in Test Trench 5, which was exposed and left *in situ*. The deposit was found in association with bricks and may be the remains of a disturbed fireplace of the former c1906 St Paul's timber church. Further investigation, including manual excavation of the deposit, is needed to confirm this initial interpretation. Other brick piles were noted in the immediate vicinity and are also likely related to the former church and its outbuildings
- In Test Trench 3 a demolition fill and associated cut into the natural ground was identified and is likely to be associated with the former Teacher's Residence shown in the c1947 aerial photo of the subject site (Area B). However, no *in situ* archaeological deposits or structural remains were identified. Similarly, in Test Trenches 2 and 4 demolition fill and an embedded stone was identified but no *in situ* archaeological relics were found.

A total of 246 individually recorded artefact fragments were recovered from the test excavation. Glass fragments formed the majority of the assemblage (94 pieces), followed by metal (75 pieces), brick and mortar (25 pieces) and ceramic (23 pieces). The majority of the artefacts were recovered from the demolition fill [Context C001] excavated in Test Trench 1. As expected, the fill contained predominantly building materials (nails, brick pieces, window glass) with occasional food and beverage pieces (cut bone fragments, tableware, bottle glass). Three small buttons, including one made of shell , and a marble were found within C001. Occasional special finds like these are not surprising in the context of a small school and associated residence.

The small number of artefacts recovered from Test Trench 5 during the cleaning of Context C027 were predominantly glass pieces, including four fragments of discoloured glass with manganese inclusions manufactured from c1890 to 1916. Two intact metal door hinges were also recovered (leaf and barrel, and leaf and pin). It is likely that the remaining *in situ* deposit which was not subject to excavation would contain a much greater range of domestic artefacts relating to occupation and use of the former church. Artefacts recovered from the topsoil with Test Trench 2 included plastic and glass pieces, a glass marble and a glass inkwell bottle. A glass inkwell bottle piece was also recovered from the topsoil in Test Trench 4. No artefacts were identified in Test Trench 3.

The archaeological test excavation has confirmed the presence of archaeological relics within the subject site, not surprisingly in the location of the former school and church as shown in the c1947 aerial photograph. Given that the project would impact on the subject site, further archaeological salvage excavation is now required to further investigate relics prior to works commencing. Given the condition of the footings of the former brick school and annex and the presence of an *in situ* artefact rich deposit associated with the former church, the relics clearly have integrity and research potential. Further analysis of both the school and church site may provide some insight into former occupation and use of the complex by local residents, teachers and students.

Given the presence of the active gas main, which traverses the subject site, it is likely that some portions of the complex have been significantly disturbed. However, as demonstrated by the results of this test excavation, this area of disturbance is likely to be restricted to the gas main corridor only, with intact relics present in surrounding deposits.

Discussion and interpretation

The subject site housed a complex of former buildings associated with the village of Cecil Park including the school (Area A) and teacher's residence (Area B), the post office (Area C) and the School Church of St Paul (Area D) (see **Figure 6-65**). The predominantly timber buildings were progressively added to the site from 1895 through to 1903 and occupied until the 1950s prior to their demolition.

Archaeological test excavation of the subject site has confirmed the presence of intact historical archaeological relics of the former Cecil Park historical complex. Relics include: intact brick footings of the former c1898 Cecil Park school, including a former annex attached to the main school building, and a brick and mortar base, possibly for a stove. The footings were found below and in association with demolition fill containing occasional ceramic, glass and metal pieces, buttons, animal bone pieces with cut marks, and a marble. Given the integrity of the footings, it is likely that some *in situ* deposits associated with occupation of the school would survive within the broader building footprint. An artefact and charcoal rich deposit was also found in the footprint of the former c1906 St Paul's timber church. The deposit was found in association with broken bricks and may be the remains of a disturbed fireplace. Further investigation, including manual excavation of the deposit and surrounding rubbish piles, is needed to confirm this initial interpretation.

The subject site maintains its significance at a local level for its historical heritage value, research potential and for its potential social heritage values. Further archaeological salvage excavation and associated artefact analysis would provide insights into the changing layout of the building complex and the lives of the children, teachers and worshippers that lived at Cecil Park during the late nineteenth and early twentieth centuries.

6.8.4 Curtilage information

The curtilage of the Cecil Park School, Post Office and Church Site is as described above and shown in **Figure 5-55**.

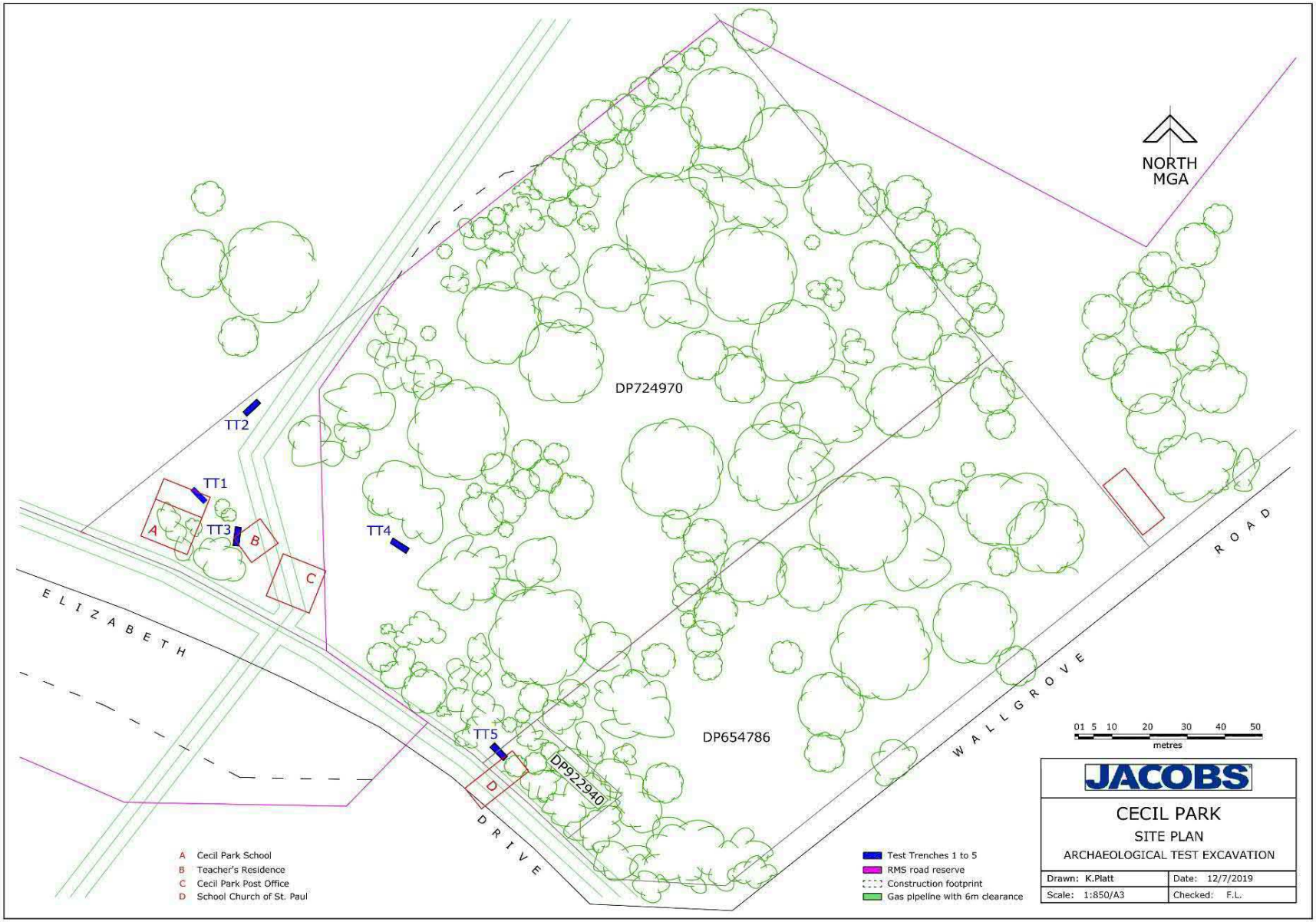


Figure 6-65 Plan showing the test trench locations across the Cecil Park School, Post Office and Church Site

6.8.5 Significance assessment

The following significance assessment was updated at the conclusion of the archaeological test excavation.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	The subject site is associated with two phases of historical development: agricultural land that formed part of the large estate known as 'Macquarie Park' granted to Thomas Wylde (1817 – 1886) and its subsequent subdivision and development for the Cecil Park Public School, post office and School Church of St Paul (1895 – 1965). Following the demolition of the school buildings in 1965 the land has remained vacant and undeveloped. As it housed the school, post office and church, the subject site was a central locality within the small community of Cecil Park. As such, it is historically significant to the local area for its association with education, religious worship and postal and telecommunications infrastructure in the settlement of Cecil Park and the broader development of western Sydney. Archaeological test excavation has confirmed the presence of substantially intact archaeological relics of the former brick school building and the timber church. Further archaeological excavation and analysis of these deposits is likely to provide further insight into the lives of Cecil Park children, teachers and worshippers during the late nineteenth and early twentieth centuries.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. The school, church and post office site have no known significant historical associations to a person or groups of people of importance in NSW or the Cecil Park area. It is likely that the School Church of St Paul, Cecil Park would have been significant to the Anglican Church and local Anglican worshippers when it was still standing.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. Despite the integrity of brick footings identified at the former Cecil Park school site, archaeological relics at the subject site are unlikely to have aesthetic significance.
D – Strong or special associations with a particular community or cultural group	Although there is no known current social significance attached to the site, the school, church and post office buildings would have represented the heart of the early Cecil Park community. Archaeological relics of the Cecil Park school and church site may be significant to the present Cecil Hills community; however, further community consultation would be required to understand the strength of this association.
E – Potential to yield information	Archaeological test excavation has revealed the presence of substantially intact brick footings of the former Cecil Park school building and *in situ* archaeological deposits associated with the former St Paul's church. Some disturbed remains of the former teacher's residence may also be present outside of the active gas main corridor (**Figure 6-65**). Archaeological evidence of the former post office, however, is unlikely to have survived the installation of this service. The condition and integrity of the archaeological relics exposed to date suggest that areas surrounding the former school and church sites have considerable archaeological potential for further archaeological relics, including brick footings and artefact-rich underfloor and yard deposits. Further salvage excavation and analysis would provide further insights into the changing layout of the buildings and their use over time. The recovery and analysis of artefacts from these contexts may also provide some significant insight into the lives of the former teachers, worshippers and local children. Information about wealth, diet and lifestyle could be gained from such analyses. This kind of information is not readily available in the historical record and could contribute to broader questions about the development of education and religious buildings in Western Sydney during the late 19th and early 20th century. As a result of investigations to-date, the subject site is significant at a local level for its research potential.
F – Uncommon or rare	The subject site is unlikely to be rare, as there are many examples of late 19th and early 20th century schools, post offices and churches still standing in NSW.
G – Principal characteristics of a class	Does not meet this criterion. The subject site is unlikely to be significant in terms of this criterion.

6.8.6 Statement of significance

The statement of significance was updated following the completion of the archaeological test excavation.

The former Cecil Park historical complex located on Lot 1 DP724970 is significant at a local level for its historical heritage value, research potential and for its potential social heritage values. The subject site housed the public school, post office and the School Church of St Paul from 1895 to the 1950s and likely became a social hub for the small rural location of Cecil Park. Since the demolition of the school buildings in 1965, the site has remained vacant and undeveloped. Although there is no known current social significance attached to the site, the school, church and post office buildings most likely would have represented the heart of the early Cecil Park community. Archaeological test excavation has confirmed the presence of structural remains and *in situ* archaeological deposits of the former brick public school and the timber Church of St Paul at the subject site. However, at this stage, no deeper sub-surface features have been identified (ie wells, cess pits). Given the condition and integrity of the remains, it is considered likely that further substantially intact archaeological relics of the former complex would survive in the surrounding areas. Further salvage excavation and analysis would provide further insights into the changing layout of the buildings and their use over time. In particular, the analysis of artefacts recovered from *in situ* deposits would provide information on the lives of children, teachers and worshippers who lived at Cecil Park. Very little information is currently available on the history of the former historical complex and, as such, these relics would be of local heritage significance.

Figure 6-66 Test Trench 1, south-east corner showing the brick and concrete pad [C022] and associated footings [C016, C023].

Figure 6-67. Buttons found in C001, Test Trench 1.

Figure 6-68 Test Trench 3, mid-excavation, showing a cut into sterile B horizon clay, facing west.

Figure 6-69 Test Trench 5, end-of-excavation showing extent of C027, facing south-west.

6.9 Item 9: Karingal, 752 Luddenham Road, Luddenham (Lot 1, DP235124)

6.9.1 Description and history

The property is Lot 1 DP235124 and was surveyed on 13 November 2017 (Survey area no. 2). The property is currently Karingal Training Stables. The potential heritage item is located inside the study area but outside the M12 Motorway proposed construction footprint. The potential heritage item was identified during the field survey.

Several buildings on the property appear to be old and are located in close proximity to each other. A large building containing stables has a central rail embedded in a concrete floor (**Figure 6-71**). There is a cart with metal wheels at one end of the shed which would have moved along the rail taking feed to the individual stables (**Figure 5-51**). The stables are located off the central rail area with moveable timber structures to assist with feeding stock. The building has exposed timber beams and a central gabled roof (**Figure 6-73**, **Figure 6-74**). The support posts for the building are complete timber logs. The building is being used as stables. Adjacent to this building, to the southwest, is a large timber framed shed. The shed is open to the southwest and has a high corrugated iron and timber roof with three gables. The support posts for the building are complete timber logs. The building has a concrete floor and is used as a garage. To the northwest of these buildings is a slab and some bricks where a two-storey sandstone building was previously located **(Figure 6-75**). There is a large peppercorn tree located next to the slab/bricks. There are two smaller timber sheds with overhanging eaves and corrugated iron roofs, located to the west and south of the main buildings described above. The buildings are used for storage and stock shelter. The property contains a training track for horses which is overgrown with vegetation (**Figure 6-76**). There is a pile of building rubble in the northeast corner of the property adjacent to creek.

Current tenant Vicky Allen believes the buildings were built before c1920 and that the property used to be a large trotting establishment 40 years ago. She stated that she believed the property was owned by Bradeys prior to the current owner, and prior to this the property was associated with John Tapp, a well-known race-caller who worked from 1965 to 1998. Online sources state that John Tapp was introduced to trotting through a celebrity challenge, and that he then bought a property in Luddenham (Property Observer 2016). No further information was available. Results of a title search (**Table 6-4**) did not reveal either of these two names; however, several companies are listed as owners instead of individuals. The tenant also stated that there was previously an old house on the property, located where the more recent house currently stands, and that it burnt down.

Horse racing developed in the wider Penrith Council region from the mid-1800s. Trotting started in the region around 1900, when a trotting track was built in Penrith. From the 1960s, night-time harness racing became popular in Penrith (Paul Davies Pty Ltd 2007:94).

A review of aerial imagery from January 1947 indicates a large number of buildings including those observed during the field survey. The two-storey sandstone building which previously stood where there is currently a slab remaining is not visible on the aerial, nor is the trotting track to the east of the buildings. A house, different in form to the current house, is located southwest of the stables. This confirms the information that there was an earlier house in this location.

Table 6-4 Title search results for Item 9

Date	Information
31st August 1819	Crown Grant of 400 acres (Portion 60 Parish of Claremont) to James Smith
30th and 31st December 1830	Lease and Release (Conveyance) No. 513 Book D to John Piper
27th and 28th May 1831	Lease and Release (Conveyance) No. 510 Book D to William Cox
22nd January 1848	Conveyance No. 110 Book 14 to William M. Benson
22nd May 1869	Conveyance No. 572 Book 114 to Alexander Benson
27th January 1898	Primary Application No. 10574 by Alexander Benson
8th May 1899	Issue of Cert. of Title Vol. 1280 Fol. 171 in the name of Daniel Buffier of Camden Park St. Peters, Cattle Dealer
14th June 1937	Transmission Application No. C546896 by Norman Daniel Buffier of Coogee, Grazier
12th September 1949	Issue of Cert. of Title Vol. 6022 Fol. 13
13th June 1957	Issue of Cert. of Title Vol. 7305 Fol. 49

Date	Information
25th July 1960	Transmission Application No H526936 by Daniel Norman Buffier of St. Marys, Grazier
28th July 1960	Transfer No. H564844 to Selkirk Estates Pty Limited
15th November 1961	Issue of Cert. of Title Vol. 9065 Fol. 201
6th September 1962	Issue of Cert. of Title Vol. 9262 Fol. 106
16th January 1963	Transfer No. J249137 to Ronald William Bevin McDive of Penrith, Company Director and Norah Olive McDive, his wife
30th May 1966	Transfer No. K345722 to Jono Tailoring Pty Limited and Saviour Emanuel Bezzina of Milsons Point, Printer
24th April 1968	Issue of Cert. of Title Vol. 10783 Fol. 80
16th September 1969	Transfer No. L572972 to Jono Tailoring Pty Limited
21st March 1973	Transfer No. N125686 to Williams Bros. (Dee Why) Pty Limited (later Williams Bros. Investments Pty Limited), Garrison Hotel Pty Limited and Gordon Grant of Careela, Booaker
10th July 1986	Transfer No. W412299 to Berrigan Pastoral Company Pty Limited
16th March 1988	Folio 1/235124 created
28th January 2003	Transfer No. 9321298 to Selim Barikhan
4th May 2005	Change of Name No. A8454870 to Salim Barikhan (current owner). Note: spelling Salim and previous entry Selim, as provided by title search agent.

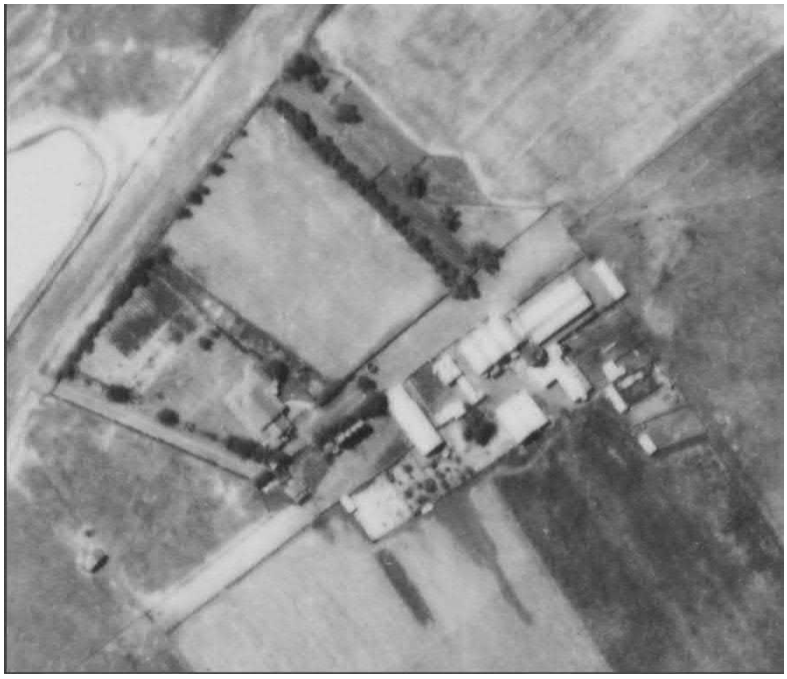


Figure 6-70 Aerial imagery from 1947 showing the location of buildings at the time

Courtesy: NSW Department of Finance, Services and Innovation.

6.9.2 Curtilage information

The curtilage of Karingal as described above is shown in **Figure 5-55**.

6.9.3 Significance assessment

No previous significance assessments have been completed for this potential heritage item.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	Does not meet this criterion. There is no physical evidence to demonstrate a connection with historically important activities or processes.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. While it has been noted that the property may be associated with a well-known trotting person, no evidence has been able to be sourced to confirm this. The association is considered insufficient to meet the criterion.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. The property is not a major work by a designer or artist, and does not display any particularly aesthetic features.
D – Strong or special associations with a particular community or cultural group	Does not meet this criterion. There is no evidence that the property has strong or special associations with a particular community or cultural group.
E – Potential to yield information	Does not meet this criterion. The property has no archaeological or research value.
F – Uncommon or rare	Does not meet this criterion. This type of property is not uncommon or rare.
G – Principal characteristics of a class	Does not meet this criterion. The property does not demonstrate any principal characteristics of a class.

6.9.4 Statement of significance

While Item 9 may be associated with John Tapp, a well-known race-caller in the second half of the 20th century, there is insufficient evidence to confirm this. Historical aerial imagery has confirmed some of the buildings on the property existed prior to 1947, but there is no evidence of trotting tracks present at this time. The item is considered to have insufficient significance to fulfil the criteria for State or local listing.

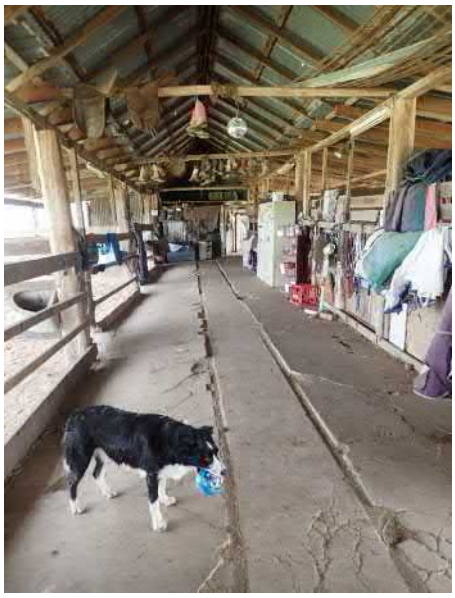


Figure 6-71 Interior of shed, showing rail and timber beams.

Figure 6-72 Interior of shed, showing cart with wheels that would have moved on rail.

Figure 6-73 Exterior of shed. Facing northeast.

Figure 6-74 Interior of shed, facing east.

Figure 6-75 Bricks where sandstone building was previously located, facing north.

Figure 6-76 Overgrown training track, facing northeast.

6.10 Item 10: Exeter Farm Archaeological Site

6.10.1 Description and history

The property is Lot 1 DP74574 and was surveyed on 14 November 2017 (Survey area no. 5) and in April 2018. The heritage item is located inside the study area and partially within the project's construction footprint.

The property was once part of a larger land grant (640 acres) to James Badgery on August 1812 which was the Exeter Farm (Paul Davies Pty Ltd 2007:12). Governor Lachlan Macquarie visited the farm with Gregory Blaxland on 28 November 1810, and wrote:

> *Called first at Badgery's Farm close on the left Bank of the South Creek, where I was much pleased to find a good Farm House built, a good Garden, and a considerable quantity of ground cleared.*

Aurecon (2016) identified Exeter Farm Estate House as a potential heritage item, but the assessment only included the house site and not the northern boundary of the estate where Lot 1 DP74574 is located. A title search of the property indicates that the property ceased being owned by the Badgery family in the mid-1800s (**Table 6-5**).

Two key features were identified during the field survey: a row of trees forming a hedge, and an artefact scatter to their immediate east (see **Figure 6-77)** There is a row of eight trees planted close to the fence line of the adjacent property, and to the west of an area containing an artefact scatter. The trees may be Osage-orange trees (*Maclura pomifera*). A review of aerial imagery from 1947 (**Figure 6-79**) indicates that the row of trees was well established at this date. The trees are in poor condition. The common names for the Osage-orange trees include Osage Orange,

bow-wood and hedge-apple and may be of heritage significance owing to their known historical use. These trees are native to Oklahoma, Texas and Arkansas, and the wood from this tree was used for war clubs and bows by native Americans, hence the common name of “Bois D’Arc” or “Bow Wood”. It is believed that this plant was imported from the United States to be used as hedges for stock management.

In relation to their use in colonial gardens, these plants appear as multiple examples on the Sydney Living Museums’ (former Historic Houses Trust) Colonial Plants Database. The earliest entry comes from 1836, under the list “Plants Received at Elizabeth Bay”, with a further note that among many other species, an Osage Orange was brought by William Sharpe Macleay on board the Royal George in 1839. Another known example of the use of these trees is at Durham Hall at Braidwood. The garden at Durham Hall was laid out in the 1840s by Mrs William Henry Roberts, nee Ann Badgery. Ann Badgery was James Badgery’s daughter and grew up on Exeter Farm.

Figure 6-77 Osage orange “hedge”, looking west.

A conservation management plan (Pickard 2007) for an Osage Orange hedge in Peats Crater, Muogamarra Nature Reserve, NSW states that:

> *Hedges were the dominant form of fence used in Great Britain in the 18th and 19th centuries, and although a few were planted in Australia, they were uncommon except in northern Tasmania. Osage orange was the favoured hedge plant in the prairie states of the United States before the invention of barbed wire in 1874. Some colonial Australian nurserymen and others praised the plant for fences, but by the 1860s the de facto standard fence in Australia was post-and-wire.*
>
> *Hedges were rarely used in rural New South Wales during the colonial period and those that survive today are considered rare and significant (Pickard 2007).*

East of the row of trees is an artefact scatter situated within a large depression in the ground. The artefact scatter comprises bricks, metal, ceramic and glass across an area about 50 metres wide (**Figure 6-80**, **Figure 6-81, Figure 6-82, Figure 6-83**). The artefact scatter comprises of less than 30 individual artefacts visible that have been scattered over the ground through ploughing. There were three main brick types noted at this site. One was a bright red, narrow profiled sandstock brick with large inclusions, likely to be of early/mid-19th century manufacture. The second was a darker, slightly bigger brick with a heart-shaped frog. The third was larger again, without any frog markings. All three had the lines along the stretcher indicating a dry-pressed variety of manufacture.

The site has been subject to ploughing and grazing and is therefore disturbed within at least the top 100 mm of subsurface deposits. An angular depression observed in the ground may indicate that there was a building there

previously due to the size and shape of the area, although no building footings were visible. There does not appear to be any small areas with stones or depressions to indicate the presence of possible cess pits. The artefact scatter stretches northward along the crest and down the north slope. The potential to yield information about the site may be limited in nature, however any additional information regarding Exeter Farm adds to the knowledge of colonial land use and is therefore considered to be of historic significance. Information such as the dates of the glass and ceramic fragments may also indicate the period of time that these items were used in the past.

No buildings are visible to the east of the Osage Orange trees on the historical aerial imagery, which is where the artefact scatter is now situated, however an angled depression is visible both on the ground and on the 1947 aerial image (**Figure 6-78**).

Figure 6-78 Angled depression to the east of the Osage Orange hedge, looking north west.

The location of the artefact scatter was subject to an assessment by Aurecon (2016). A general map (Aurecon 2016: Figure 2-1) showing the survey areas and location of option B5 overlaps with the artefact scatter location. Aurecon recorded the location of the Exeter Homestead site further south (about 1.35 kilometres). They noted that the southern part of the original estate contained sandstock brick fragments located in cultivated fields where plum trees were previously grown. This location is outside the current study area.

Table 6-5 Title search results for Item 10

Date	Information
25th August 1812	Crown Grant of 640 acres (Portion 31 Parish of Claremont) to James Badgery
22nd October 1823	By the Will of James Badgery title passed to Henry Badgery and Many Ann Badgery
25th February 1854	Conveyance No. 622 Book 31 to James Boyd McKanghan
5th November 1855	Conveyance No. 705 Book 41 to Joseph McMullen
18th September 1860	Conveyance No. 997 Book 68 to William Sharpe
12th July 1913	Conveyance No. 87 Book 1005 to Donald Bruce MacIntyre
21st September 1916	Conveyance No. 597 Book 1092 To Henry Horton
2nd November 1922	Primary Application No. 24574 by Henry Horton

Date	Information
19th August 1924	Issue of Cert. of Title Vol. 3629 Fol. 121
3rd September 1930	Transmission Application No. C8963 by Perrpetual Trustee Company (Limited)
28th June 1934	Transfer No. C264907 to Greenfields Limited
17th January 1945	Transfer No. D762537 to Joseph Henry Bawn of Bexley, Butcher and Richard Setten Stone of Kingsgrove, Butcher
16th February 1954 and 19th May 1954	Transfers Nos. G53086 and G104013 to J. H. Bawn Pty Limited
25th January 1968	Transfer No. K943628 to Number Two Fleurs Pty Limited
18th October 1972	Issue of Cert. of Title Vol. 11957 Fol. 14
9th May 1979	Transfer No. R117847 to The University of Sydney (current owner)
20th September 1991	Folio 1/74574 created

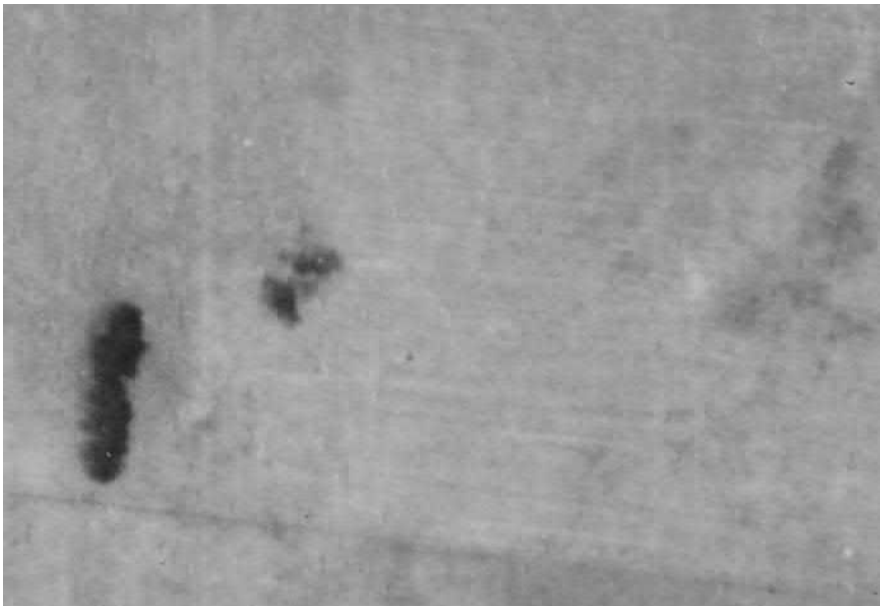


Figure 6-79 Aerial imagery from 1947 showing the row of trees on the left
Courtesy: NSW Department of Finance, Services and Innovation

6.10.2 Curtilage information

The curtilage comprises a small area within Lot 1 DP 74574 as described above and shown in **Figure 5-55**.

6.10.3 Significance assessment

No previous significance assessments have been completed for this potential heritage item. As this is an archaeological site, and as the relics have the potential to be of local heritage significance, the significance assessment has been carried out as per the *Assessing Significance for Historical Archaeological Sites and* 'Relics' (Heritage Branch NSW 2009)

NSW Heritage Criterion (Archaeological)	Assessment
Archaeological research potential	The artefact scatter has the archaeological potential to yield information about previous use of the site. Many of the surface artefacts can be dated and may indicate a range of dates of when the items were being used and occupation dates. While surface information is limited to the trees adjacent and artefact scatter, subsurface deposits may aid in the interpretation of any intact building footings which would yield further information about the site, and/or add to the categories of artefacts already observed. This in turn may aid in interpreting land use in the local area or add to existing information regarding Exeter Farm.

NSW Heritage Criterion (Archaeological)	Assessment
Associations with individuals, events or groups of historical importance	The property was originally part of the Exeter Farm owned by James Badgery and his descendants, who were known to have farmed the property until the mid-1800s. The nearby creek and suburb is named for this family. There is physical evidence of historical use of the property in the form of brick, glass, metal and ceramics.
Aesthetic or technical significance	There is no known aesthetic or technical significance attached to this site.
Ability to demonstrate the past through archaeological remains	The surface material identified as part of the artefact scatter is not considered to be rare. However, if further substantial archaeological evidence relating to Exeter Farm is discovered, it would be considered rare and may have the ability to visually demonstrate the location of former buildings. While the trees appear to be in poor condition this species is known as a hedge plant and therefore may represent a former boundary. The survival of such a hedge boundary is considered as rare in the local area.

6.10.4 Statement of significance

The property was originally part of the Exeter Farm owned by James Badgery, and while the property ceased to belong to the family in the mid-1800s, the family gave the name to the adjacent creek and suburb. The whole property is therefore considered to be historically significant at a local level. The artefact scatter may be indicative of subsurface deposits which would have potential to yield information about the previous use of the site. Despite the condition of the individual trees, the remnant hedge of Osage orange is a rare local example of an imported species being used as field markers and is indicative of that European practice.

Figure 6-80 Area of site, facing southwest, with row of trees in background.

Figure 6-81 Impression in the ground, facing south.

Figure 6-82 Brick and metal items located on ground surface.

Figure 6-83 19th century ceramic fragment located on ground surface.

6.11 Item 11: Artefact Scatter, 12-20 Salisbury Ave, Kemps Creek (Lot 2, DP736951)

6.11.1 Description and history

Lot 2/DP736951 was surveyed on 15 November 2017 (Survey Area no. 6). The potential heritage item is located inside the project's construction footprint.

The field survey identified a diffuse scatter of less than 15 ceramic, glass and metal pieces on the ground surface in an area about 20 metres wide immediately east of Salisbury Road. There did not appear to be any building footings present in the area and there was some disturbance evident in the area which the current tenant said was previously a swimming pool at the property which had been filled in. The top of a concrete tank is visible on the ground surface as well. The area was generally flat with no mounded areas. The tenant also stated that there was previously two rail tracks out the front of the property which had no sleepers. The rail tracks are no longer visible but were located about 40 metres northwest of the artefact scatter. The tenant stated that the site was the original Kemps Creek post office which burnt down.

The property was once part of a larger land grant (300 acres) to Anthony Fenn Kemp on 8 June 1809 (Paul Davies Pty Ltd 2007:112).

An undated Melville parish map indicates that an unnamed road passed to the north of the property and that the current Elizabeth Drive route is a more recent route (**Figure 6-84**). The previous road alignment appears to be visible on aerial imagery where it crossed Kemps Creek, to the northeast of the property. In addition, Salisbury Avenue appears to be a more recent road which divided three previous properties. John Reynolds, listed as an owner in 1823 (**Table 6-6**) is shown on a 1968 Parish map as owning the larger property which this property falls within.

A review of 1947 historical aerial imagery indicates that there were no distinctive features in this area at the time.

Table 6-6 Title search results for Item 11

Date	Information
30th June 1823	Crown Grant of 40 acres (Portion 68 Parish of Cabramatta) to John Reynolds
1st and 2nd December 1836	Lease and Release (Conveyance) No. 896 Book K to Richard Driver
7th February 1878	Conveyance No. 394 Book 186 to Ebenezer Vickery
23rd December 1880	Conveyance No. 194 Book 212 to John Wetherill
16th June 1881	Conveyance No. 251 Book 221 to William John Clarke and James Aitcheson Brown
7th April 1883	Conveyance No. 502 Book 268 to Joseph Rigg
27th July 1883	Conveyance No. 600 Book 274 to John Craig
31st January 1890	Conveyance (? Unregistered) to Richard Watkins and Joseph William Withers of Sydney, Gentlemen
14th February 1890	Primary Application No. 8012 by Richard Watkins and Joseph William Withers
27th February 1890	Issue of Cert. of Title Vol. 992 Fol. 11
6th March 1893	Transfer No. 210826 to Ebenezer Vickery
24th June 1893	Issue of Cert. of Title Vol. 1098 Fol. 213
22nd August 1898	Transfer No. 282307 to Ethel Annie Farrah, wife of Robert Farrah of Cabramatta, Farmer
23rd September 1898	Issue of Cert. of Title Vol. 1264 Fol. 81
1st February 1900	Transfer No. 302280 to Robert Burfield Barton of Sydney, Accountant
24th April 1920	Transfer No. B133805 to Sarah Farrar of near Liverpool, Spinster
23rd July 1943	Transmission Application No. D218940 by Mary Jane Hutton of Glenfield, Married Woman
16th November 1944	Transfer No. D345865 to John Stanley Abercrombie of Kemps Creek, Poultry Farmer
13th March 1945	Issue of Cert. of Title Vol. 5483 Fol. 43
1 July 1960	Transfer No. H569831 to Glenworth Francis Keogh of Kemps Creek, Farmer
22nd November 1960	Issue of Cert. of Title Vol. 8046 Fol. 32
6th March 1961	Transfer No. H767254 to Charles Phillip Heckenberg of Canley Vale, Builder

Date	Information
20th March 1979	Transfer No. R132119 to Phillip John Heckenberg, Beryl Daisy Heckenberg, Alan Charles Heckenberg & Carolyn Evelyn Heckenberg
18th November 1981	Transfer No. 5792823 to Pilisi Pty Limited (later Mecca Thoroughbreds Pty Ltd)
9th October 1986	Folio 2/736951 created
18th December 1986	Transfer No. W666882 to Kevin Joseph Thompson & Pauline Teresia Thompson
29th June 1989	Transfer No. Y453714 to Kevin Joseph Thompson
25th May 2001	Transfer No. 764830 to Edward Tomko & Thomas Ross Tomko (current owners)

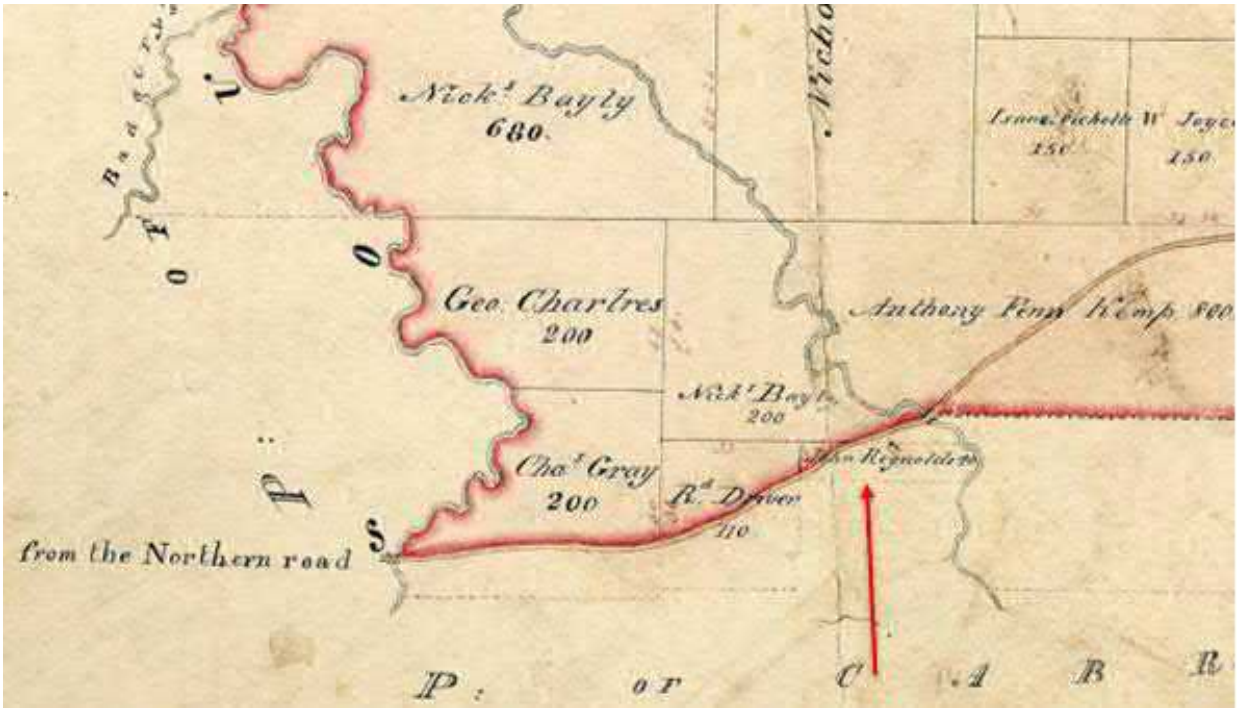


Figure 6-84 Undated Melville Parish map showing location of John Reynolds property and road to the north.

6.11.2 Curtilage information

The curtilage includes Lot 2 DP736951 as described above and shown in **Figure 5-55**.

6.11.3 Significance assessment

No previous significance assessments have been completed for this potential heritage item.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	Does not meet this criterion. There is insufficient evidence to indicate that the artefact scatter is important in the pattern of NSW's history.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. There is insufficient evidence that the artefact scatter has strong or special associations.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Does not meet this criterion. The artefact scatter has no aesthetic significance.
D – Strong or special associations with a particular community or cultural group	Does not meet this criterion. The artefact scatter has no strong or special associations with a particular community or group.
E – Potential to yield information	Does not meet this criterion. The artefact scatter contains a minimal number of metal, glass and ceramic fragments and the site has been disturbed by the previous construction of a swimming pool and concrete tank. There are no building footings visible in the area. There is little

NSW Criterion	Assessment
	potential for information to be obtained from the artefact scatter or the site in general.
F – Uncommon or rare	Does not meet this criterion. The artefact scatter is not considered to be uncommon.
G – Principal characteristics of a class	Does not meet this criterion. The artefact scatter does not display principal characteristics of a class.

6.11.4 Statement of significance

There is no evidence to suggest that the site was originally a post office. In addition, the site has been disturbed through the construction of a swimming pool and there is little evidence that any building footings are present. The artefact scatter is considered to have insufficient significance to fulfil the criteria for State or local listing. The site is therefore not considered to be a heritage item and no further impact assessment is required.

Figure 6-85 Area of artefact scatter, facing northwest.

Figure 6-86 Piece of ceramic (late 19th to early 20th century) located on the ground surface at the property.

6.12 Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (Lot 21 DP258414)

6.12.1 Description and history

The southern part of the South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape, which is located in Lot 21 DP258414, was surveyed on 14 November 2017 (Survey Area No. 5). The scenic landscape item is not located within the study area, however is immediately adjacent. Due to the landscape nature of the heritage item, it was included in the significance assessment.

The South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape was originally identified by Perumal Murphy (1990) and then by Aurecon (2016) as a potential heritage landscape. The reports describe the landscape as:

> *A scenic landscape of assessed regional significance comprising the weirs and surrounds located at the confluences of Badgerys and Kemps Creek with South Creek. The Badgerys Creek weir is no longer functioning* (Aurecon 2016: Table 3.3).

In the assessment of significance, the South Creek Study noted:

> *The areas at the confluence of Kemps and Badgerys Creeks are scenic areas of regional significance in their own right. The whole of this area was identified as having cultural interest in the Penrith Heritage Study* (Perumal Murphy 1990:19) and,
>
> *The best local example of scenic landscapes are those featuring lake-like dams* (Perumal Murphy 1990:24)

The statement of significance did not address individual elements in the heritage study but the South Creek Valley as a whole:

> *The original landscape has been substantially modified. Nevertheless, those areas spared from recent subdivision retain a traditional rural landscape of considerable value. The primary elements of significance are: the remnant stands of natural vegetation along creeks and roadsides; the aesthetic cultural landscapes associated with early homesteads; and the many fine scenic landscapes, both natural and cultural.* (Perumal Murphy 1990:26)

Only the southern portion of the circular shaped scenic landscape curtilage as defined by Aurecon (**Figure 3-5**) is located immediately adjacent to the study area. South Creek traverses this part of the landscape and crosses the study area. The area has not been subject to subdivision as defined above, and therefore does retain a traditional rural landscape in this area. The area overlaps with the registered historical heritage place Fleurs Radio Telescope. Vegetation comprised grass in an open paddock environment with occasional small trees located in the vicinity of buildings associated with the eastern side of the Fleurs Radio Telescope site (**Figure 6-87** and **Figure 6-88**). Note: these photographs were taken during the field survey when the study area was larger in size. After the field survey the study area was reduced in size, resulting in this area being located to the north of the study area. The area of the overlap of the scenic landscape and study area was also reduced so that the landscape is now located adjacent to the study area.

6.12.2 Curtilage information

The curtilage within the study area includes Lot 21 DP258414 as described above and shown in **Figure 5-55** and **Figure 6-89**.

6.12.3 Significance assessment

No previous significance assessments have been completed for this heritage item.

NSW Criterion	Assessment
A – Important in the pattern of NSW's (or local) history	Does not meet this criterion. The small section of the landscape adjacent to the study area is not important in the pattern of NSW's history.
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	Does not meet this criterion. The landscape has no strong or special association with the life or works of a person, or group of persons.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	Overall it is likely that the entire scenic landscape is significant for its areas of remnant vegetation, presence of creeks and weirs and cultural landscapes associated with early homesteads. However, the small section of landscape adjacent to the study area does not contain any of these elements.
D – Strong or special associations with a particular community or cultural group	Does not meet this criterion. The landscape has no strong or special associations with a particular community or group.
E – Potential to yield information	Does not meet this criterion. The landscape does not have potential to yield information.
F – Uncommon or rare	Overall it is likely that the entire scenic landscape is significant for its area of rural landscape. Traditional rural landscape is becoming increasingly uncommon in this region as more development occurs within the region; however, the small section of the landscape adjacent to the study area does not contain any weirs or creeks which are significant elements of the listing.
G – Principal characteristics of a class	Does not meet this criterion. The landscape does not display principal characteristics of a class.

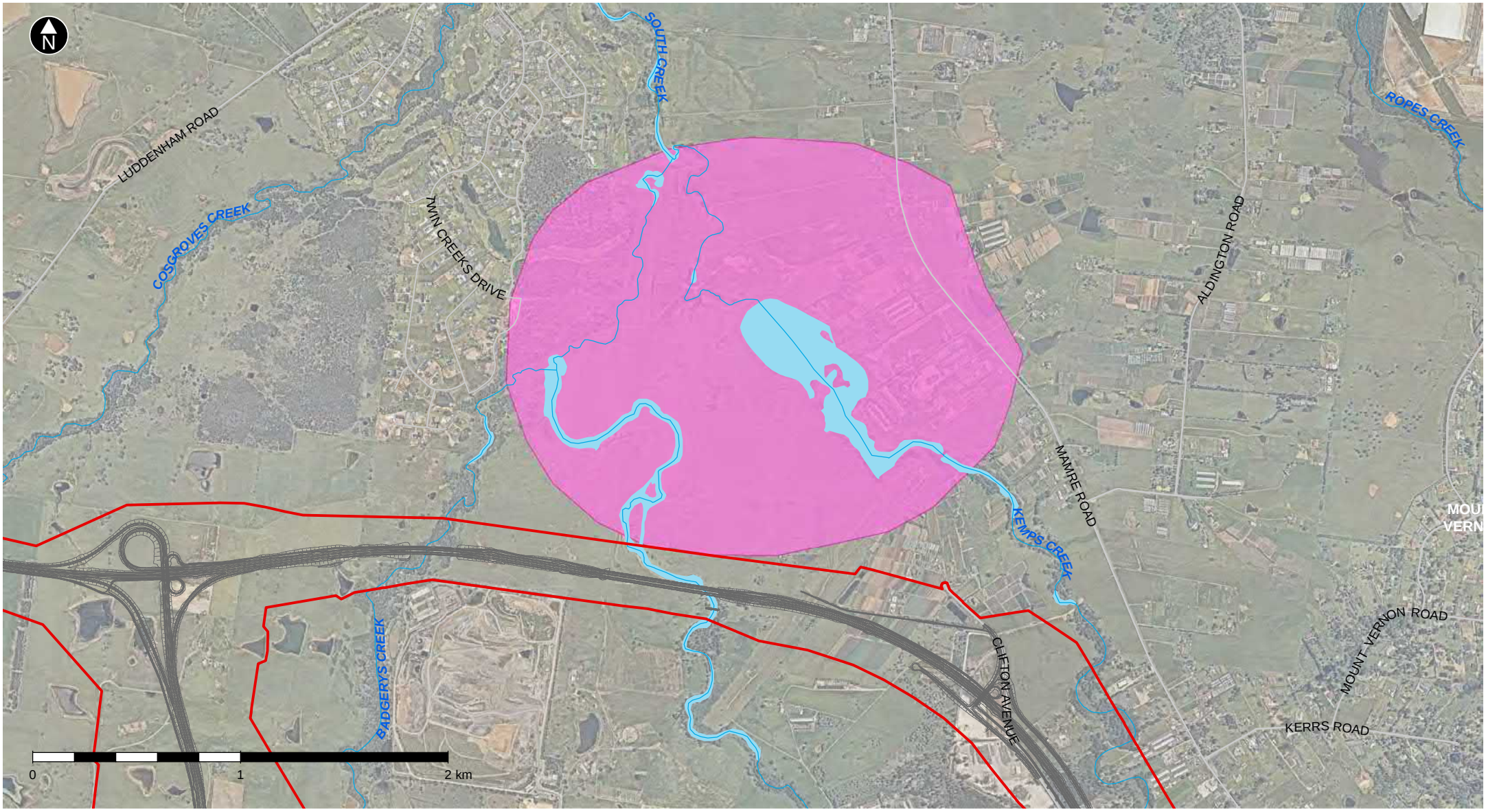
6.12.4 Statement of significance

The South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape is significant for the weirs and surrounds located at the confluences of Badgerys and Kemps Creek with South Creek, remnant vegetation along creeks and roads, cultural landscapes associated with early homesteads, and presence of overall traditional rural landscape. However, the small section of the landscape adjacent to the study area is limited in these elements. The

landscape adjacent to the study area comprises traditional rural landscape with open paddocks with occasional small trees located in the vicinity of buildings associated with the eastern side of the Fleurs Radio Telescope site. The South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape is considered to have sufficient significance to fulfil the criteria for local listing.

Figure 6-87 Part of the scenic landscape that overlaps with the study area, facing northwest.

Figure 6-88 Part of scenic landscape that overlaps with the study area, facing southeast.



The project

Study area

Waterways

South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

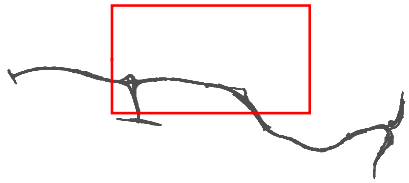


Figure 6-89 Location of South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape in relation to the study area

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6.13 Item 13: Former Cecil Park Public Hall

6.13.1 Description and History

The former Cecil Park Public Hall is located within the study area in Lot 6/DP629798 and Lot1/DP308358 and was surveyed on 7 March 2019 (Survey Area No. 45). The property was initially identified during the desktop assessment as an area with archaeological potential. Aurecon (2016:71) noted that a 1906 reconnaissance map for the Liverpool Army Camp and aerial photograph from 1930 indicated that there was a structure within the general area of this location.

Cecil Park residents began campaigning for a public hall in the early 1920s. This campaign was successful, with a proclamation for the Cecil Park Public Hall issued in the New South Wales Government Gazette 1923 under Part II of the *Theatres and Public Halls Act 1908.* Following the enactment of that Act, all public halls needed to be licensed under the Act. A file regarding the hall is therefore held at the NSW State Archives (Series 15318 Item T582) chronicling the licensing history of the hall.

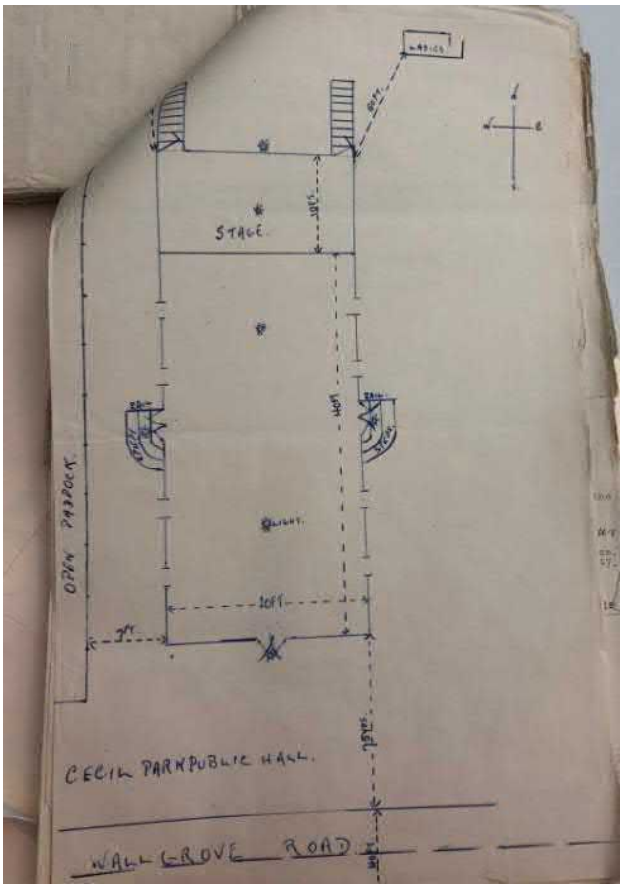


Figure 6-90 Copy of plan of Cecil Park Public Hall
Courtesy: NSW State Archives, Series 15318 Item T582

According to a conditions report undertaken by the local police in 1950 the hall measured 20 feet by 10 feet (6.096 metres by 3.048 metres) and was constructed of timber with an iron roof on brick piers. Two flights of wooden stairs, three feet (0.914 metres) wide, were located at the western end of the hall. A stage was located at the north of the hall (**Figure 6-90**). The building was unceiled and unlined. Four windows were located on each of the east and west elevations (measuring 2 feet by 3 feet, or 0.6096 metres by 0.9144 metres) (Senior Constable O S Gimbert 13 March 1950).

The hall was owned and managed by the Cecil Park Progress Association. The hall used for various civic and social purposes, including weekly dances on Saturday night, and public meetings when needed. Its proximity to Cecil Park Public School made it a suitable venue for school functions as well. However, with the advent of World War II, the hall fell into disuse and consequently disrepair.

In 1949 a public meeting was held in the hall to elect new representatives to the Progress Association and bring the hall back to its former glory. The hall was again licensed in June 1950, and local newspapers report regular dances and meetings until around 1957. However, an inspection in 1967 notes that the hall was in “a bad state of disrepair”, with movement in the walls, a lack of fire-fighting equipment, panic lighting or working lighting. The external toilet facilities had left “a lot to be desired” (Sgt A W Ellis 13 August 1967). In April 1968 the Secretary of the Cecil Park Progress Association, Mr J Story, informed the investigating officer that the Progress Association had not used the hall for the previous year and did not anticipate using it again owing to the extensive repairs needed to meet the licensing conditions. The licence was not renewed, and this was proclaimed in the NSW Gazette on 23 April 1971 (p. 7176).

The only structures still standing *in situ* on the site are the brick piers, timbers and a set of concrete stairs (**Figure 6-91**). There is abundant material strewn about the site, comprising timbers, bricks and brick fragments and corrugated iron. The remains were strewn over a large area, with the extensive vegetation concealing much of it.

Figure 6-91 Northern end of former Public Hall, looking east towards Wallgrove Road. A small set of concrete stairs is located to the right (out of frame)

6.13.1 Curtilage information

The item is located at 37A Wallgrove Road, Cecil Park with the legal description of Lot 1/DP308358. Given the area over which the material of the former public hall has been spread, the entire lot is included in the heritage curtilage. The curtilage is shown in **Figure 5-55** and **Figure 6-92**.

6.13.2 Significance assessment

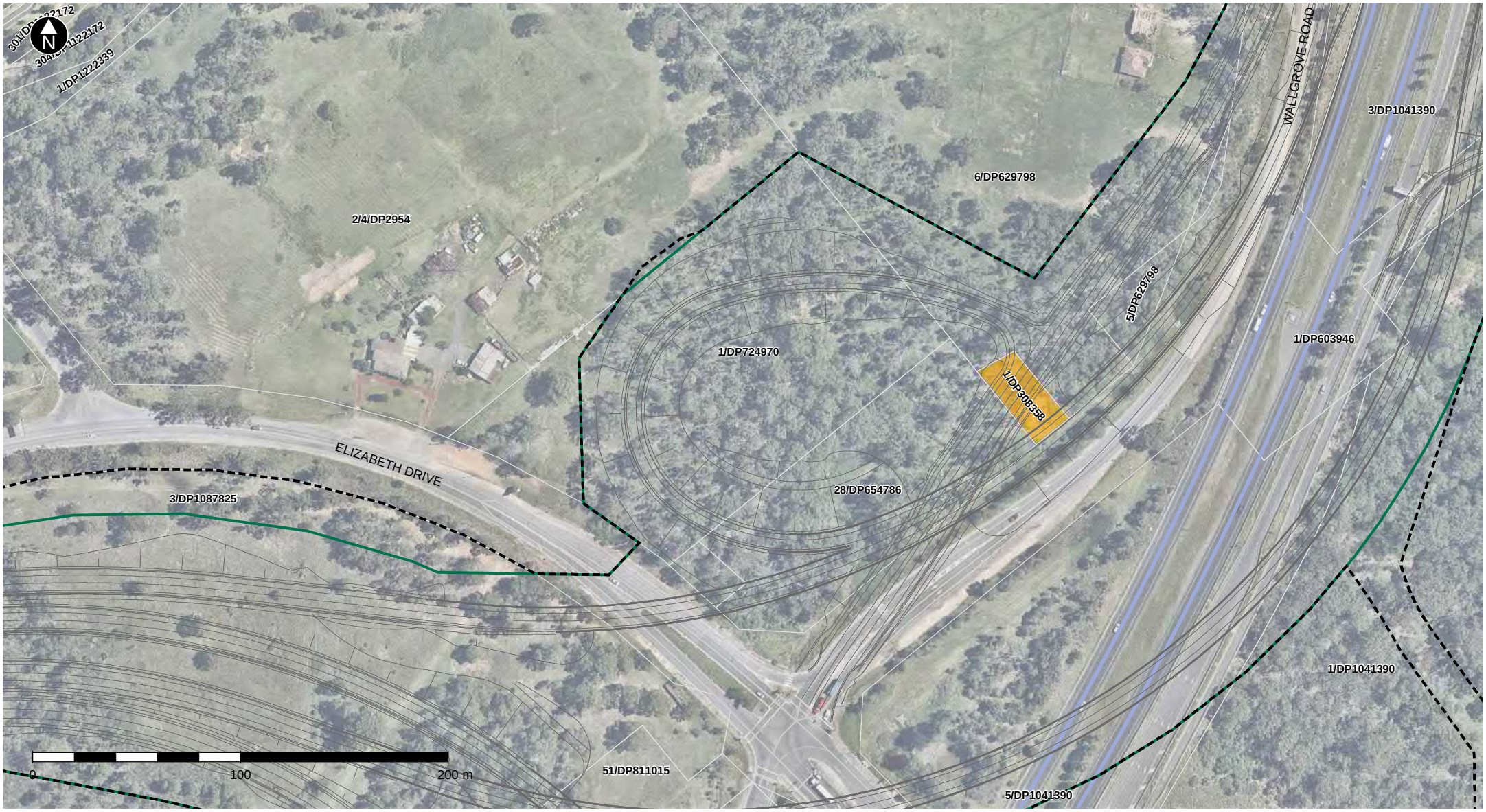
No previous significance assessments have been completed for this heritage item.

NSW Criterion	Assessment
A – Important in the pattern of NSW’s (or local) history	The item is associated, temporally and physically, with the nearby Cecil Park School, Post Office and Church Site (Item 8) as part of the development of the Cecil Park community. The overall area of Cecil Park has two phases of historical development: agricultural land that formed part of the large estate known as ’Macquarie Park’ granted to Thomas Wylde (1817 – 1886) and its subsequent subdivision and development for the Cecil Park Public School, post office and School Church of St Paul (1895 – 1965). The Public Hall is an important part of the social history of the Cecil Park area and represents an attempt by residents in the years of the late nineteenth and early twentieth centuries to establish a civic centre for the Cecil Park community.

NSW Criterion	Assessment
B – Strong or special association with the life or works of a person, or group of persons, of importance in NSW's (or local) history	The item does not meet this criterion.
C – Demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement	The item does not meet this criterion.
D – Strong or special associations with a particular community or cultural group	The item may have been important to the local community when it was built, and again when it was renovated in c1950, however there is no evidence that the ruin of the hall now meets this criterion.
E – Potential to yield information	This item may contain some archaeological evidence associated with users of the public hall. The site was opened in 1923 and fell into disuse roughly 25 years later. It reopened in c1950 and closed again in 1967 after being disused for "some time". The hall was therefore only operational for a limited amount of time Even when operational the use of the hall was sporadic and confined to social occasions and public meetings. All of these events were conducted inside the hall. Any archaeological remains would therefore be associated with the ephemera associated with social dances and public meetings held therein. There was only one other outbuilding, being toilets. These were constructed c1950 and are therefore unlikely to yield any information of heritage significance. Unlike other nearby buildings at Cecil Park, such as the public school and post office, the public hall was used for a relatively short period of time (1923-c1940; c1950-c1967) and even while operational was used for social events, such as dances, and civic purposes, such as public meetings. While the hall was open, dances were held there once a week, and public meetings once a month. Owing to licensing laws applicable to public halls, the NSW State Archives holds a file on this hall which contains information regarding the fabric and configuration of the hall, including the plan at Figure 6 88 above, and periodic structural changes and upgrades to the hall necessitated by technology and fire laws. The relatively modern, utilitarian construction and fragmentary use indicates that any archaeological deposits associated with the structure are unlikely to meet the threshold for local heritage significance, nor reveal any information that is not already available from other sources. The item therefore does not meet this criterion.
F – Uncommon or rare	This item comprises the ruins of a public hall. As there are many examples of existing and intact public halls locally (eg Luddenham Progress Hall), regionally (eg Camden Agricultural Hall) and State wide (eg Kendall School of Arts), it does not meet this criterion.
G – Principal characteristics of a class	The item does not meet this criterion.

6.13.3 Statement of significance

The Cecil Park Public Hall is associated, temporally and physically, with the nearby Cecil Park School, Post Office and Church Site (Item 8) as part of the development of the Cecil Park community. The overall area of Cecil Park has two phases of historical development: agricultural land that formed part of the large estate known as 'Macquarie Park' granted to Thomas Wylde (1817 – 1886) and its subsequent subdivision and development for the Cecil Park Public School, post office and School Church of St Paul (1895 – 1965). The Public Hall is an important part of the social history of the Cecil Park area and represents an attempt by residents in the years of the late nineteenth and early twentieth centuries to establish a civic centre for the Cecil Park community. It is therefore assessed as being of historical significance at the local level but not for any other criteria. It therefore does not meet the local significance threshold.

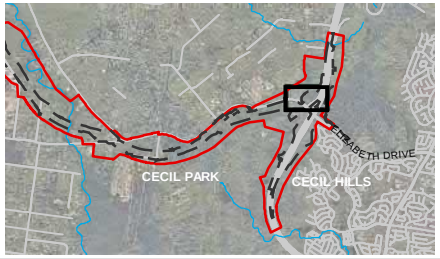


The project

The project construction footprint

The project operational footprint

Subject site boundary



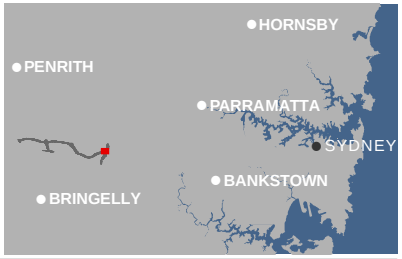


Figure 6-92 Location of Cecil Park Public Hall

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6.14 Summary

An initial review of existing research and previous heritage studies identified 13 heritage items and/or potential heritage items within or adjacent to the study area. These potential heritage items are mapped in **Figure 5-55**.

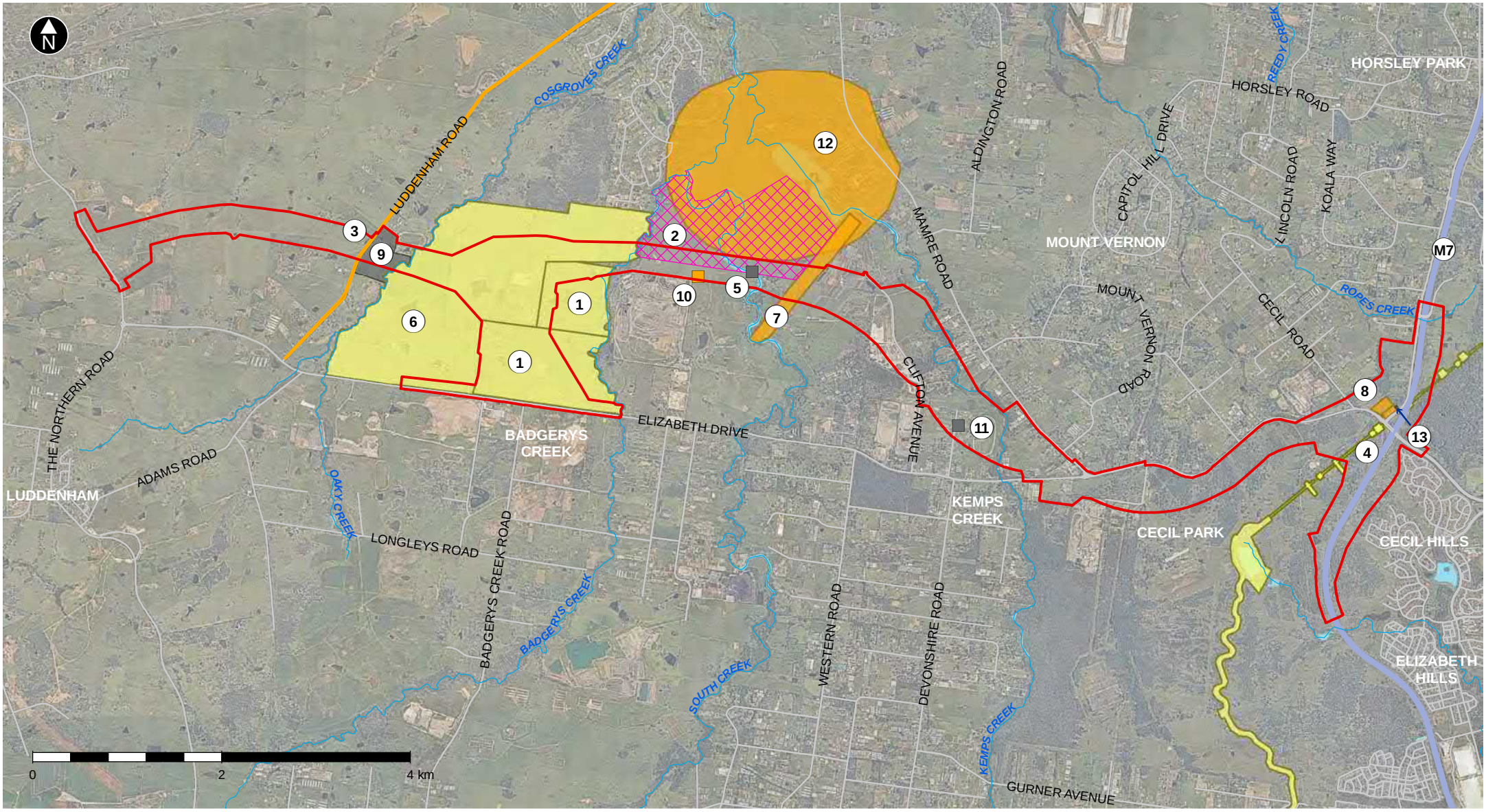
Following a comparative analysis, only nine of the 13 heritage items have been assessed as having either local, State or National heritage significance, these are:

- Item 1: McGarvie Smith Farm (**State significance**)
- Item 2: Fleurs Radio Telescope (**State and potentially National significance**)
- Item 3: Luddenham Road Alignment (**local significance**)
- Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (**State significance**)
- Item 6: McMaster Field Station (**State significance**)
- Item 7: Fleurs Aerodrome (**local significance**)
- Item 8: Cecil Park School, Post Office and School Church (**local significance**)
- Item 10: Exeter Farm Archaeological Site (**local significance**)
- Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (**local significance**).

A summary of the significance of heritage items within and immediately adjacent to the project is provided in **Table 6-7** and demonstrated in **Figure 6-93**. The impact of the project on each of the nine heritage items is provided in **Chapter 7** and **Chapter 8**.

Table 6-7 Summary significance of heritage items within and immediately adjacent to the project

Heritage item number	Source	Heritage item name	Significance
Item 1	Penrith LEP	McGarvie Smith Farm	Listed under Penrith LEP as Local but assessed as State
Item 2	Penrith LEP	Fleurs Radio Telescope Site	Listed under Penrith LEP as Local but assessed as State and potentially National
Item 3	Penrith LEP	Luddenham Road Alignment	Listed under Penrith LEP as Local
Item 4	SHR Liverpool LEP s170	Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	Listed under State Heritage Register as State Listed under Liverpool LEP as Local
Item 5	Aurecon (2016)	South Creek Bridge	None
Item 6	Aurecon (2016)	McMaster Field Station	Not currently listed but assessed as State
Item 7	Aurecon (2016)	Fleurs Aerodrome	Not currently listed but assessed as local
Item 8	Aurecon (2016)	Cecil Park School, Post Office and School Church	Not currently listed but assessed as local
Item 9	Field survey 13 November 2017	Karingal	None
Item 10	Field survey 14 November 2017	Exeter Farm Archaeological Site	Not currently listed but assessed as local
Item 11	Field survey 15 November 2017	Artefact Scatter, Salisbury Avenue	None
Item 12	Aurecon (2016)	South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	Not currently listed but assessed as Local
Item 13	Field survey 7 March 2019	Former Cecil Park Public Hall	None



Study area
Waterways
Motorway
Main roads

Assessed heritage significance

State and potentially National
State
Local
None

Item number	Item name
Item 1	McGarvie Smith Farm
Item 2	Fleurs Radio Telescope Site
Item 3	Luddenham Road Alignment
Item 4	Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
Item 5	South Creek Bridge
Item 6	McMaster Field Station/McMaster Farm
Item 7	Fleurs Aerodrome

Item number	Item name
Item 8	Cecil Park School, Post Office and School Church
Item 9	Karingal
Item 10	Artefact Scatter and Trees, Exeter Farm
Item 11	Artefact Scatter, Salisbury Avenue
Item 12	South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape
Item 13	Former Cecil Park Public Hall

Figure 6-93 Significance of heritage items within and immediately adjacent to the project

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7. Impact assessment

7.1 Proposed works

The project is described in **Section 1.2** of this report and illustrated in **Figure 1-2.** The following sections describe the project's likely impacts on non-Aboriginal heritage for each of the nine heritage items assessed as having either local, State or National heritage significance (**Table 6-7**).

7.2 Summary of potential impacts

The proposed activities within, or adjacent to, each heritage item identified for this assessment and the potential impacts of these activities are presented in **Table 7-1.** A detailed assessment of impacts is provided in each SOHI described in **Section 8.**

Table 7-1 Potential impacts from proposed works for each heritage item

Heritage item number	Heritage item name	Register number	Proposed activities	Potential impacts
1	McGarvie Smith Farm	Penrith LEP 857	Construction of dual carriageway motorway with two lanes in each direction and access road to the planned Western Sydney Airport at Badgerys Creek	The project would result in the demolition of five buildings and one silo: • McGarvie Smith Farm 6; • McGarvie Smith Farm 7 • McGarvie Smith Farm 8 • Shed 1 • Shed 2 The entire site would be bisected.
2	The Fleurs Radio Telescope Site	Penrith LEP 832	Construction of dual carriageway motorway with two lanes in each direction	The project would demolish one element of the Fleurs Radio Telescope site - Shain Cross (SC01), which . is located within the construction footprint. Further assessment for this heritage item can be found in **Annexure A.**
3	Luddenham Road Alignment	Penrith LEP 843	Construction of dual carriageway motorway with two lands in each direction.	No physical impacts as there is little or no original physical road fabric or associated features within study area to be impacted.
4	Upper Canal System	SHR 01373, Liverpool LEP	Construction of grade separated interchanges including associated ramps, with M7 Motorway	The project would not destroy any sections of pipeline that are located underground. The Tunnel Shaft 4, located in the M7 central road median, would not be demolished as this location would not be subject to works.
6	McMaster Field Station/McMaster Farm	N/A	Construction of grade separated interchanges including associated ramps, with access road to the planned Western Sydney Airport at Badgerys Creek	The project would bisect the landscape of the McMaster Farm overall as the dual carriageway and interchange would be located within the property. Some modified landscape elements would be destroyed by the project. A potential construction laydown area overlaps with the complex of buildings on the property, and may be reused as construction offices and facilities.

Heritage item number	Heritage item name	Register number	Proposed activities	Potential impacts
7	Fleurs Aerodrome	N/A	Construction of dual carriageway motorway with two lanes in each direction	The proposed construction footprint would bisect the previous runway to the north of the existing runway. A remnant metal object is located 13 metre south of the construction footprint and is unlikely to be impacted by the project.
8	Cecil Park School, Post Office and Church Site	N/A	Construction of grade separated interchanges including associated ramps, with M7 Motorway	The project would physically disturb and destroy the area of archaeological potential through ground disturbance activities.
10	Exeter Farm Archaeological Site	N/A	Construction of dual carriageway motorway with two lanes in each direction	The item is within 50 metres of the southern boundary of the project and would therefore not be directly impacted. This is based on the assumption that all vehicle movements, compounds, etc. would be confined to the area within the project boundary. However, should this not be the case, or if the alignment be modified to include the site, it would physically impact the site.
12	South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	N/A	Construction of dual carriageway motorway with two lanes in each direction	There would be no direct impacts associated with the project as works would not be undertaken within the item's curtilage. There would be no direct impacts associated with the project as works would not be undertaken within the item's curtilage. The potential hydrological changes associated with the project (see Flood assessment report [Appendix L of the EIS]) are minor and localised.

8. Statements of heritage impact

8.1 Item 1: McGarvie Smith Farm (Penrith LEP 857) (Lots 62 and 63 DP1087838)

8.1.1 Proposed works

Construction of dual carriageway motorway with two lanes in each direction and access road to the planned Western Sydney Airport at Badgerys Creek would result in demolition of several buildings at the site. A construction laydown area located on the property, to the west of the carriageway, would physically alter the landscape of the heritage item. The laydown area would be used for stockpiling of material and earthworks and construction support.

8.1.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

While the project would have a direct impact on the landscape elements of the heritage item, some of the older buildings (McGarvie Smith Farm 1, McGarvie Smith Farm 2 and McGarvie Smith Farm 3) on the site would not be impacted as they are located outside the construction footprint.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

The project would directly impact on a section of the site as the proposed Western Sydney Airport access road bisects the site from north to south. The construction of the road would result in the demolition of several buildings (McGarvie Smith Farm 6, McGarvie Smith Farm 7 and McGarvie Smith Farm 8) and a silo at the site. In addition, the project would alter the landscape of the site which includes features such as dams, and demonstrates a general rural nature. As the project bisects the entire property from north to south, the site's landscape context and overall layout would be diminished. The use of part of the site for a construction laydown area (AF2) also has the potential to directly impact on the landscape features of the site through physical impacts from ground disturbance and demolition of features due to the stockpiling of materials, earthworks and construction support.

The demolition of the three buildings and silo would reduce the relatively intact nature of the heritage item, impacting on the ability to understand its layout and principal characteristics. The demolition of the buildings would reduce the historical significance of the site through the reduction in the examples of structures constructed over the entire history of the site. The bisection of the site would also reduce the intactness of the heritage item and subsequently its principal characteristics. Further, the bisection across the broader landscape of the site would reduce the significance of the setting of the experimental farm, and its modified landscape and the features demonstrating innovative water harvesting practices. The potential impacts on the site from construction laydown activities (AF2) would also reduce the significance of the modified landscape and its features.

McGarvie Smith Farm 1, McGarvie Smith Farm 2 and McGarvie Smith Farm 3 – the oldest buildings at the site - are located to the north of the construction footprint and would not be directly impacted by construction. There are also buildings outside and to the east of the construction footprint which would also not be subject to direct impacts: McGarvie Smith Farm 10, McGarvie Smith Farm 11 and McGarvie Smith Farm 12. These buildings have been constructed more recently. While these would not be subject to direct impacts, there is the potential for accidental or incidental impacts from vehicles and other machinery during construction.

By implementing the following management measures the potential impacts on the heritage item would be minimised:

- Roads and Maritime /Contractor would engage a suitably qualified heritage consultant to prepare an archival photographic recording of the entire site, in accordance with the DPC (Heritage) guidelines (Heritage Council of NSW 2006). This would include both buildings and landscape features such as dams, and earthworks. The recording would include a detailed map showing the location of the features.
- Roads and Maritime /Contractor to investigate options to provide funding support to the property's current owner to prepare a thematic heritage study of CSIRO and other agricultural research stations, including McGarvie Smith Farm and McMaster Field Station, and other relevant agricultural research stations, and similar facilities located in NSW. The thematic study would include a review of the role of such properties in veterinary research, association with agricultural, pastoral and animal husbandry groups, use of pioneering methods and practices, and contribution to the development of farming in Australia. In the event that landowners do not prepare this study, Roads and Maritime would engage a heritage specialist to do so.

- Procedures would be included in the Construction Cultural Heritage Management Plan (CCHMP) would protect the section of the site outside the construction footprint from accidental or incidental damage during construction from vehicles and other machinery. Protective barrier fencing would be installed along the construction footprint boundary in the vicinity of the two buildings to the west of the construction footprint: McGarvie Smith Farm 1 and 2.

The following impacts have been assessed:

- Vibration:
  - Of the buildings that are located on the eastern side of the construction footprint, the closest building is located about 37 metres from the construction footprint and about 60 metres from the alignment. These structures are likely to be outside the safe working distances for heritage items as outlined in Table 3-12 of Appendix K of the EIS
  - Of the buildings that are located on the western side of the construction footprint, the closest building is about 40 metres from the construction footprint and about 60 metres from the alignment. These three buildings are also located adjacent to an ancillary facility (AF2), about 20 metres, 30 metres and 50 metres respectively from the boundary. Depending on the location of vibration works undertaken within AF2, there is potential to be within the safe working distances for heritage items as outlined in Table 3-12 of Appendix K of the EIS
- The structures within the safe working distances would be inspected prior to the commencement of nearby vibration intensive works. A dilapidation survey would be undertaken to confirm the sensitivity of the item to vibration induced damage and the appropriate criteria applied. An assessment of the proposed vibration intensive activities to occur at AF2 would be carried out to determine the appropriate offset distances/exclusion zones to structures associated with McGarvie Smith Farm
- Demolition - the construction of the project would result in the demolition of several buildings (McGarvie Smith Farm 6, McGarvie Smith Farm 7 and McGarvie Smith Farm 8) and a silo at the site
- Archaeological disturbance – it is unlikely that there are archaeological deposits at McGarvie Smith Farm. The project is therefore unlikely to impact on archaeological deposits
- Altered historical arrangements and access – McGarvie Smith Farm is located on private property and is not accessible to the public. Access to the whole property would be impacted as the project would bisect the entire site
- Visual amenity – visual impacts, and the impacts to the landscape setting of the site, would be mitigated to some extent by the proposed vegetation and design elements such as the ‘abstracted gateway landscape’ which would reinforce a new identity in this zone. Interpretive themes related to the site’s historical significance in the development of NSW’s pastoral and agricultural industries are to be embedded into the fabric of the project. Further information is provided in Appendix G of the EIS
- Landscape and vistas – the landscape and vistas would be impacted by the project as the project bisects the heritage item
- Curtilages – the curtilage would be impacted by the project as the project bisects the heritage item
- Subsidence – not applicable for this project
- Architectural noise treatment –Two buildings - McGarvie Smith Farm 2 and McGarvie Smith Farm 11 - have been identified as potentially being eligible for at-property noise attenuation treatment. The procedures outlined below are typically followed for at-property acoustic treatment. However if at-property treatment is required, specific requirements for the heritage item would be taken into consideration, and proposed treatments would be undertaken under the guidance of an appropriately qualified heritage consultant to minimise impacts. The types of at-property architectural treatments provided under the Roads and Maritime At-Receiver Noise Treatment Guideline (2017) are typically limited to:
  - Fresh air ventilation systems that meet the Building Code of Australia requirements with the windows and doors shut.
  - Upgraded windows and glazing and solid core doors on the exposed facades of the substantial structures only (eg masonry or insulated weather board cladding with sealed underfloor).
  - Upgrading window or door seals and appropriately treating sub-floor ventilation.
  - The sealing of wall vents.
  - The sealing of the underfloor below the bearers and appropriately treating sub-floors ventilation
  - Roof insulation.
  - The sealing of eaves.

Alternative at-property acoustic treatments can include:

- The installation of courtyard screen walls that break line-of-sight between the affected facade window and the road where they are feasible and reasonable and are preferred by the owner
- The final operational noise mitigation strategy would be determined as the project progresses and would likely use a combination of the approaches discussed in this report and in Appendix K of the EIS
- Identification of receivers eligible for consideration of at-receiver noise treatments would be undertaken during the detailed design stage after finalisation of any at-source and in-corridor management measures.

8.1.3 Conclusion

The project would result in both construction and operational impacts on the McGarvie Smith Farm. Both the buildings and landscape of the heritage item would be impacted by the construction of the project. Operational impacts would be applicable as the proposed carriageway bisects the heritage item.

The proposed works within McGarvie Smith Farm would be of medium-large scale and moderate intensity, with some of the changes being permanent and irreversible. As such, the level of impact on the heritage items overall would be **major**. However, due to other factors, there were limited options to avoid the structures at the McGarvie Smith Farm. The concept design for the M12 Motorway was developed through a multi-disciplinary process that identified and assessed a number of potential road corridor options against a wide range of engineering, environmental, social, land use and economic criteria. This process, which is documented in chapter 4 of the EIS, ultimately determined that the project's design as currently proposed, represented the best balance after a multi-criteria analysis of all of the known constraints and opportunities.

While permanent and irreversible impacts would occur due to the demolition of some of the buildings and structures at the site, and bisection of the site by the project, undertaking a full archival photographic recording provides an opportunity to capture important information about the site. Further, undertaking a thematic study into CSIRO and other agricultural research stations would be important in identifying other potential heritage items in NSW that would demonstrate the same or similar significance as the McGarvie Smith Farm, therefore reducing the overall impact on that type of heritage item. Proposed vegetation and design elements and development of an interpretation strategy for the project would further minimise the level of impacts, however, the level of impact on the site would still be **major**.

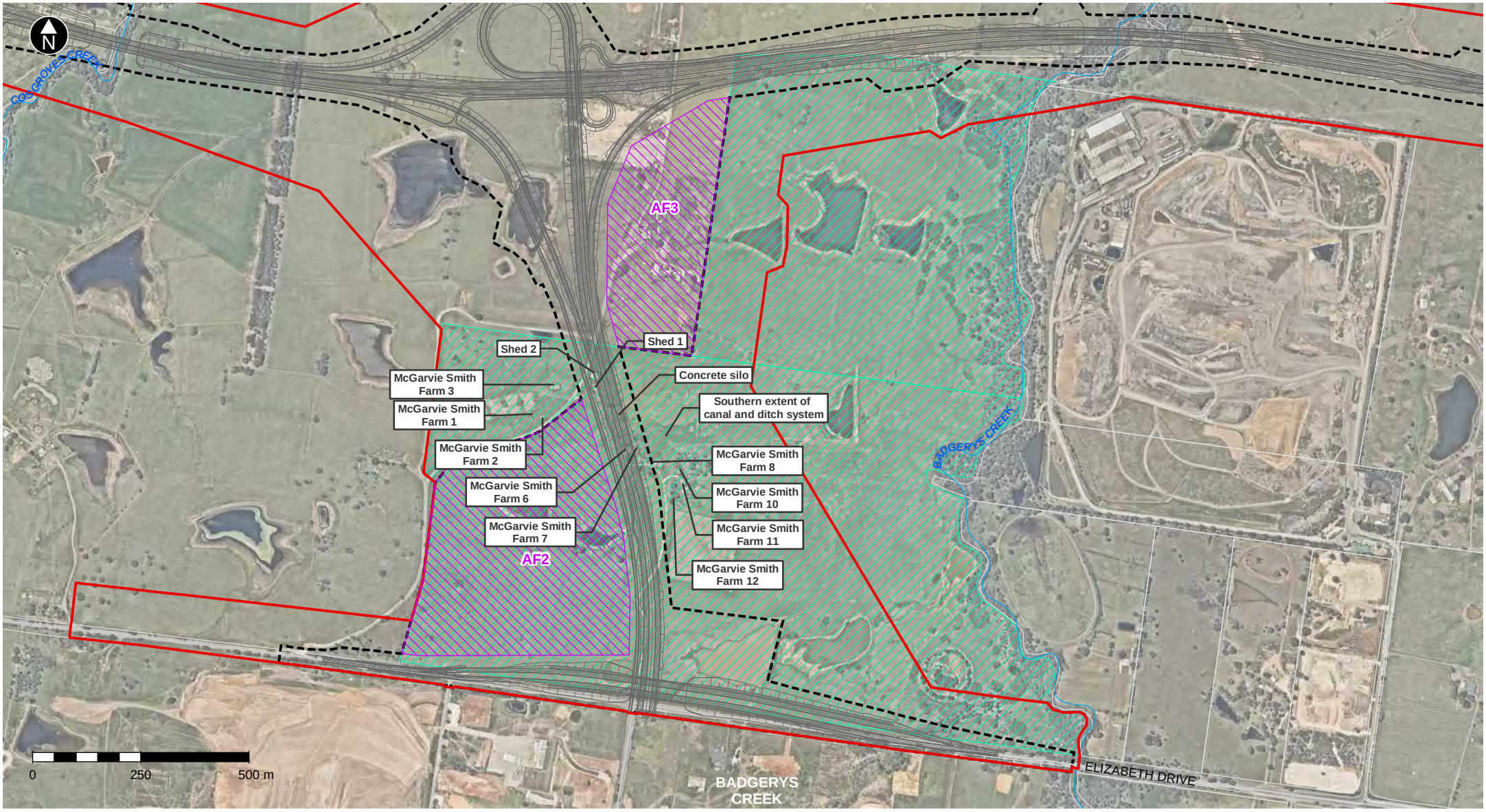

Figure 8-1 Location of McGarvie Smith Farm (Item 1) in relation to proposed works

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8.2 Item 2: The Fleurs Radio Telescope Site (Penrith LEP 832)

8.2.1 Proposed works

Construction of dual carriageway motorway with two lanes in each direction. The proposed works bisects the Fleurs Radio Telescope site from west to east on the southern boundary of the site. One element of the Shain Cross would be demolished by the project. A set of installations, including cables, signal boxes, dishes and the location of an excavated antenna, from the FST are also within the study area, but not within the construction footprint.

8.2.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

While the project would be located along the southern part of the heritage item, only a single element of the Shain Cross would be impacted, with the majority of elements of the Fleurs Radio Telescope site being avoided. As this element of the Shain Cross is located within the construction footprint, the entire element would be demolished.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

One element of the Shain Cross (SC01) – one of the antenna poles forming the larger array - is located within the study area and within the construction footprint. A set of installations, including an antenna, from the FST (South Creek 1 and 2) are within the study area but outside the construction footprint. Other remaining antenna infrastructure is not directly impacted but requires further consideration, including a standing FST antenna in the north of the site and an intact portion of the Shain Cross. Both FST antennas are *in situ* but in poor condition. Further information about Fleurs Radio Telescope can be found in *A Heritage Survey of the Fleurs Radio Telescope Field Site, Badgerys Creek* (Gorman 2018) (**Annexure A**).

Gorman (2018) recommends that '*SC01 should be left in situ and an* exclusion zone *50 metres in diameter be maintained around it. No vehicle entry or road construction activities should take place within this zone'.* However, it is not feasible to change the design to allow an exclusion zone of 50 metres around this heritage item. The concept design for the M12 Motorway was developed through a multi-disciplinary process that identified and assessed a number of potential road corridor options against a wide range of engineering, environmental, social, land use and economic criteria. This process, which is documented in chapter 4 of the EIS, ultimately determined that the project's design as currently proposed, represented the best balance after a multi-criteria analysis of all of the known constraints and opportunities. In the context of the single remaining Shain Cross element it was determined that on balance, moving the project alignment to avoid this item would not be justified because this would not result in any real benefits to the project, but may result in other impacts particularly to biodiversity, hydrology and land use. The southern element of the Shain Cross would be completely removed through the construction of the road.

The project would require the removal of one element of the Shain Cross (SC01), which reduces the intactness of the array, however the rest of the remaining elements of the overall Fleurs Radio Telescope site would be avoided. Therefore, the overall significance of the site, including its historical significance, principal characteristics, potential to yield information, would be retained.

Common road construction activities such as vegetation clearance, vehicle traverse, plant operation, laydowns and excavation all have the potential to damage or impact on the significant fabric of the Fleurs Radio Telescope site.

The following recommendations, relevant to the construction footprint, were provided by Gorman (2018). Further details of condition, significance, impact and recommendations for Fleurs Radio Telescope site can be found in **Table 8-1**. Gorman (2018) recommended that:

- All extant elements of the radio telescopes and associated infrastructure, including rubbish mounds (outside of the construction footprint) are to be left intact
- Some of the most intact parts of the site might be sub-surface in the form of buried cables, which connected the antenna elements to the signal processing units. Ground penetrating radar, or other remote sensing survey techniques, would be undertaken under the supervision of a suitably qualitied and experienced archaeologist prior to any ground disturbance within the heritage curtilage of Fleurs Radio Telescope Site (Item 2) within the construction footprint
- Measures would be included in the CCHMP to describe how the heritage values of the site would be conserved and managed during the construction of the road

- Contractors and subcontractors working in the area must be informed of the exclusion zones, the elements and their significance, to prevent accidental damage or encroachment
- Roads and Maritime to provide a copy of this report to the University of Sydney.

By implementing the following management measures the potential impacts on the heritage item would be minimised:

- Roads and Maritime would engage a suitably qualified heritage consultant to prepare an archival photographic recording of the impacted areas of the property, in accordance with the DPC (Heritage) guidelines (Heritage Council of NSW 2006)
- The heritage interpretation framework for the project would include interpretation measures that would improve community awareness of the history of the Fleurs Radio Telescope site as well as determine suitable locations for the presentation of information that are publicly accessible.

The following construction impacts have been assessed:

- Vibration – Gorman (2018:73) noted that the longer term impacts of the proximity of vibration on the significant fabric is unknown. All features, with the exception of the Shain Cross, at the Fleurs Radio Telescope Site have been identified to be at least 50 metres from the project, which is beyond the safe working distances for cosmetic damage from vibration, presented in the Table 2 of the Roads and Maritime's Construction Noise and Vibration Guideline (Roads and Maritime 2016*)* as per British Standard 7385. Construction works would likely comply with the German Standard DIN 4150:Part 3-1999 Structural vibration - Effects of vibration on structures vibration limits (Standard for all buildings). That said, a dilapidation survey, review of the vibration criteria with respect to the condition of the structural item (eg footing, frame, beams, or fabric) and vibration monitoring on all the structures at Fleurs Radio Telescope Site would be performed during construction. Further details can be found in Appendix K of the EIS
- Demolition – demolition of one element of the Shain Cross is proposed. No demolition to occur on remainder of site
- Archaeological disturbance – the site contains archaeological potential; however, as the archaeological features are outside the construction footprint, archaeological disturbance would be minimised
- Altered historical arrangements and access – the site is located on private property. Access would not be impacted
- Visual amenity – visual impacts would occur to the southern side of the site. There is an opportunity to interpret these historical elements through landscape treatments. Interpretive themes would be embedded into the fabric of the motorway. Further details are provided in Appendix G of the EIS
- Landscape and vistas – the majority of the site is located to the north of the construction footprint. The landscape along the southern section of the site would be impacted as the project extends from the western side of the site to the eastern side of the site. Vistas across the site from the south would be retained, while vistas across the site from the north would be impacted by the visual aspects of the project. However, the concept design reinforces the identity of the Fleurs Radio Telescope Site as new tree plantings would align with the Fleurs Aerodrome runway which is adjacent to the Fleurs Radio Telescope Site, minimising impacts to key view and vistas
- Curtilages – the curtilage of the site would be impacted with the project encroaching on the southern extent of the site
- Subsidence – not applicable for this project
- Architectural noise treatment – A building that is not a heritage element of the Fleurs Radio Telescope Site has been identified as eligible for architectural noise treatment. Further details can be found in Appendix K of the EIS.

Operational impacts on the site may occur due to the proximity of vibration and traffic fumes on the significant fabric, however the specific impacts at this stage are unknown (Gorman 2018). Excluding the Shain Cross, the closest heritage features at the Fleurs Radio Telescope Site are located more than 50 metres away from the project. Given the deteriorating nature of some of the elements of the site, there is the potential for impacts to occur.

Table 8-1 Condition, significance and impact and recommendations for Fleurs Radio Telescope site

Element	Condition	Significance	Impact	Recommendation	Effect if impacted
Shain Cross SC01	Intact but deteriorating	High. SC01 is the terminal element of the N-S arm of the Shain Cross array, aligned with several further elements at the northern end of the site.	High, due to its removal being required for the project to be constructed.	• Roads and Maritime to engage a suitably qualified heritage consultant to prepare an archival photographic recording of the entire property, in accordance with the DPC (Heritage) guidelines (Heritage Council of NSW 2006). • Historic heritage interpretation and improvement of community awareness of the history of the Fleurs Radio Telescope site could be undertaken. • Further investigation by Roads and Maritime during detailed design should be undertaken to investigate where and how this information could be presented near the site in an area accessible by the public.	SC01 is the southernmost element of the cross demonstrating the scale and original layout of the N-S arm. SC02-SC07 demonstrate the spacing of poles but not the extent of the cross.
South Creek 1 Antenna Complex	Good	Low, as the antenna has been removed. However, the 'signal box' is intact and in good condition. The plinths have been moved from original location and cables are exposed.	Low, as it is approximately 50 m outside the construction footprint.	The construction footprint would be fenced, therefore excluding vehicle entry or road construction activities. Archival photographic recording to be carried out as part of entire site recording.	Not impacted
South Creek 2 Antenna Complex	Poor	High. This is one of two FST elements remaining on site, and despite having collapsed, the structure is in better condition than the North antenna, (which would not be impacted).	Low, as it is approximately 50 m outside the construction footprint.	The construction footprint would be fenced, therefore excluding vehicle entry or road construction activities. Archival photographic recording to be carried out as part of entire site recording.	Not impacted

8.2.3 Conclusion

The proposed works within Fleurs Radio Telescope site would be of at a localised scale and low intensity, with the demolition of the one element of the Shain Cross being permanent and irreversible. As such, the level of impact on the heritage item overall would be **minor**.

While there is the potential for operational impacts on the site, including deterioration due to vibration and fumes, detailed archival photographic recording of the site would capture information about the site and reduce the impacts. Interpretation of the site and its history and significance incorporated into the project, would also assist in minimising impacts.

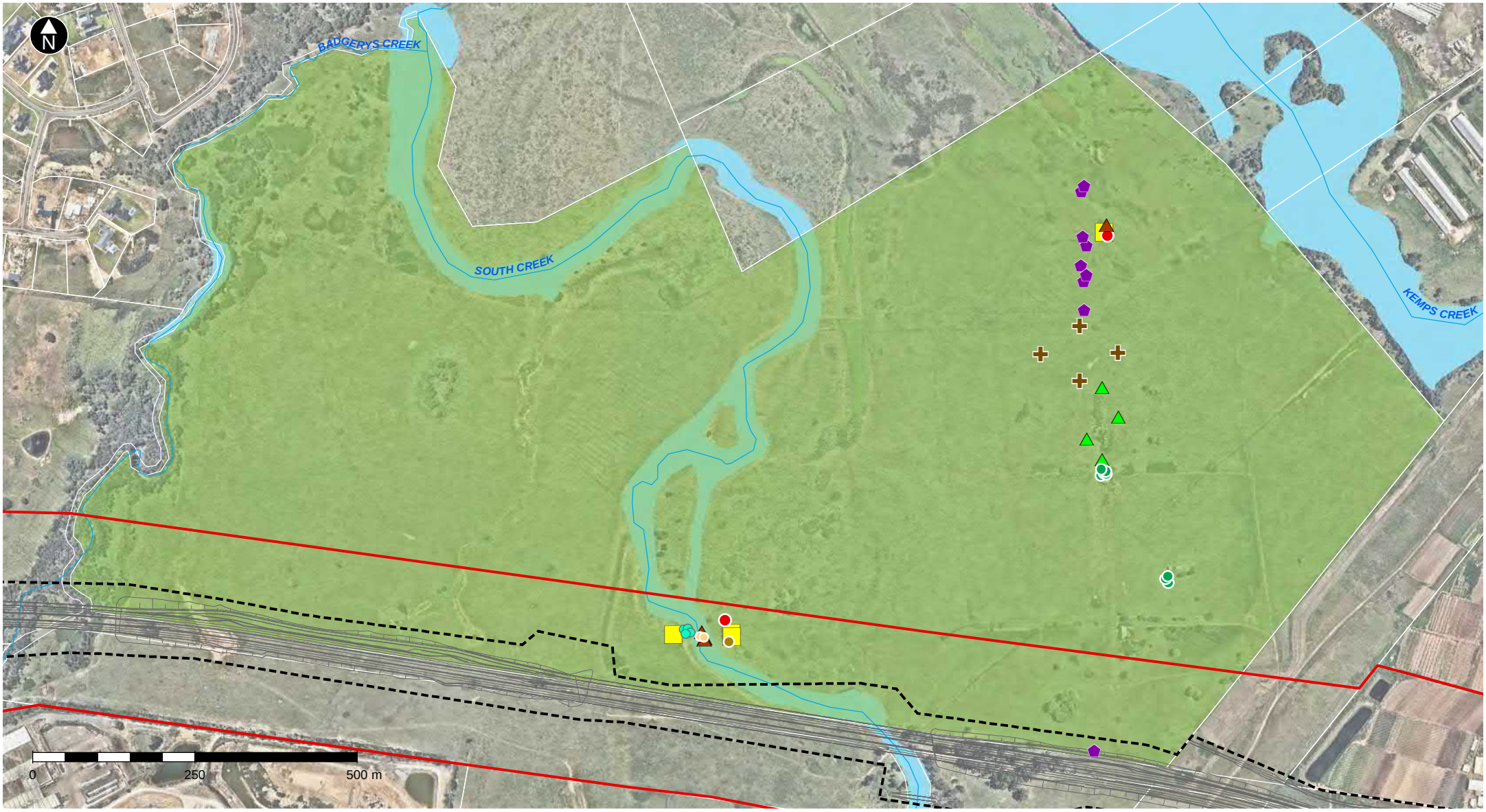

Figure 8-2 Location of Fleurs Radio Telescope Site (Item 2) in relation to the proposed works

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8.3 Item 3: Luddenham Road Alignment (Penrith LEP 843)

8.3.1 Proposed works

Construction of dual carriageway motorway with two lanes in each direction on a bridge over Luddenham Road.

8.3.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

There would be a bridge located over the Luddenham Road alignment. While the motorway intersects with the curtilage of the heritage item, there would be no physical works within the curtilage. The roadway should therefore not be physically impacted by the construction or operation of the proposed motorway, and consequently the significance of the Luddenham Road alignment would also not be impacted.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

There are no adverse impacts on the Luddenham Road alignment based on current plans.

8.4 Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (SHR 01373) (Lot 1/DP 603946 and Lot 51/DP811015)

8.4.1 Proposed works

The project involves construction of a grade separated interchange with M7 Motorway and Elizabeth Drive, including associated ramps. This interchange is over a section of the Upper Canal System which includes underground and above ground features (refer to **Figure 8-3**).

8.4.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

The grade separated interchange is located over the Upper Canal System pipeline that is below the ground to the southwest and northeast of the intersection. As such, the construction would not directly impact on the pipeline in this location. The above ground component of the Upper Canal System in this location, Tunnel Shaft 4, is located in the existing M7 central road median. The Tunnel Shaft 4 is located in an area of that would not be subject to impacts. While it is within the project's construction footprint, no works are proposed in the M7 Motorway median and Tunnel Shaft 4 would not be impacted by the project's construction or operation.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

There is potential for accidental physical damage to the Tunnel Shaft 4 from road construction machinery, vehicles or other activities, and the potential for vibration impacts on the Upper Canal System from construction works in the vicinity. However, *The Guidelines for development adjacent to the Upper Canal and Warragamba Pipelines* (Sydney Catchment Authority 2012) sets out guidelines when designing, planning or assessing development on land adjacent to this pipeline, which would be implemented as part of this project. The document outlines risks to the pipeline through construction works in the vicinity. A Construction Environmental Management Plan is recommended for major development projects (Sydney Catchment Authority 2012:9). The measures include the following:

- *The design, construction and operation of structures within or alongside the Upper Canal or Warragamba Pipelines should not impact the heritage significance*
- *Any development that could potentially affect the heritage significance of the Upper Canal requires a separate planning approval under section 60 or the Heritage Act 1977 from NSW Heritage Council*
- *The proponent will need to submit a heritage exemption notification to NSW Heritage Division for minor works*
- *The demolition and installation of boundary fencing will also require Heritage approval or exemption*
- *The consent of WaterNSW, as landowner, is required to submit a section 60 application or an exemption notification.*

The *Upper Canal Pheasants Nest to Prospect Reservoir. Conservation Management Plan* (CMP) (NSW Public Works Government Architect's Office 2016) is the key heritage management document for the Upper Canal and is applicable

to this project. The document outlines exemptions to works, including excavation for services and maintenance where this does not impact on areas designated as archaeologically significant (NSW Public Works Government Architect's Office 2016:101). This includes installation of new access roadways adjacent to the Upper Canal System provided these are in accordance with the conservation policies and guidelines of the CMP (NSW Public Works Government Architect's Office 2016:103). The relevant conservation policies are listed below.

Preparation of a CCHMP by Roads and Maritime is recommended to ensure the Upper Canal is protected from impacts during construction. Contractors working in the vicinity of Tunnel Shaft 4 would be required to undertake the activities in accordance with the policies and procedures in the CHMP.

By implementing the following management measures the potential impacts on the heritage item would be minimised:

- Incorporate relevant conservation policies from the Upper Canal CMP (NSW Public Works Government Architect's Office 2016) into the CCHMP to ensure heritage fabric is not impacted by the project. As a minimum, the following conservation policies would be addressed in the CCHMP:
  - Policy 1: The following aspects of the Upper Canal are integral to the significance of the place. Manage them to ensure they are conserved and their heritage values retained
    a. Key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allow it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges. These elements are ranked as having Exceptional or High heritage significance
    b. Remaining fabric relating to the phase of upgrading flumes and bridges by the Metropolitan Water Sewerage and Drainage Board in the 1920s and 30s. These elements are generally ranked as having high heritage significance
  - Policy 3: Retain all elements of Exceptional Significance as a priority
    a. Aim to retain all original fabric of elements of exceptional significance as a first conservation option. Where this will affect the safe operation or structural integrity of the Upper Canal, renew elements using matching components. Undertake all new work in accordance with the policies in this CMP
    b. Avoid adding new fabric, where this will result in a negative impact on significance
    c. If adaption is necessary for the continued use of the place, minimise changes unless such changes would result in the removal of intrusive elements or will have minimal impacts of significance
    d. Give preference to changes that are reversible
    e. Prior to any major change, full archival recording is essential
  - Policy 4: Retain a representative sample of elements of High Significance within each type
    a. Changes to fabric of high significance should be minimal
    b. Alterations that detract from significance should be removed to recover significance to enhance the ability of the item to demonstrate significance
    c. Aim to retain the original fabric of these or renew using matching components
    d. Give preference to changes that are reversible
    e. Some adaptation of elements may be acceptable, particularly where this process might assist in the continuing use of the site for water provision and any new work complies with the policies of this CMP and does not detract from the significance of the Canal
    f. Prior to major changes full archival recording is recommended
  - Policy 5: Retain a representative sample of elements of Moderate Significance. If the retention of the item compromises the sage operation or structural integrity of the Upper Canal, the elements could be altered or demolished, provided that the change can be justified and the new work complies with the policies of this CMP and does not detract from the significance of the Canal
  - Policy 6: Elements of Little Significance may be demolished or removed to reveal significant fabric or as required, provided that their removal would cause no damage to adjacent significant fabric and any new work complies with the policies of this CMP and does not detract from the significance of the Canal
  - Policy 10: Conserve surviving historic landscape features associated with the Canal, particularly the avenues of pines, cultural plantings at cottage and depot sites and historic plantings associated with the intersection of the Canal with old travel routes
  - Policy 11: Retain existing grass verges and open grass areas along the majority of the Canal corridor as a means of retaining some of the historic rural setting of the Canal
  - Policy 12: Retain areas of native woodland within the Canal corridor as a means of retaining some of the historic rural setting of the Canal

  - Policy 13: Where significant trees have died or are deemed unsafe by an arborist and need to be removed, replace them with like specimens
  - Policy 15: Retain spoil heaps and associated dry stone retaining walls as a first preference and avoid impacts wherever possible. These elements could be removed or otherwise impacted, if necessary, for works associated with the ongoing operation of the Canal
  - Policy 35: Make decisions requiring change to the Upper Canal with a clear understanding of the implications for the identified heritage values of the Canal and seek to minimise negative heritage impacts
  - Policy 36: Undertake an informal assessment of heritage impact for all proposed works within the Upper Canal corridor to determine if an automatic exemption applies or if a formal Heritage Impact Statement is required
  - Policy 37: Prepare a Heritage Impact Statement for all works requiring an exemption notification or application for approval under the NSW Heritage Act, 1977
  - Policy 40: Undertake formal archival recording in accordance with NSW Heritage Council guidelines when undertaking major changes to elements of Exceptional and High heritage significance
  - Policy 41: Keep and archive ongoing, informal records of changes to the Canal
  - Policy 43: Obtain any necessary heritage and planning approvals or exemptions prior to undertaking changes to the place. Carry out the works in accordance with any conditions placed on these approvals
  - Policy 48: For polices regarding new elements within the Upper Canal corridor associated with development outside the corridor
  - Policy 63: Ensure new safety or regulatory signage is freestanding or fixed to elements of lower or no heritage significance. Do not fix new signage to elements of Exceptional or High heritage significance
  - Policy 64: Do not install above ground services that run parallel to the Upper Canal within the Canal corridor. Linear installations within the corridor will negatively impact the setting of the Canal as a whole or large sections of it. Above ground services such as power lines that cross the Canal corridor will have localised impacts. Ensure that these cross the Canal corridor in areas of lesser significance
  - Policy 65: When installing below ground services, avoid areas of identified historical or Aboriginal archaeological potential and avoid impacts to elements of Exceptional heritage significance
  - Policy 69: Avoid excavation in areas of identified historical or Aboriginal archaeological significance
  - Policy 70: Where excavation is unavoidable, seek advice from a suitably qualified and experienced historical or Aboriginal archaeologist early in the planning stages for any work and undertake historical archaeological and Aboriginal cultural heritage assessment as appropriate
  - Policy 71: Follow the policies in Section 5.5.4 of the CMP regarding approvals required for excavation work
  - Policy 74: Adopt this CMP as the basis for ongoing management of the heritage values of the Upper Canal
  - Policy 75: Provide a copy of this CMP to all staff responsible for managing the Upper Canal or planning works to it. Provide relevant sections to contractors undertaking work in the Canal Corridor
- Include a safe working distance exclusion zone around the exposed tunnel air in the M7 Motorway median in accordance with the process that is in line with the safe work distances outlined by the Noise and Vibration Assessment.

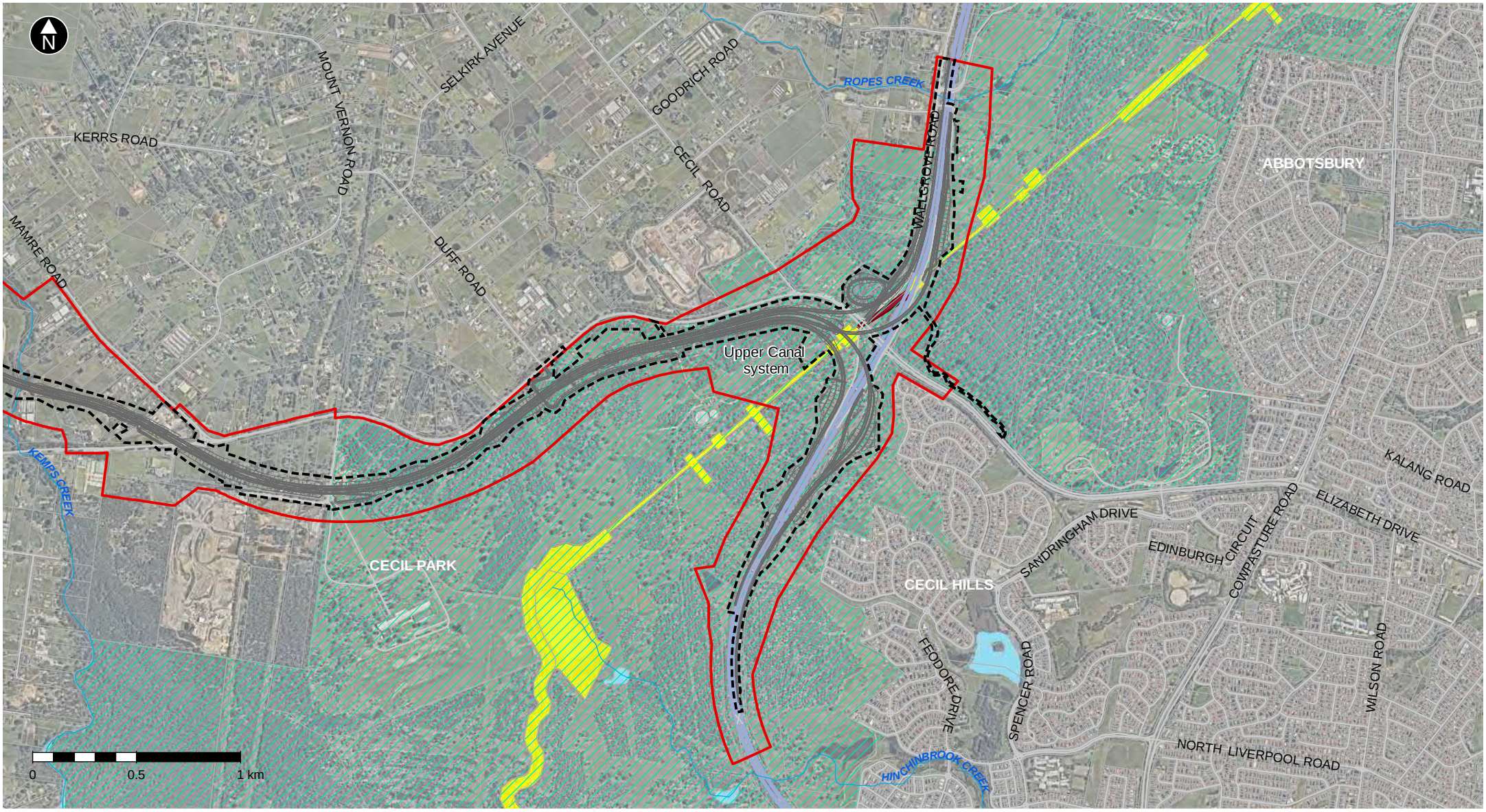
The following impacts have been assessed:

- Vibration – as the Upper Canal is an operational Water NSW asset, vibration impacts are unlikely due to the application of the measures outlined in the *Guidelines for development adjacent to the Upper Canal and Warragamba Pipelines* (Sydney Catchment Authority 2012). Construction works would comply with the German Standard DIN 4150:Part 3-1999 Structural vibration - Effects of vibration on structures vibration limits (Standard for all buildings). Further, a condition (or dilapidation) survey of the Upper Canal pipeline would be undertaken during a scheduled Water NSW closure of the pipeline (conducted periodically for routine maintenance), prior to commencement of construction. In addition, vibration monitoring would be performed during piling operations. Further details can be found in Appendix K of the EIS
- Demolition – neither the pipeline nor Tunnel Shaft 4 would be demolished
- Archaeological disturbance – not applicable as there are no archaeological deposits identified in this location of the Upper Canal System
- Altered historical arrangements and access – the heritage item is located within Western Sydney Parklands and is accessible to the public. Tunnel Shaft 4 is located within the M7 central median. Access would not be impacted
- Visual amenity – as the majority of the pipeline is below ground, there would be no visual impact to these sections. There would be no visual impact to Tunnel Shaft 4, already located in the M7 central median. Further details are provided in Appendix G of the EIS

- Landscape and vistas – the landscape and vistas of the heritage item would not be impacted as the pipeline is below ground in this location
- Curtilages – while the motorway intersects with the curtilage of the heritage item there would not be any physical impact to the pipeline within the curtilage, and therefore no impact to the significance of the pipeline
- Subsidence – not applicable for this project
- Architectural noise treatment – The Upper Canal System to the southeast of the M7 and Elizabeth Drive intersection has been identified as eligible for architectural noise treatment. The Upper Canal System in this section is below ground. Further details can be found in Appendix K of the EIS.

8.4.3 Conclusion

The proposed works within the heritage curtilage of the Upper Canal System are not planned to physically impact the heritage item as the motorway in this location is a raised structure, and any potential impacts are able to be prevented through implementation of protective measures. Additionally, there would be no impact on views to the heritage item. As such, the level of impact on the heritage item would be **negligible** during construction and operation.



The project
Study area
The project construction footprint
Waterways
Motorway
Main roads
Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
Assumed Upper Canal System curtilage
Western Sydney Parklands

Figure 8-3 Location of Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (Item 4) in relation to the proposed works

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8.5 Item 6: McMaster Field Station

8.5.1 Proposed works

The project involves construction of dual carriageway motorway with two lanes in each direction and access road to the Western Sydney Airport which overlaps with various elements of the site. The proposed road construction overlaps with a large portion of the McMaster Field Station, which would require ground disturbing works to occur in locations where there are dams and other landscape modifications, and concrete remnants that are important elements of the heritage item. The identified buildings are located a minimum distance of 36 metres from the project's operation footprint. However, a construction ancillary facility (AF3) located on the property to the east of the carriageway, has potential to impact the complex of buildings, including animal pens and stockyards. The ancillary facility would be used for bridges construction support, material and earthworks stockpile, possible workshop for plant servicing, double-handling laydown and outpost site office (secondary compound). The buildings at the site would not be demolished but may be reused as office and other similar facilities during construction.

8.5.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

While the project would have a direct impact on the heritage item, the management measures outlined below would reduce the impact of the significance of the heritage item as much as possible. The retention of the main building complex at the site and the possibility of future use of these buildings has the potential to enhance the significance of this part of the site by improving the condition of the buildings and structure enabling more effective future management of the heritage significance of the site.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

The project would directly impact on a large section through the centre of the curtilage of the McMaster Field Station. The proposed carriageway would involve ground disturbing works that would physically damage or destroy the existing dams, other modified landscape elements and trees on the property. The project would also destroy concrete remnants, which are separate to the main building complex. As the project bisects the entire property, the site in its entire landscape context would be destroyed, which impacts on the modified landscape elements of the site and the overall rural nature of the site which are significant.

The archaeological site in the northeast of the farm curtilage is about 100 metres to the north of the construction footprint and is therefore unlikely to be impacted by the proposed works. However, should the construction footprint be extended to include the archaeological site, then this site would require additional assessment and archaeological test and/or salvage excavation.

The destruction of the dams, other landscape features, and concrete remnants, and the bisection of the site would reduce the relatively intact nature of the heritage item, reducing the significance of the setting of the farm, and its modified landscape and the features. The construction of the carriageway would also isolate the main building complex was its setting, also reducing the level of intactness and the ability to understand the site's principal characteristics, and historical significance.

The proposed carriageway is located to the west of the main building complex of the site, however an ancillary facility (AF3) is proposed for the building complex. The buildings are not proposed to be demolished, however may be used as construction offices and facilities. The buildings would be placed within an 'area of potential use' zone (**Figure 8-4**) which would identify the area as of significance and exclude construction works, but enable the use and occupation of the buildings.

By implementing the following management measures the potential impacts on the heritage item would be minimised:

- Roads and Maritime /Contractor to engage a suitably qualified heritage consultant to prepare an archival photographic recording of the impacted area, in accordance with the Heritage Division of the DPC (Heritage) guidelines (Heritage Council of NSW 2006). This would include both buildings and landscape features such as dams, and earthworks. The recording would include a detailed map showing the location of the features
- Roads and Maritime /Contractor to investigate options to provide funding support to the property's current owner to prepare a thematic heritage study of CSIRO and other agricultural research stations, including McGarvie Smith Farm and McMaster Field Station, and other relevant agricultural research stations, and similar facilities located in NSW. The thematic study would include a review of the role of such properties in veterinary research, association

with agricultural, pastoral and animal husbandry groups, use of pioneering methods and practices, and contribution to the development of farming in NSW and Australia. In the event that landowners do not prepare this study, Roads and Maritime would engage a heritage specialist to do so

- An potential use zone would be established around the McMaster Farm building complex (as identified in **Figure 8-4**), including a suitable buffer zone, and no construction activities would take place within this zone. This zone would be incorporated into the CCHMP. The potential use zone should include safe working distances to be adhered to for heritage structures as outlined in Appendix K of the EIS.

It should be noted that if the construction contractor seeks to occupy or in some way utilise the buildings during construction this would be subject to further investigation and assessment, and would depend on the nature of the proposed use and the nature and extent of any proposed modifications. The buildings would be subject to dilapidation survey prior to use and may require safety requirements being met. This may involve works to fix buildings or make them safe for use. Any repairs, changes, updates or modifications to the buildings at McMaster Farm would be undertaken under the guidance of a heritage architect. Further investigation and assessment would be undertaken once the nature of any proposed use is known, and any measures to protect or preserve heritage fabric would then be included in a heritage management plan under the contractor's overall CEMP. Appropriate reuse of the buildings would benefit and enhance the heritage significance of the site as it would improve the current condition of the structures for future management of the heritage item.

The following impacts have been assessed:

- Vibration – the site would be likely be impacted by vibration given the construction laydown area overlaps with the building complex at the site. Guidelines and associated safe working distances would be adhered to for heritage structures as outlined in Appendix K of the EIS. As works have the potential to occur in close proximity to these structures, the structures would be inspected prior to the commencement of nearby vibration intensive works. A dilapidation survey would be carried out to confirm the sensitivity of the item to vibration induced damage and the appropriate criteria applied. Where vibration intensive activities are proposed to occur within the safe working distances, appropriate environmental management measures would be implemented as outlined in **Section 11** of the Appendix K of the EIS. An assessment of the proposed vibration intensive activities to occur at AF3 would be carried out to determine the appropriate offset distances to structures associated with McMasters Field Station
- Demolition – no buildings would be demolished
- Archaeological disturbance – not applicable to this heritage item. One area of archaeological potential was identified in Paddock 1 of McMaster Field Station, however that site is outside the study area and therefore not impacted
- Altered historical arrangements and access – the site is located on private property and is not accessible by the public. Access to the whole property would be impacted as the project would dissect the entire site
- Visual amenity - visual impacts, and the impacts to the landscape setting of the site, would be mitigated to some extent by the proposed vegetation and design elements such as the 'abstracted gateway landscape' which would reinforce a new identity in this zone. Interpretive themes to be embedded into the fabric of the motorway. Further details are provided in Appendix G to the EIS
- Landscape and vistas – the landscape and vistas of the entire site would be impacted as the project would dissect the entire site; however, management measures would minimise these impacts by recording as much information as possible about the site prior to commencement of construction
- Curtilages – the curtilage of the site would be impacted as the project would bisect the entire site
- Subsidence – not applicable to this project
- Architectural noise treatment - The procedures outlined below are typically followed for architectural treatment. However, specific requirements for the heritage item would be taken into consideration, and proposed treatments would be undertaken under the guidance of an appropriately qualified heritage consultant to minimise impacts. The architectural treatments provided by Roads and Maritime At-Receiver Noise Treatment Guideline (2017) are typically limited to:
  - Fresh air ventilation systems that meet the Building Code of Australia requirements with the windows and doors shut
  - Upgraded windows and glazing and solid core doors on the exposed facades of the substantial structures only (eg masonry or insulated weather board cladding with sealed underfloor)
  - Upgrading window or door seals and appropriately treating sub-floor ventilation
  - The sealing of wall vents
  - The sealing of the underfloor below the bearers and appropriately treating sub-floors ventilation
  - Roof insulation

- The sealing of eaves.

Alternative at-property mitigation can include:

- The installation of courtyard screen walls that break line-of-sight between the affected facade window and the road where they are feasible and reasonable and are preferred by the owner
- The final operational noise mitigation strategy would be determined as the project progresses and would likely use a combination of the approaches discussed in this report (ie low noise pavements, noise barriers and at-property architectural treatment)
- Identification of residual noise impacts and receivers eligible for consideration of at-receiver noise treatments would be undertaken during the detailed design stage after finalisation of any at-source and in-corridor management measures.

8.5.3 Conclusion

There would be construction and operational impacts to the site. The landscape of the heritage item would be impacted by the construction of the project. Operational impacts would be applicable as the proposed motorway bisects the heritage item.

The proposed works within McMaster Field Station would be of medium-large scale and moderate intensity, with some of the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be **major**. The main building complex at the site would be avoided, which mitigates some of the impact. Due to other factors, there were limited options to avoid the McMaster Field Station completely, or to alter the alignment to enable the connection of the building complex to its setting to be retained. The concept design for the M12 Motorway was developed through a multi-disciplinary process that identified and assessed a number of potential road corridor options against a wide range of engineering, environmental, social, land use and economic criteria. This process, which is documented in chapter 4 of the EIS, ultimately determined that the project's design as currently proposed, represented the best balance after a multi-criteria analysis of all of the known constraints and opportunities.

While permanent and irreversible impacts would occur due to the destruction of some of the landscape features, and bisection of the site by the motorway, undertaking a full archival photographic recording provides an opportunity to capture important information about the site. Further, undertaking a thematic study into CSIRO and other agricultural research stations would be important in identifying other potential heritage items in NSW and nationally that would demonstrate the same or similar significance as the McMaster Field Station, therefore reducing the overall impact on that type of heritage item. The possibility of appropriate reuse of some of the buildings at the McMaster Field Station would mitigate some of the impact on the broader site, by improving the condition of the structures. Proposed vegetation and design elements and development of an interpretation strategy for the project would further minimise the level of impacts, however, the level of impact on the site would still be **major**.

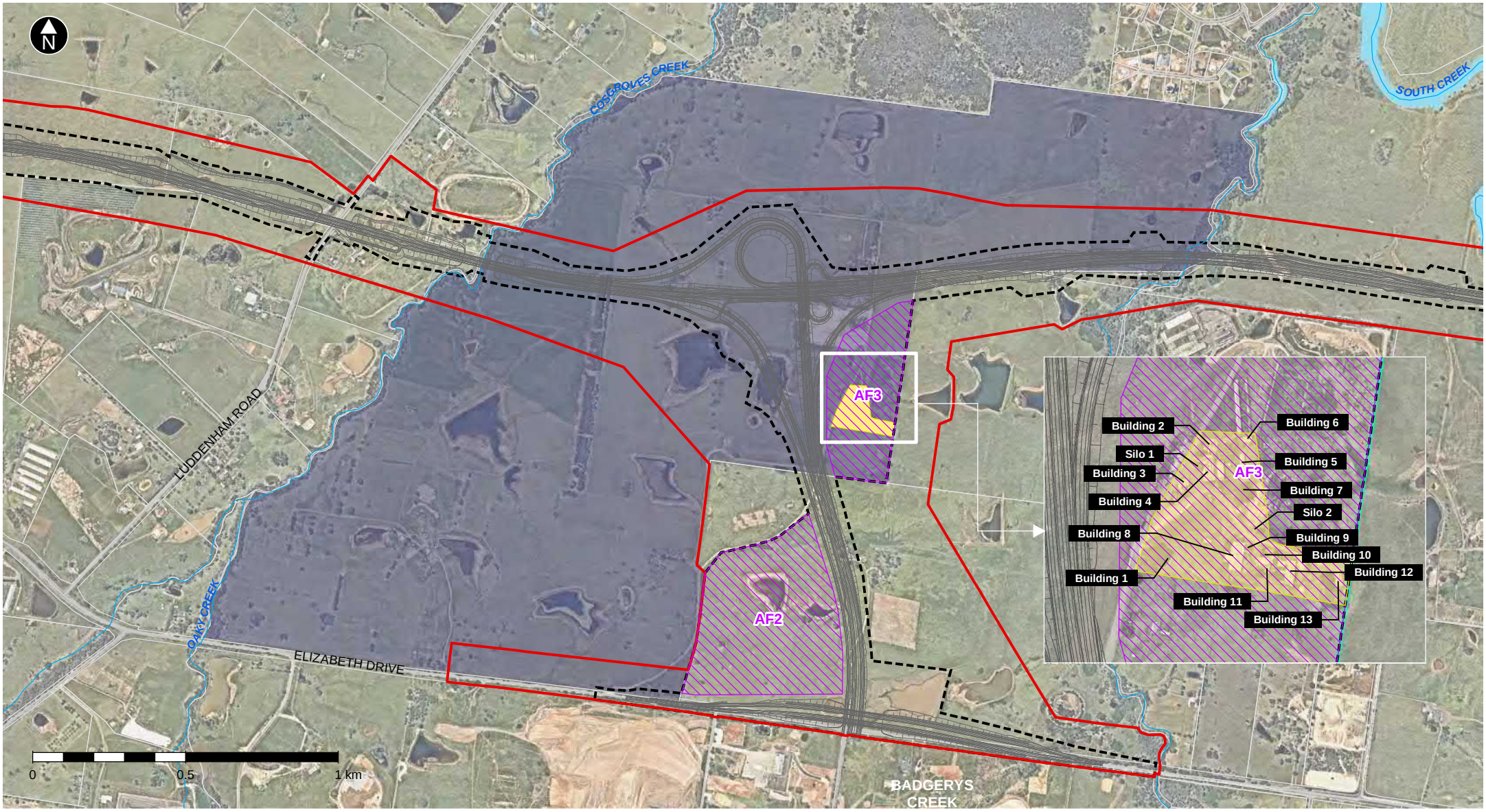

Figure 8-4 Location of McMaster Field Station (Item 6) in relation to the proposed works

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8.6 Item 7: Fleurs Aerodrome

8.6.1 Proposed works

Construction of a dual carriageway motorway with two lanes in each direction would bisect the Fleurs Aerodrome site curtilage. The location of the Fleurs Aerodrome in relation to the project is illustrated in **Figure 8-5**. The construction footprint extends over the grassed middle section of the Fleurs Aerodrome, while the study area includes sections of bitumen runway and grassed areas to the south, and grassed areas to the north. About 446 metres of the study area and 100 metres of the M12 construction footprint overlap with the Fleurs Aerodrome.

8.6.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

While the project would have a direct impact on a portion of the site, the impacts are confined to the middle grassed section of the aerodrome, avoiding the southern bituminised and northern grassed sections. It is likely that the northern end of the aerodrome contains building remnants as observed previously by Aurecon (2016); although this area was outside the current study area and was not inspected by the field team. A metal structure, located at the northern end of the bituminised section, is located 13 metres south of the M12 construction footprint, and impact would be avoided.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

The construction footprint crosses the grassed middle section of the Fleurs Aerodrome, bisecting the aerodrome curtilage east to west. There are no obvious surface features, and any potential archaeological evidence of the runways within the study area have been assessed as having little information to yield that is not already able to be obtained from documentary sources. Therefore, there would be no impact on any archaeological significance.

The bisection of the site however would reduce the intactness of the Fleurs Aerodrome and the ability of the site to be understood as a whole, essentially dividing the airstrip into sections, and diminishing its linear and continuous nature. This would impact on the site's principal characteristics, historical significance and rarity as an operational WWI aerodrome.

The metal structure (13 metres south of the construction footprint) and other sections of the Fleurs Aerodrome outside the construction footprint would not be subject to direct impacts from the project but may be inadvertently or accidently damaged during construction from vehicles or machinery in the vicinity, therefore protective temporary fencing should be erected to protect the structure, prior to works taking place.

By implementing the following management measures the potential impacts on the aerodrome would be minimised:

- Roads and Maritime /Contractor would engage a suitably qualified heritage consultant to prepare an archival photographic recording of the impacted area prior to its disturbance, in accordance with the DPC (Heritage) guidelines (Heritage Council of NSW 2006). The recording would include a detailed map showing the location of the features. An interpretive framework developed for the project would include consideration of elements to enable the continued interpretation and understanding of the airstrip at Fleurs Aerodrome as a linear and continuous element. This would be carried out in consultation with Department of Defence and consider opportunities for involvement of veterans groups
- In the CCHMP, include exclusion zones around sections of the aerodrome that are outside the construction footprint, so that they remain protected from accidental or incidental damage during construction. Protective barrier fencing would be constructed along the construction footprint boundary within the aerodrome curtilage prior to construction commencing and would remain in place until the conclusion of the works, at which time it would be removed. This measure would protect the metal structure, located 13 metres south of the M12 construction footprint from being inadvertently or accidently impacted.

The following impacts have been assessed:

- Vibration – overall this heritage item would not be impacted by vibration as there are no physical structures within the M12 construction footprint. However, the metal structure is located 13 metres south of the construction footprint and guidelines and associated safe working distances would be adhered to for heritage structures as outlined in the Noise and Vibration Assessment
- Demolition – not applicable for this heritage item

- Archaeological disturbance – there is little archaeological potential within the section of the aerodrome that overlaps with the construction footprint
- Altered historical arrangements and access – the site is located on private property
- Visual amenity – the majority of the project would be blended into the surrounding context with a combination of cut and fill embankments and revegetation work along the corridor, including:
  - Interpretive themes would be embedded into the fabric of the motorway, including for example the development of WWII aerodromes and the strategies used to support the war in the Pacific
  - The concept design reinforces the identity of the Fleurs Aerodrome as new tree plantings would align with the runway, minimising impacts to key view and vistas. Further details are provided in Appendix G of the EIS.
- Landscape and vistas – not relevant to this heritage item
- Curtilages – the curtilage of the site would be split between the north and south of the site
- Subsidence – not relevant to this project
- Architectural noise treatment – not relevant to this heritage item.

8.6.3 Conclusion

There would be both construction and operational impacts to the Fleurs Aerodrome as the proposed carriageway bisects the heritage item.

The proposed works within the Fleurs Aerodrome would be of medium-large scale and moderate intensity, with the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be **major**. However, due to other factors, there were limited options to avoid the bisection of the site. The concept design for the project was developed through a multi-disciplinary process that identified and assessed a number of potential road corridor options against a wide range of engineering, environmental, social, land use and economic criteria. This process, which is documented in chapter 4 of the EIS, ultimately determined that the project's design as currently proposed, represented the best balance after a multi-criteria analysis of all of the known constraints and opportunities.

While permanent and irreversible impacts would occur due to the bisection of the site by the motorway, undertaking a full archival photographic recording provides an opportunity to capture important information about the site. Proposed vegetation and design elements and development of an interpretation strategy for the project would further minimise the level of impacts, however, the level of impact on the site would still be **major**.

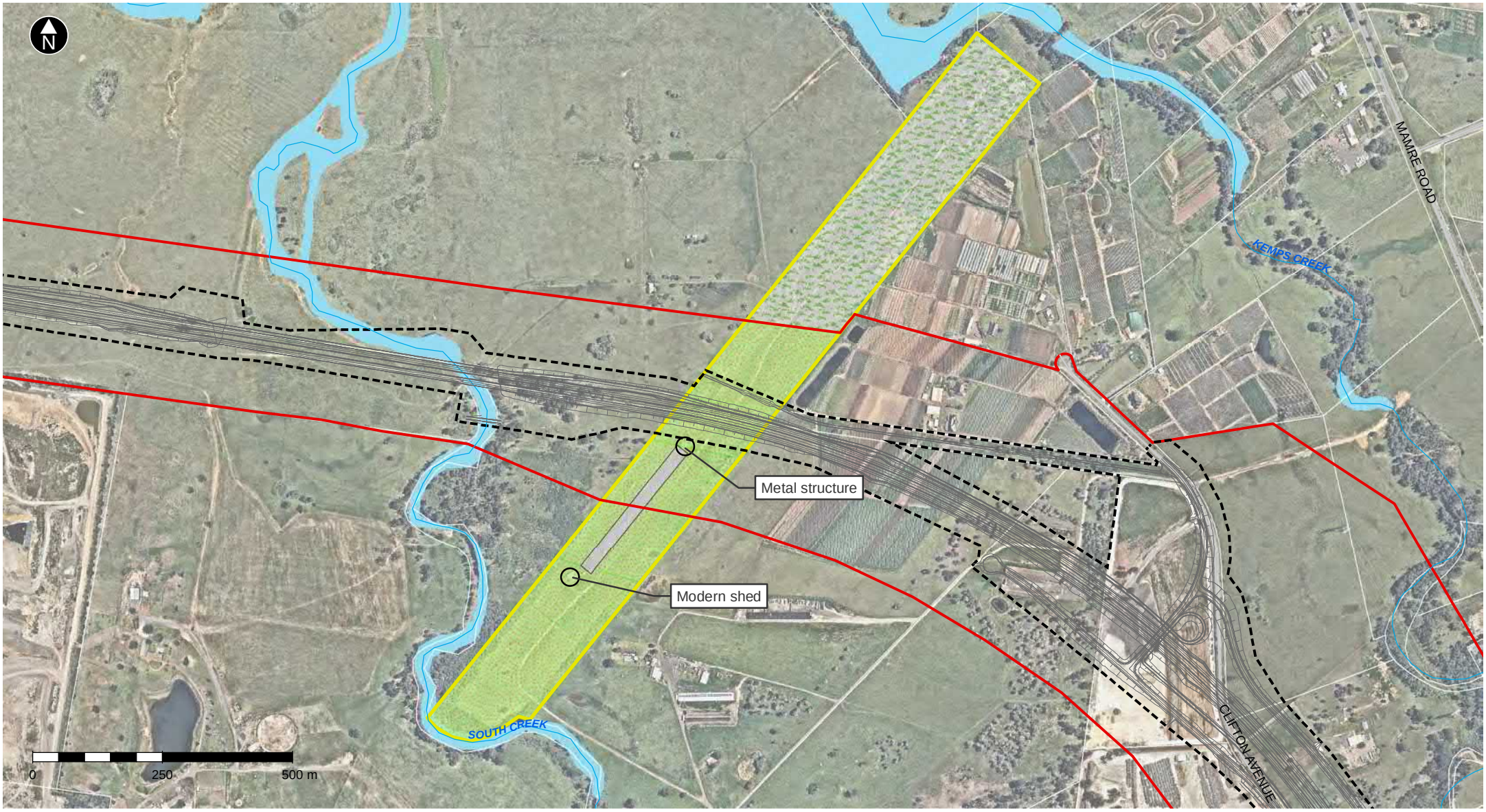

Figure 8-5 Location of Fleurs Aerodrome (Item 7) in relation to the proposed works

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8.7 Item 8: Cecil Park School, Post Office and School Church (Lot 1 DP724970)

8.7.1 Proposed works

Construction of a grade separated interchange with M7 Motorway overlaps with the Cecil Park School, Post Office and School Church (historical complex). The proposed works would disturb or destroy archaeological relics associated with the former historical complex. An archaeological test excavation undertaken at the historical complex confirmed the presence of archaeological relics (Annexure B) which can yield information about the past relating to development of education and postal and telecommunications infrastructure in the late 19th century and early 20th century.

8.7.2 Impact assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

While the project would have a direct impact on archaeological deposits of the Cecil Park Post Office and the former School Church of St Paul, a detailed archaeological investigation of the entire complex prior to its disturbance may enhance its significance through the realisation of its research potential. Undertaking further archaeological investigation of the complex under a well-structured research design by an appropriately qualified historical archaeologist would reveal further information and the development of education and postal and telecommunications in western Sydney from the late 19th century and into the 20th century. As with the test excavation, it is recommended that any further salvage excavation be undertaken by an archaeologist who fulfils DPC (Heritage)'s Excavation Director criteria.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

- The project would have a direct impact on archaeological relics of the former Cecil Park Post Office and the former School Church of St Paul within the complex due to ground disturbance from construction which would destroy archaeological deposits. As the School site straddles the construction footprint at least part of it would likely be destroyed and would affect the site significance. By following the management measures as much information as possible can be obtained which contributes to our knowledge and significance of the heritage item. To minimise impacts to the site and maximise the opportunity for realising its research potential archaeological salvage excavation of impact areas should be undertaken in accordance with an archaeological research design and methodology. The archaeological investigation would be conducted under the supervision of a suitably qualified and experienced historical archaeologist who fulfils the DPC (Heritage)'s Excavation Director Criteria.

The following impacts have been assessed:

- Vibration – this item would not be impacted by vibration as the archaeological deposits would be salvaged prior to construction commencing
- Demolition – relics associated with the former Cecil Park Post Office and the former School Church of St Paul would be disturbed or removed, whereas relics of the Cecil Park school site would not be impacted. Given the nature of the site as a complex, archaeological salvage excavation of all components of the site would mitigate this impact
- Archaeological disturbance – potential relics of the former Cecil Park Post Office and the former School Church of St Paul would be subject to disturbance as they are located within the construction footprint and would likely be removed or disturbed during excavation. Archaeological relics of the Cecil Park school site, however, would not be impacted. Given the nature of the site as a complex, archaeological salvage excavation of all components of the site would mitigate this impact
- Altered historical arrangements and access – given the archaeological nature of the subject site the potential impacts would be limited to potential relics. The site is not currently accessed via formal roads so access to the site would not be affected
- Visual amenity – as the heritage significance of this heritage item is related to subsurface archaeological remains, and the site does not have aesthetic significance, assessment of visual impacts is not relevant to this item
- Landscape and vistas – as the heritage significance of this heritage item is related to subsurface archaeological remains, and the site does not have aesthetic significance, assessment of visual impacts is not relevant to this item
- Curtilages – not relevant to this heritage item, as much of the area of archaeological potential would be removed and no longer exist following archaeological investigation and project construction, and the site would no longer be of significance

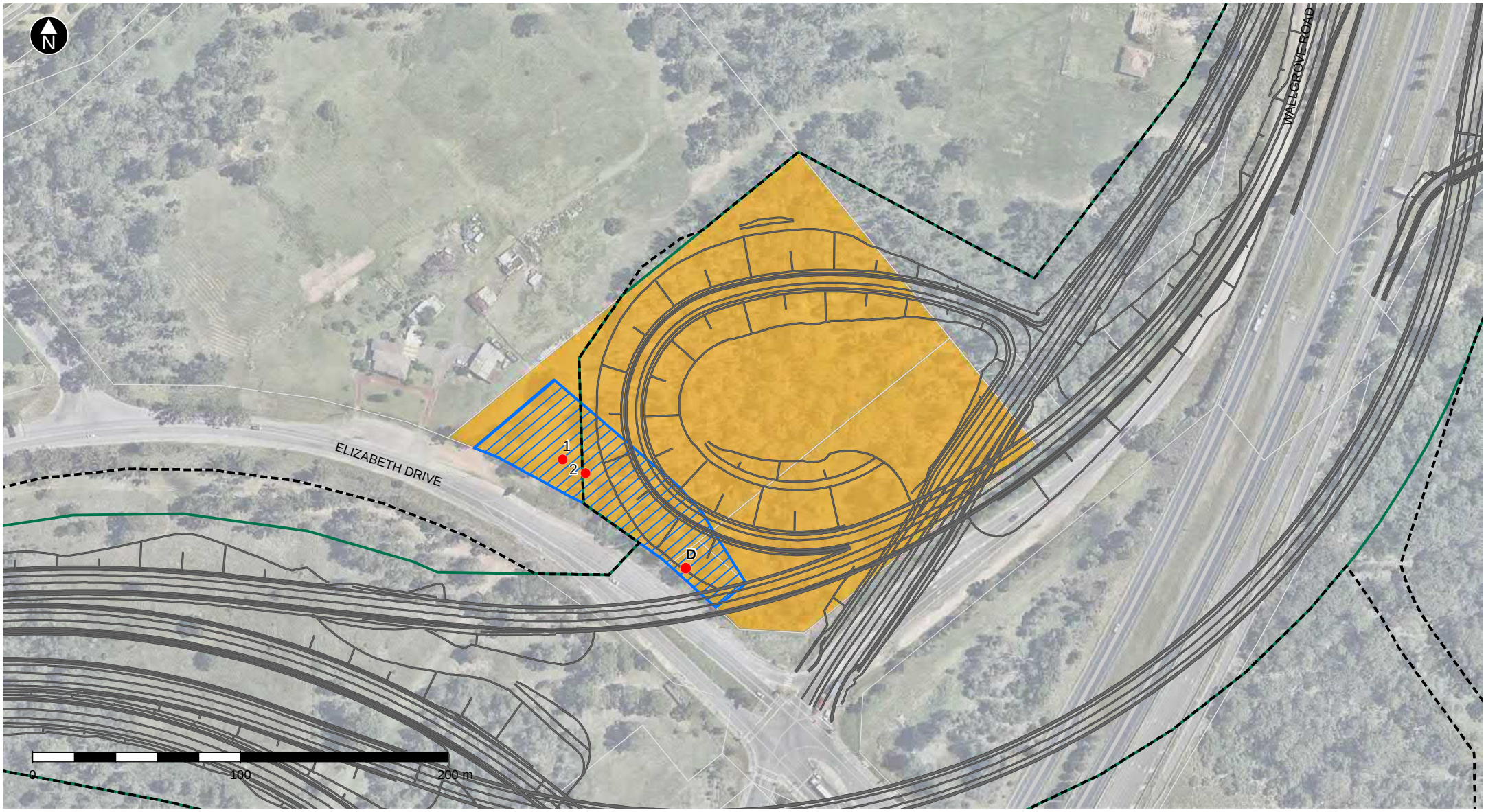
- Subsidence – not applicable to this project
- Architectural noise treatment – not relevant to this heritage item.

8.7.3 Conclusion

Construction impacts to Item 8 would cause physical damage to the entire area of archaeological potential within the heritage item, with the exception of the Cecil Park school site. As the construction would remove most of the archaeological aspects of the heritage item, it would no longer be of significance and would therefore not be subject to further operational impacts.

The proposed works within the Cecil Park historical complex would be of medium-large scale and moderate-high intensity, with the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be **major**. Due to other factors, there were limited options to avoid the Cecil Park historical complex. The concept design for the project was developed through a multi-disciplinary process that identified and assessed a number of potential road corridor options against a wide range of engineering, environmental, social, land use and economic criteria. This process, which is documented in chapter 4 of the EIS, ultimately determined that the project's design as currently proposed, represented the best balance after a multi-criteria analysis of all of the known constraints and opportunities.

While permanent and irreversible impacts would occur through the destruction of the area of archaeological potential, undertaking archaeological salvage investigations would provide opportunity to obtain information about the archaeology and history of the site not available from other sources.



The project
The project construction footprint
The project opreational footprint

Archaeological potential
Subject site boundary

Heritage items
1. Cecil Park Public School
2. Cecil Park Public School (and post office)
D. School Church of St Paul

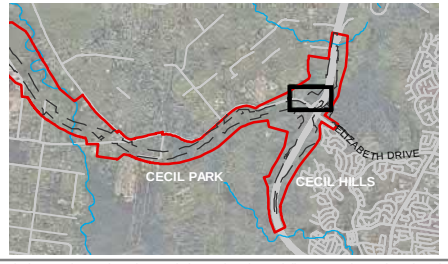


Figure 8-6 Location of Cecil Park School, Post Office and Church (Item 8) in relation to the proposed works

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8.8 Item 10: Exeter Farm archaeological site

8.8.1 Proposed works

This Exeter Farm archaeological site is located about 50 metres outside to the south of the M12 construction footprint. Currently there are no construction works within the curtilage of the site. Vehicle movements, temporary compounds and lay-down areas, and other early and/or enabling activities may occur in the vicinity of the site, however, it is assumed that these activities would be confined to the construction footprint shown in **Figure 8-7**.

8.8.2 Impact Assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

The M12 construction footprint would not directly impact on the archaeological site. Should all construction activities, including early and enabling works, avoid this item then the project would have no impact on the heritage significance of the item.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

All early and/or enabling works should be confined to the construction footprint. However, should the proposed alignment be modified to intersect with the Exeter Farm archaeological site, then it would result in the destruction of the site. Only if the site is impacted should it be fully investigated prior to any construction works being undertaken. As a minimum, this archaeological investigation would include testing and salvage of the site by a qualified archaeologist who fulfils the DPC (Heritage) Excavation Director Criteria (as per the SEARs).

The following impacts have been assessed:

- Vibration –this heritage item would not be impacted by vibration as there are no physical structures within the M12 construction footprint
- Demolition – not applicable for this heritage item
- Archaeological disturbance –this is an archaeological site that is currently not impacted by the project. However, should the alignment be modified and the site impacted then the site should be subject to archaeological investigation
- Altered historical arrangements and access – the site is located on private property
- Visual amenity – as the heritage significance of this heritage item is related to subsurface archaeological remains and does not have any aesthetic significance, assessment of visual impacts is not relevant to this item
- Landscape and vistas – not relevant to this heritage item
- Curtilages – the curtilage of the site is outside of the construction footprint and would not be impacted by the project
- Subsidence – not relevant to this project
- Architectural noise treatment – not relevant to this heritage item.

8.8.3 Conclusion

There are no works planned to occur within the curtilage of the Exeter Farm archaeological site, therefore there would be no construction impacts to the item. However, as the item is located within 50 metres of the construction footprint, shifting the alignment to the south would result in physical damage to the item. Due to the distance of the motorway from the site, there would also no operational impacts to the heritage item. As such, the level of impact on the heritage item would be **negligible** during construction and operation.

Figure 8-7 Location of Exeter Farm Archaeological Site (Item10) in relation to the proposed works

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8.9 Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

8.9.1 Proposed works

Construction of a motorway with two lanes in each direction immediately outside the southern boundary of the South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape heritage item.

8.9.2 Impact Assessment

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

Project works are not proposed within the item's curtilage. Direct impacts would therefore not be expected. However, vegetation clearance and impact on hydrology may have indirect impacts on this landscape heritage item and its heritage values, which are discussed below.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

All early and/or enabling works should be confined to the construction footprint. However, should the proposed alignment be modified to intersect with this landscape item, then further impact assessment would be required. As an item of heritage landscape, this would need to include a visual assessment as well as a heritage impact assessment.

Overall the scenic landscape is significant for its areas of remnant vegetation, presence of weirs, and cultural landscapes associated with early homesteads. However, the small section of landscape immediately adjacent to the construction footprint does not contain any of these elements. Therefore, these aspects of the site's significance would unlikely be impacted by the project.

There is the potential for visual impacts from the motorway as an intrusive element in very close proximity to the traditional rural landscape which is becoming increasingly rare. However, given the size of the landscape item, and the motorway being situated outside its southern margin, the visual impacts have been minimised as much as possible, while considering other multiple factors in the development of the concept design.

The presence of creeks is a significant element for this landscape item and there is the potential for indirect impacts on the heritage item, as the motorway would cross South Creek, just outside the curtilage of the item, potentially disrupting or changing the hydrology of the area within the heritage item curtilage. An increase in impervious area would result in an increase in runoff volume, because less rainfall is retained on a paved surface compared to a vegetated surface. This is likely to result in localised increased flow velocities, which if untreated may result in scouring and erosion.

Protection measures would be either incorporated into the project's design or recommended as environmental management measures from the flooding assessment or surface water quality and hydrology assessment, Appendix L and Appendix M of the EIS respectively. For example, low-flow creek channels where bridge piers are proposed have had localised creek re-alignments so that piers are outside the channels. In addition, bridges have been designed so that where possible, piers are located outside the low flow channels on the floodplain so as to not directly impact on the hydrology of the waterways.

The Flooding assessment report (Appendix L of the EIS) and the Surface water quality and hydrology assessment report (Appendix M of the EIS) found the potential hydrological changes associated with the project to be minor and localised. Therefore, impact on the landscape's heritage significance as a result of potential hydrological changes is not anticipated.

The following impacts have been assessed:

- Vibration – this heritage item would not be impacted by vibration as there are no physical structures within the M12 construction footprint
- Demolition – not applicable for this heritage item
- Archaeological disturbance – this heritage item does not have archaeological potential, therefore this is not applicable
- Altered historical arrangements and access – the site is located on private property

- Visual amenity – while the project would result in a new road, which is an intrusive element in relation to the natural landscape elements of this heritage item, the new road would be situated to the south of the heritage item and therefore these impacts would be minimal. Further details are provided in Appendix G of the EIS
- Landscape and vistas – there would be the potential for visual impacts from the motorway as an intrusive element in very close proximity to the traditional rural landscape which is becoming increasingly rare. However, given the size of the landscape item, and the motorway being situated outside its southern margin, the visual impacts have been minimised as much as possible, while considering other multiple factors in the development of the concept design. Further details are provided in Appendix G of the EIS in relation to measures being implemented across the project to improve visual amenity
- Curtilages – the curtilage of the site is located 90 metres outside of the M12 construction footprint
- Subsidence – not relevant to this project
- Architectural noise treatment – not relevant to this heritage item.

8.9.3 Conclusion

There are no works planned to occur within the curtilage of the South, Kemps and Badgerys Creek Scenic Landscape, however there is the potential for indirect impacts to the hydrology of South Creek, and visual impacts to the heritage landscape. These impacts would also continue during operation.

There would be no direct physical impacts on the heritage item, the visual impacts have been minimised as much as possible through project design, and the hydrological impacts are minor and localised and able to be prevented through the implementation of management measures. As such the level of impact on this heritage item, during construction and operation would be **negligible**.

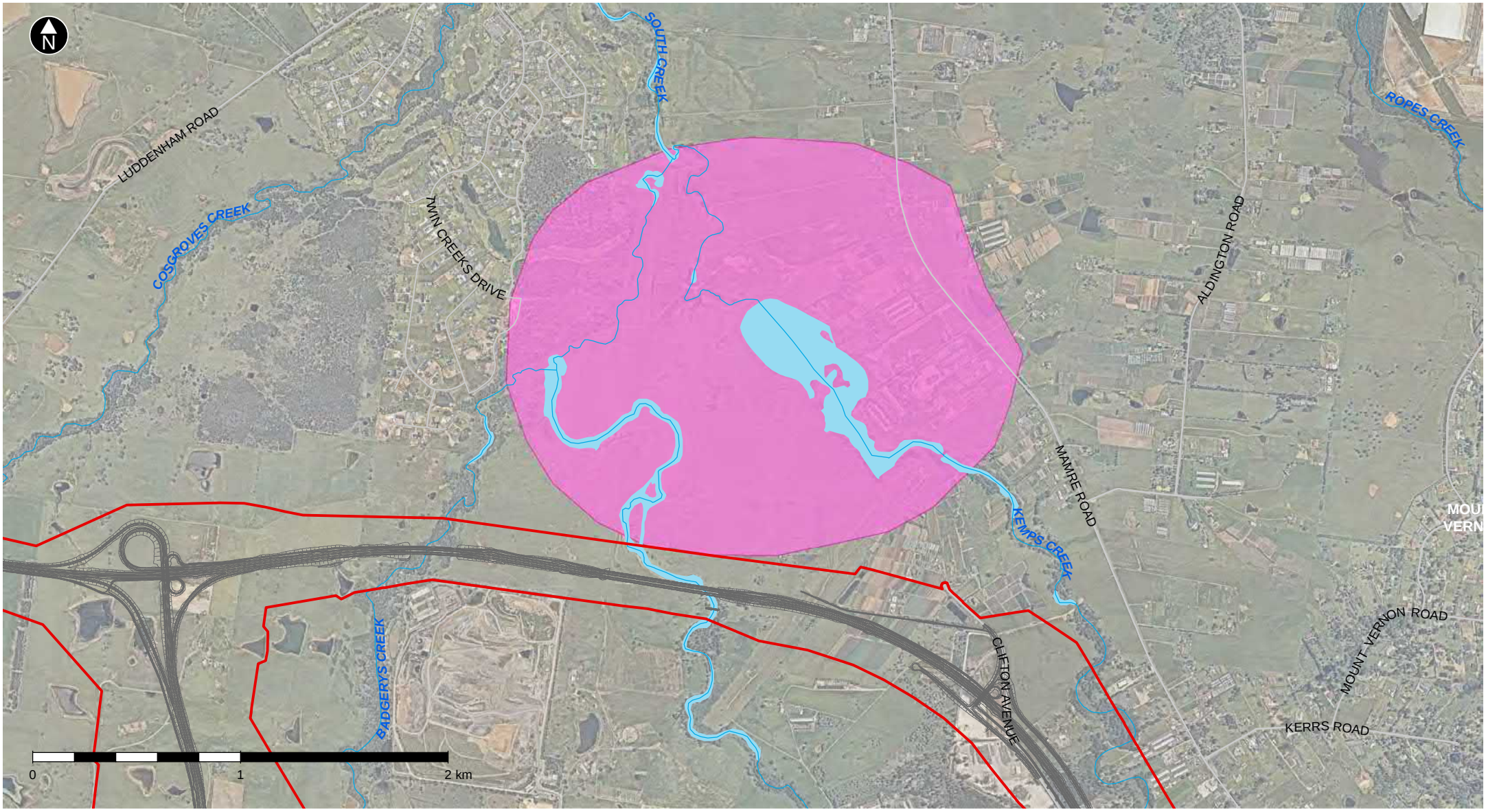

Figure 8-8 Location of South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (Item 12) in relation to the proposed works

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8.10 Heritage items located outside the study area requiring architectural noise treatment

The following heritage items located outside the study area have been identified within property lots listed as receivers identified as eligible for consideration of additional mitigation in Appendix K of the EIS. Two heritage items are identified in the State Environment Planning Policy (SEPP) (Western Sydney Parklands) 2009:

- Liverpool Offtake Reservoir – comprises a 19th century earthen reservoir, and other later water tanks, chlorination sheds, old landscaping features, and fencing, local significance (NSW Heritage Database)
- Kemps Creek Forest – classed as landscape, local significance, no further information available.

One heritage item is identified in the State Environment Planning Policy (Sydney Region Growth Centres) 2006:

- Hellenic Monument, Austral, Lot 10 DP771080 – Greek style concrete monument elevated on Judges Hill, north of Gurner Avenue, installed by the Federation of Hellenic Associations, local significance (AMBS 2012).

Based on the limited information available about these three sites, it appears unlikely that any of these heritage items contain residential structures requiring architectural noise treatment. As such, while the lots on which these are situated have been identified as requiring architectural noise treatment, there are likely no residences that meet the criterion for such treatment. There would therefore be no impact on the heritage significance of these heritage items.

9. Cumulative impacts

Cumulative non-Aboriginal heritage impacts may arise from the interaction of construction and operation activities of the project and other approved or proposed projects in the area. When considered in isolation, specific project impacts may be considered minor. These minor impacts may be more substantial, however, when the impact of multiple projects on the same receivers is considered. As such, the non-Aboriginal heritage impacts discussed in **Section 7** and **Section 8** are assessed here in consideration of the recently completed, ongoing and proposed projects described in **Table 9-1**.

The identified projects are in varying stages of delivery and planning. This chapter provides an assessment of cumulative non-Aboriginal heritage impacts based on the most current and publicly available information on the above. In many instances this is a high-level qualitative assessment. The identified projects are relevant to the consideration of cumulative non-Aboriginal heritage impacts as they are or would be located within the vicinity of the project and may share common types of sites, for example homesteads or experimental farms. This is discussed further in the sections below.

9.1 Assessment of cumulative impact

For non-Aboriginal heritage, overlapping construction or operational timeframes do not usually add to the overall level of heritage impact as it does for other disciplines, such as traffic or noise. This is because once physical changes are made to a heritage place, regardless of whether they are made at the same time or separately, the impact level doesn't change.

Table 9-1 Identification of relevant projects

Project	Relevance of the identified project to consideration of cumulative non-Aboriginal heritage impacts of the M12 project
Western Sydney Airport (approved)	Temporal and spatial relevance, due to following characteristics: • Located directly adjacent to the project (overlapping areas of potential influence) • Potential to generate impacts on same heritage items • Concurrent (simultaneous) construction and operation.
Sydney Metro Greater West	Temporal and spatial relevance, due to following characteristics: • Located directly adjacent to the project, with overlapping construction footprints near the Western Sydney Airport interchange and approach to the Airport • Potential to generate impacts on same heritage items • Likely to be concurrent (simultaneous) construction, with concurrent operation.
The Northern Road Upgrade • Stage 5 (Littlefields Road to Glenmore Park) • Stage 6 (Littlefields Road to Eaton Road)	Temporal and spatial relevance, due to following characteristics: • Located directly adjacent to the project • Likely to be consecutive (back to back) construction and concurrent (simultaneous) operation.
Other existing road network upgrades and potential road projects, including: • Elizabeth Drive Upgrade • Mamre Road Upgrade • Outer Sydney Orbital.	Temporal and spatial relevance, due to following characteristics: • Located directly adjacent to the project • Potential to be consecutive (back to back) construction and concurrent (simultaneous) operation. These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available.
Major land releases, including: • Western Sydney Aerotropolis • South West Growth Area	Temporal and spatial relevance, due to following characteristics: • Located directly adjacent to the project • The project would traverse the South West Growth Area and service the Western Sydney Aerotropolis, and indirectly, the Western Sydney Employment Area

Project	Relevance of the identified project to consideration of cumulative non-Aboriginal heritage impacts of the M12 project
• Western Sydney Employment Area.	The project would serve and facilitate the growth by providing increased road capacity and reducing congestion and travel times in the area Outcomes of these strategies would guide the potential future context of the M12 project (operation). These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available.

9.2 Western Sydney Airport

The Australian Government is currently constructing the Western Sydney Airport on the 1,780-hectare Commonwealth-owned land at Badgerys Creek. The airport would service both domestic and international markets and development would be staged in response to ongoing growth in aviation demand. Stage 1 includes the establishment of the following to provide operational capacity for about 10 million passengers per year and freight traffic:

- A single 3,700 metre runway in the north-western portion of the site
- A terminal
- Other support facilities
- Foundation for further expansion.

It is anticipated that the demand in relation to this airport would reach about 82 million passengers a year by 2063. To cater for this, a second parallel runway would be constructed at a later stage.

The EIS for the Western Sydney Airport was placed on display in October 2015 and finalised on 15 September 2016 with a Revised Draft Airport Plan. The assessment found that the airport would result in some adverse impacts on the environment and community, particularly in relation to the following:

- Air quality
- Biodiversity
- Health
- Noise
- Water quality.

Management measures were proposed to reduce these potential impacts during construction.

The Western Sydney Airport is relevant to the consideration of cumulative non-Aboriginal impacts both temporally and spatially as it is located directly adjacent to the project (see **Figure 1-1**).

9.2.1 Construction cumulative impacts

Construction of Western Sydney Airport is under way and the airport is set to open in 2026. Construction activities for Stage 1 involve three major work phases:

- Site preparation works, including:
  - Securing the construction impact zone
  - Establishing site services and construction facilities
  - Clearing vegetation
  - Undertaking major earthworks
- Aviation infrastructure works, including construction of the:
  - Runway, taxiways and apron areas
  - Internal road network
  - Terminal complex
  - Air traffic control tower
  - Freight, cargo and maintenance facilities

  - Fuel farm
- Site commissioning activities at the completion of the aviation infrastructure works
  - Involves testing and commissioning of all facilities in readiness for the operation.

The heritage assessment for the construction of Western Sydney Airport indicated that all 20 European and other heritage items on the airport site will be removed and/or demolished to facilitate development of the airport. No heritage items which are located outside the airport site, but within the study area, were determined to be directly impacted. However, the development was assessed to indirectly impact two heritage items within the study area; McGarvie Smith Farm and Luddenham Road, as a result of the initial and long-term development at the airport site.

One heritage item, McGarvie Smith Farm, is subject to direct and indirect impacts by the Western Sydney Airport construction as a result of use for High Intensity Approach Lighting. The level of impact to this heritage item is minor, as a small portion of the property adjacent to the driveway would be impacted and not affect the significance of the heritage item. However, the project would impact this heritage item to a major level as the proposed road would bisect the heritage item, affecting the significance of the heritage item. Luddenham Road alignment, would be also be indirectly impacted by the Western Sydney Airport construction. However this heritage item would not be impacted by the project.

Overall, the types of non-Aboriginal heritage places to be impacted by the Western Sydney Airport include site types and associated archaeological deposits such as farm complexes, a public school, a butchery, post office, saw pit, churches and homesteads. The number of site types impacted by the project is less; however, site types to be impacted by the project are similar, ie farming complexes.

Therefore, there would be major cumulative non-Aboriginal heritage impacts associated with the construction of the project and the Western Sydney Airport, specifically in relation to the McGarvie Smith Farm. There would be negligible cumulative non-Aboriginal heritage construction impacts for the remainder of the project.

9.2.2 Operation cumulative impacts

The Western Sydney Airport and the project would be operational at the same time. As a result, indirect impacts such as changes to the landscape, vistas and ambience will occur to the heritage items located within the Western Sydney Airport site area.

These impacts relate to McGarvie Smith Farm which would be impacted by the project through the bisection of the site by the motorway. The bisection across the broader landscape of the site would reduce the significance of the setting of the experimental farm, and its modified landscape and the features demonstrating innovative water harvesting practices. There would be no additional heritage items impacted by the project.

As the impact on the McGarvie Smith Farm has been assessed for the project as being major, and impacts for the Western Sydney Airport are minor, there would be a major cumulative non-Aboriginal heritage impact associated with the operation of the project and the Western Sydney Airport, as a result of the impact to McGarvie Smith Farm.

9.3 Sydney Metro Greater West

Transport for NSW recently identified recommended corridors for a rail option to provide a major transport link between the North West Growth Area, Western Sydney Airport, and the South West and Greater MacArthur Growth Area. This rail option would connect the existing Main South Line (T8) near Macarthur Station to the existing Main Western Line (T1) near St Marys Station, via the Western Sydney Airport.

This railway servicing the new Western Sydney Airport will be developed and delivered by Sydney Metro. It is referred to as the Sydney Metro Greater West. Planning for this project is currently underway and, as such, environmental assessment results are not yet available. The construction and operation of these two projects would likely have overlapping timeframes.

The Sydney Metro Greater West is relevant to the consideration of cumulative non-Aboriginal heritage impacts as it would be located to the east of the M12 Motorway connection to Western Sydney Airport Main Access Road.

9.3.1 Construction cumulative impacts

Construction timeframes for the Sydney Metro Greater West would overlap with the construction of the project. Despite timeframes where construction activities are concurrent, the level of non-Aboriginal heritage impacts that occur due to this overlap would not be increased. The magnitude of cumulative construction impacts would be

dependent on the specific construction locations, activities and impacts which are yet to be determined for the Sydney Metro Greater West.

However, the McMaster Field Station and McGarvie Smith Farm are located within the Sydney Metro Greater West project area and would likely be subject to major impact by construction of the Sydney Metro Greater West. Therefore there would be major cumulative non-Aboriginal heritage impacts associated with the construction of the project and the Sydney Metro Greater West, particularly in relation to McGarvie Smith Farm and McMaster Field Station.

9.3.2 Operation cumulative impacts

The Sydney Metro Greater West and the project would both be operational in the longer term (ie opening of the Metro may occur after the opening of the project). As a result, impacts such as changes to the landscape, vistas and ambience would occur to the heritage items located within the Sydney Metro Greater West operational footprint.

These impacts relate to McGarvie Smith Farm and McMaster Field Station which would be impacted by the project through the bisection of the site by the motorway. The bisection across the broader landscape of both sites would reduce the significance of the setting of the experimental farms, and their modified landscapes. There would be no additional heritage items impacted by the project.

9.4 The Northern Road Upgrade

An upgrade of the Northern Road was approved in May 2018 as part of the Western Sydney Infrastructure Plan. The upgrade will improve the capacity of the existing road and create about eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham to realign the section of The Northern Road that currently runs through the Western Sydney Airport site. Once the upgrade is complete, The Northern Road will connect the project and the M4 Western Motorway, and improve connectivity with the Western Sydney Airport (Roads and Maritime 2017).

The upgrade is being carried out in six stages:

- Stage 1 – between The Old Northern Road, Narellan and Peter Brock Drive, Oran Park
  - Completed
- Stage 2 – between Peter Brock Drive, Oran Park and Mersey Road, Bringelly
  - Under construction
- Stage 3 – between Glenmore Parkway, Glenmore Park and Jamison Road, South Penrith
  - Under construction
- Stage 4 – between Mersey Road, Bringelly and Eaton Road, Luddenham
  - Under construction
- Stage 5 – between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park
  - Construction to start early 2019
- Stage 6 – between Eaton Road, Luddenham and Littlefields Road, Luddenham
  - Construction to start mid-2019.

The Northern Road upgrade is relevant to the consideration of cumulative non-Aboriginal heritage impacts both temporally and spatially as it would be located directly adjacent to the project.

9.4.1 Construction cumulative impacts

Stages 1 through 4 of The Northern Road upgrade will be completed by the time construction of the project commences. The construction for Stage 5 is scheduled for early 2019 to end of 2022. The construction for Stage 6 is scheduled for mid-2019 to end of 2021. Construction activities associated with these two stages may overlap with the project construction. Both these stages are in the vicinity of the project.

The non-Aboriginal heritage assessment for Stages 4, 5 and 6 The Northern Road was undertaken within one assessment and determined that three heritage items would be impacted by the upgrade of The Northern Road:

- Orchard Hills Cumberland Plain Woodland
- Miss Lawson's Guesthouse Site

- Lawson's Inn Site.

The non-Aboriginal heritage assessment for the Northern Road states that Miss Lawson's Guesthouse Site would be destroyed by construction and impacts would be a major impact. A portion of the other two heritage items would be impacted by construction of The Northern Road, resulting in minor impacts. A fourth heritage item (Warragamba Dam to Prospect Reservoir pipeline) was assessed as having no impacts expected from The Northern Road upgrade.

None of these heritage items would directly impacted by the project.

The site types that will be impacted by The Northern Road construction are related to early accommodation in the region and a canal associated with the Orchard Hills Cumberland Plain Woodland. These site types would not be impacted by the project as there are no sites relating to early accommodation or irrigation within the project area that would be impacted. There would be negligible cumulative non-Aboriginal heritage impacts associated with the construction of the project and The Northern Road Upgrade Stages 5 and 6.

9.4.2 Operation cumulative impacts

There would be negligible cumulative non-Aboriginal heritage impacts associated with the operation of the project and The Northern Road Upgrade Stages 5 and 6.

9.5 Other road network upgrades

There are a number of other planned and potential road upgrade projects in the western Sydney area that may contribute to cumulative non-Aboriginal heritage impacts. These potential projects include:

- Elizabeth Drive upgrade – Roads and Maritime has started site investigations, including preliminary engineering, preliminary/strategic designs, environmental field investigations, and strategic modelling. These investigations are expected to be completed by mid-2019
- Mamre Road upgrade – the NSW Government has started early planning for a future upgrade of a 10 kilometre section of Mamre Road, between the M4 Motorway and Kerrs Road to support economic and residential growth in the area
- Outer Sydney Orbital – a future north-south motorway and freight rail line in Sydney's West to support the growth of western Sydney and the distribution of freight across Sydney and regional NSW (Transport for NSW, 2018b). While the Outer Sydney Orbital is in early stages of planning, it would provide connections to the Western Sydney Airport.

These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available. These projects are relevant to the consideration of cumulative non-Aboriginal heritage impacts as they would be located in close proximity to the project.

The timing for construction of the above projects has not yet been announced. However, there is potential for overlaps in construction timing between the project and some of these road upgrade works which are in the vicinity of the project. Should this occur the cumulative impacts would likely be minimal as the temporal aspect of impacts on heritage places does not usually add to the overall level of heritage impact. This is because once physical changes are made to a heritage place, regardless of whether they are made at the same time or separately, the impact level doesn't change.

As there has been no environmental assessment undertaken for the planned and potential road upgrade projects in the western Sydney area, it is currently unknown as to the level of impact on heritage items generated by those projects. Consequently, cumulative non-Aboriginal heritage impacts associated with the construction or operation of the project and other road projects is unknown.

9.6 Growth areas

Western Sydney is the focus of a number of plans and policies to promote changes in land use and to increase employment opportunities, in particular within the following defined areas:

- Western Sydney Aerotropolis – The area surrounding the Western Sydney Airport that was previously known as the Western Sydney Airport Growth Area (refer to **Figure 1-1**). The Aerotropolis would establish a new high-skill jobs hub across aerospace and defence, manufacturing, healthcare, freight and logistics, agribusiness, education and research industries, and is expected to contribute to establishing 200,000 new jobs for Western Sydney

(DPE, 2018). The Aerotropolis Land Use and Infrastructure Implementation Plan outlines a proposed State Environmental Planning Policy provision that includes controls relating to land acquisition, development near zone boundaries, preservation of trees or vegetation, and heritage conservation.

- South West Growth Area – The broader area surrounding the Western Sydney Airport (refer to **Figure 1-1**). This would guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the area. The NSW Government is currently at the early stages of investigations.
- Western Sydney Employment Area – The area north-east of the Western Sydney Growth Area (refer to **Figure 1-1**). Established by the NSW Government to be a new employment space, providing opportunities for local people to work closer to home.

The land within the areas above would be developed by individual developers at varying timeframes. Each would be subject to their own environmental assessments, based on the scale and potential impact of each project. There are currently no defined plans available for the individual developments within these growth areas.

The project would traverse the South West Growth Area and service the Western Sydney Aerotropolis, and indirectly, the Western Sydney Employment Area. The project would serve and facilitate the growth by providing increased road capacity and reducing congestion and travel times in the area.

These projects are relevant to the consideration of cumulative non-Aboriginal heritage impacts as they would be located in close proximity to the project.

The timing for the construction of developments within the above-mentioned growth areas has not yet been announced. There is potential of overlaps in construction timing between some developments and the project. Should this occur the cumulative impacts would likely be minimal as the temporal aspect of impacts on heritage places does not usually add to the overall level of heritage impact. This is because once physical changes are made to a heritage place, regardless of whether they are made at the same time or separately, the impact level doesn't change.

As there has not been environmental assessment undertaken for the Growth Areas projects, it is currently unknown whether there would be cumulative non-Aboriginal heritage impacts associated with the project and the development associated with the nearby growth areas. However, it can be surmised that this area would undergo substantial changes in the near future. While individual proposals would be subject to assessment for heritage impacts and other environmental assessments, there is likely to be long term impacts that would materially change the landscape and the heritage character of this area.

9.7 Conclusion

Western Sydney is currently experiencing an unprecedented level of urban development, particularly in the areas around the new Western Sydney Airport. Alongside the airport, planned development includes urban release areas (Western Sydney Aerotropolis) as well as supporting public infrastructure investment (eg Sydney Metro Greater West and various road upgrades). Planned future development is likely to result in extensive change to the character of the existing peri-urban landscape and land use typologies.

While these projects are transformative, such extensive change is likely to generate impacts on historical heritage values associated with heritage items and landscapes associated with the historically rural nature of the region. The contribution of the M12 Motorway project to cumulative impacts on non-Aboriginal heritage in the area is minor, considering the heritage impacts are being addressed and managed through the implementation of a range of environmental management measures. These measures include archival recording, heritage interpretation integrated into the proposal and proposed landscape works. Through the heritage interpretation framework and its integration with the concept design proposal as described in Appendix G of the EIS, the project would provide a positive contribution by communicating the history of the area to users of the motorway, including those visitors using the Western Sydney Airport.

10. Environmental management measures

A Construction Cultural Heritage Management Plan (CCHMP) will be prepared for the project as part of the Construction Environment Management Plan (CEMP) in consultation with the DPC (Heritage). The CCHMP will include as a minimum:

- A list, plan and maps with GIS layers showing the location of identified heritage items both within, and in proximity to, the construction footprint
- A significance assessment and statement of significance for each item
- Protocols and procedures including inductions and toolbox talks for all contractors and subcontractors working in the area to be informed of all exclusion zones, the elements and their significance, to prevent accidental damage or encroachment
- Protocols and procedures to be implemented during construction to avoid or minimise impacts to items of heritage significance including protective fencing
- The Roads and Maritime Unexpected Heritage Items Procedure (Roads and Maritime, 2015b) which would be followed in the event that unexpected heritage finds are uncovered during construction.

A suitably qualified heritage specialist will be engaged to prepare a heritage interpretation framework to guide development of the detailed urban design for the project. This framework will be prepared in accordance with the Interpreting Heritage Places and Items Guidelines (NSW Heritage Office 2005) and will include:

- Integrations of heritage themes and values to be incorporated
- Collaboration with other design elements and themes for the project, including those associated with Western Sydney Airport and Sydney Metro Greater West, to develop an integrative design approach with surrounding development
- Opportunities for design responses for Aboriginal and non-Aboriginal heritage

Impacts to non-Aboriginal heritage items will be avoided or minimised where reasonable and feasible. Where impacts are unavoidable, works will be undertaken in accordance with the measures for individual non-Aboriginal heritage items outlined in **Table 10-1**.

A copy of this report should be provided to the appointed construction and design team to ensure that key heritage themes are elements are integrated into:

- The urban design of the project
- An interpretation framework – During detailed design an interpretation framework will be prepared to guide further development of the urban design of the project. Roads and Maritime will also investigate opportunities for collaboration with other agencies to integrate the interpretation framework and themes into surrounding development
- Master plans, or similar, prepared by owners of heritage items/properties.

A summary of the site-specific management measures discussed in **Section 8** are provided in **Table 10-1.**

Table 10-1 Environmental management measures for non-Aboriginal heritage items

Heritage item ID and name	Heritage Register Number (if applicable)	Potential impacts	Environmental Management measures
Item 1: McGarvie Smith Farm	Penrith LEP 857	The project would result in the demolition of five buildings, two sheds and a silo: • McGarvie Smith Farm 6; • McGarvie Smith Farm 7 • McGarvie Smith Farm 8 • Shed 1 • Shed 2. The entire site would be bisected.	• Roads and Maritime /Contractor to engage a suitably qualified heritage consultant to prepare an archival photographic recording of the entire site, in accordance with the DPC (Heritage) (Heritage Council of NSW 2006). This will include both buildings and landscape features such as dams, and earthworks. The recording will include a detailed map showing the location of the features. • Roads and Maritime /Contractor to investigate options to provide funding support to the property's current owner to prepare a thematic heritage study of CSIRO and other agricultural research stations, including McGarvie Smith Farm and McMaster Field Station, and other relevant agricultural research stations and similar facilities located in NSW. The thematic study will include a review of the role of such properties in veterinary research, association with agricultural, pastoral and animal husbandry groups, use of pioneering methods and practices and contribution to the development of farming in Australia. In the event that landowners do not prepare this study, Roads and Maritime will engage a heritage specialist to do so.
Item 2: The Fleurs Radio Telescope Site	Penrith LEP 832	The project would demolish one element of the Fleurs Radio Telescope site - Shain Cross (SC01), which is located within the construction footprint. Further assessment for this heritage item can be found in **Annexure A.**	• All extant elements of the radio telescopes and associated infrastructure, including rubbish mounds, situated outside the construction footprint will be left intact • Ground penetrating radar, or other remote sensing survey techniques, will be undertaken under the supervision of a suitably qualified and experienced archaeologist prior to any ground disturbance within the heritage curtilage of the Fleurs Radio Telescope Site contained within the construction footprint to identify any sub-surface cables • Measures will be included in the CCHMP to describe how the heritage values of the site will be conserved and managed during construction • Roads and Maritime will provide a copy of this report to the University of Sydney • Roads and Maritime will engage a suitably qualified heritage consultant to prepare an archival photographic recording of the impacted areas of the property, in accordance with the DPC (Heritage) guidelines (Heritage Council of NSW 2006) • The heritage interpretation framework for the project will include interpretation measures that will improve community awareness of the history of the Fleurs Radio Telescope site as well as determine suitable locations for the presentation of information that are publicly accessible.
Item 3: Luddenham Road Alignment	Penrith LEP 843	Nil	N/A

Heritage item ID and name	Heritage Register Number (if applicable)	Potential impacts	Environmental Management measures
Item 4: Upper Canal System (Pheasants Nest Weir to Prospect Reservoir	SHR 01373	The project would not destroy any sections of pipeline that are located underground. The Tunnel Shaft 4, located in the M7 central road median, would not be demolished as this location would not be subject to works.	• Relevant conservation policies outlined in the Upper Canal CMP (NSW Public Works Government Architect's Office 2016) will be incorporated into the CCHMP to ensure heritage fabric is not impacted by the project. A list of relevant policies is provided in **Section 8.4.** • The CCHMP will be consistent with and require implementation of relevant measures outlined in *The Guidelines for development adjacent to the Upper Canal and Warragamba Pipelines* (Sydney Catchment Authority 2012), which sets out guidelines for designing, planning or assessing development on land adjacent to this pipeline. Further details of measures are outlined in **Section 8.4.2** • Guidelines and associated safe working distances to be adhered to for heritage structures as outlined in Appendix K of the EIS. • A safe working distance exclusion zone will be established around the exposed tunnel air shaft in the M7 Motorway median in accordance with the process outlined by Table 3-12 in the Noise and Vibration Assessment.
Item 6: McMaster Field Station	N/A	The project would bisect the landscape of the McMaster Farm overall as the dual carriageway and interchange would be located within the property. Some modified landscape elements would be destroyed by the project. A potential construction laydown area overlaps with the complex of buildings on the property, and may be reused as construction offices and facilities.	• Roads and Maritime /Contractor will engage a suitably qualified heritage consultant to prepare an archival photographic recording of the impacted area, in accordance with the Heritage Division of the DPC (Heritage) guidelines (Heritage Council of NSW 2006). This will include both buildings and landscape features such as dams, and earthworks. The recording will include a detailed map showing the location of the features. • Roads and Maritime /Contractor will investigate options to provide funding support to the property's current owner to prepare a thematic heritage study of CSIRO and other agricultural research stations, including McGarvie Smith Farm and McMaster Field Station, and other relevant agricultural research stations, and similar facilities located in NSW. The thematic study will include a review of the role of such properties in veterinary research, association with agricultural, pastoral and animal husbandry groups, use of pioneering methods and practices, and contribution to the development of farming in NSW and Australia. In the event that landowners do not prepare this study, Roads and Maritime will engage a heritage specialist to do so. • An potential use zone will be established around the McMaster Farm group of buildings, including a suitable buffer zone, and no construction activities will take place within this zone. This zone will be incorporated into the CCHMP. The potential use zone will include safe working distances to be adhered to for heritage structures as outlined in Appendix K of the EIS. Prior to occupying or utilising the buildings, a dilapidation survey will be carried out and a heritage architect will be engaged to advise on proposed modifications and management measures to avoid and minimise impact to the buildings.

Heritage item ID and name	Heritage Register Number (if applicable)	Potential impacts	Environmental Management measures
Item 7: Fleurs Aerodrome	N/A	The proposed construction footprint would bisect the previous runway to the north of the existing runway. A remnant metal object is located 13 m south of the construction footprint and is unlikely to be impacted by the project. The metal structure (13 metres south of the construction footprint) and other sections of the Fleurs Aerodrome outside the construction footprint would not be subject to direct impacts from the project but may be inadvertently or accidently damaged during construction from vehicles or machinery in the vicinity.	• Roads and Maritime /Contractor to engage a suitably qualified heritage consultant to prepare an archival photographic recording of the impacted area prior to its disturbance, in accordance with the DPC (Heritage) guidelines (Heritage Council of NSW 2006). The recording will include a detailed map showing the location of the features. • An interpretive framework developed for the project will include consideration of elements to enable the continued interpretation and understanding of the airstrip at Fleurs Aerodrome as a linear and continuous element. This will be carried out in consultation with Department of Defence and consider opportunities for involvement of veterans groups. • Relevant guidelines and associated safe working distances will be adhered to for remaining heritage structures as outlined in the Appendix K of the EIS.
Item 8: Cecil Park School, Post Office and Church Site	N/A	The project would physically disturb and destroy the area of archaeological potential through ground disturbance activities.	Archaeological test excavation of the former Cecil Park historical complex has been conducted in accordance with the Archaeological Research Design included in **Annexure B** to this report. The archaeological excavation was conducted under the supervision of a suitably qualified and experienced historical archaeologist who fulfils the DPC (Heritage) Excavation Director Criteria. The results of the archaeological test excavation informed the following measures. • Roads and Maritime will liaise with local museums and/or historical societies to arrange a long-term secure artefact repository for the artefact assemblage. Once that arrangement has been made, DPC (Heritage) must be notified for their records. In the short term, Roads and Maritime must provide secure short-term secure storage for the assemblage. • An Archaeological Research Design (ARD) for archaeological salvage of the former historical complex will be prepared and implemented prior to construction commencing by a suitably qualified historical archaeologist who fulfils the Heritage Council's *Excavation Director Criteria* to conduct open area excavation of a locally significant archaeological site. The ARD will include a revised impact assessment, revised research questions and a methodology to ensure archaeological relics within the project construction footprint are adequately investigated in accordance with standard NSW archaeological practice.

Heritage item ID and name	Heritage Register Number (if applicable)	Potential impacts	Environmental Management measures
Item 10: Exeter Farm Archaeological site	N/A	The item is within 50 metres of the southern boundary of the project and would therefore not be directly impacted. This is based on the assumption that all vehicle movements, compounds, etc. will be confined to the area within the construction footprint.	N/A
Item 12: South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	N/A	There would be no direct physical impacts on the heritage item, the visual impacts have been minimised as much as possible through project design, and the hydrological impacts are minor and localised.	• Management measures identified in the project Urban design, landscape character and visual impact assessment report (Appendix G of the EIS) will be implemented during detailed design to minimise impacts on landscape and vistas. • Flooding management measures (F01 to F08) identified by the Flooding assessment report (Appendix L of the EIS) and surface water quality and hydrology management measures (SWH01 to SWH13) in the Surface water quality and hydrology assessment report (Appendix M of the EIS) will be implemented to reduce broader impacts to the surrounding scenic landscape.

11. Conclusion

An initial review of existing research and previous heritage studies identified 13 heritage items and potential heritage items within the study area. Following a comparative analysis, only nine heritage items have been assessed as having either local, State or National heritage significance. Four of the nine heritage items are already registered; three on the Penrith LEP and one heritage item on both the SHR and the Liverpool LEP. The remaining five heritage items have not been previously registered. Four of these five heritage items were assessed as of Local significance and one heritage item as of State significance.

There were limited options to avoid impacts to these four non-Aboriginal heritage items. The concept design for the M12 Motorway was developed through a multi-disciplinary process that identified and assessed a number of potential road corridor options against a wide range of engineering, environmental, social, land use and economic criteria. This process, which is documented in Chapter 4 of the EIS, ultimately determined that the project's design as currently proposed, represented the best balance after a multi-criteria analysis of all of the known constraints and opportunities.

Site-specific management measures would be applied at heritage sites that have been identified as being subject to impact generated by project activities. Management measures are provided in **Chapter 11** and include archival photographic recording, protective fencing, exclusion zones, interpretive strategies and archaeological salvage excavation. Site specific management measures would be further described in the CHMP that would be developed for the project.

Following the implementation of management measures, the project would impact on five of the nine heritage items identified; a major impact on four items and a minor impact on one item. The project was assessed as having a negligible impact on the remaining four heritage items.

A summary of the significance and level of impact for non-Aboriginal heritage items is provided in **Table 11-1**. A map showing the location and significance of the non-Aboriginal heritage items is provided in **Figure 6-93**.

Table 11-1 Summary of non-Aboriginal heritage items within the study area

Heritage item number	Heritage item name	Register number	Significance level	Level of impact after mitigation
1	McGarvie Smith Farm	Penrith LEP 857	Listed under Penrith LEP as Local, but assessed as State	Major
2	The Fleurs Radio Telescope Site	Penrith LEP 832	Listed under Penrith LEP as Local, but assessed as State and potentially National	Minor
3	Luddenham Road Alignment	Penrith LEP 843	Listed under Penrith LEP as Local	Negligible
4	Upper Canal System	SHR 01373, Liverpool LEP	Listed on SHR as State Listed under Liverpool LEP as Local	Negligible
6	McMaster Field Station/McMaster Farm	N/A	Not currently listed but assessed in this report as State	Major
7	Fleurs Aerodrome	N/A	Not currently listed but assessed in this report as Local	Major
8	Cecil Park School, Post Office and Church Site	N/A	Not currently listed but assessed in this report as Local	Major
10	Exeter Farm Archaeological Site	N/A	Not currently listed but assessed in this report as Local	Negligible
12	South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	N/A	Not currently listed but assessed in this report as Local	Negligible

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Electoral rolls

1930 Commonwealth Division of Werriwa, State Electoral District of Nepean, Subdivision of Ingleburn
1935 Commonwealth Division of Werriwa, State Electoral District of Nepean, Subdivision of Ingleburn
1937 Commonwealth Division of Werriwa, State Electoral District of Nepean, Subdivision of Ingleburn
1943 Commonwealth Division of Werriwa, State Electoral District of Nepean, Subdivision of Ingleburn

Annexure A. A Heritage Survey of the Fleurs Radio Telescope Field Site, Badgerys Creek, NSW (Gorman 2018)

Prepared for

Jacobs Arcadis Joint Venture

Report Title

A Heritage Survey of the Fleurs Radiotelescope Field Site, Badgerys Creek, NSW

Author

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5 March 2018

WALLIS HERITAGE CONSULTING

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LIST OF ACRONYMS

ATNF	Australian Telescope National Facility
CDSCC	Canberra Deep Space Communication Complex
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Research Organisation
DCP	Development Control Plan
EIS	Environmental Impact Statement
FST	Fleurs Synthesis Telescope
GPS	Global Positioning System
GRT	Giant Radio Telescope
IAU	International Astronomical Union
ISEPP	Infrastructure State Environment Planning Policy
LEP	Local Environment Plan
LGA	Local Government Area
MSH	Mills, Slee and Hill
NMA	National Museum of Australia
NOHC	Navin Officer Heritage Consultants
NSW	New South Wales
OEH	Office of Environment and Heritage
RAAF	Royal Australian Air Force
RMS	Roads and Maritime Services
SETI	Search for Extraterrestrial Intelligence
SHEVE	Southern Hemisphere VLBI (Very Long Baseline Interferometry) Experiment
SOHI	Statement of Heritage Impact
SOW	Scope of Works
SNR	Supernova remnant
SWPLRA	South West Priority Land Release Area
URSI	International Union of Radio Science
WHC	Wallis Heritage Consulting
WHL	World Heritage List
WSIP	Western Sydney Infrastructure Plan
WSPGA	Western Sydney Priority Growth Area

ACKNOWLEDGEMENTS

Thanks to Dr Phil Crosby (CSIRO), Dr John Bunton (CSIRO), and Dr Jonathan McDowell (Harvard-Smithsonian Center for Astrophysics, USA) for useful discussions about antenna technology, and Tim Colman, Karen Murphy and Denis Gojak for their useful comments and feedback.

EXECUTIVE SUMMARY

The Australian and NSW governments are funding the Western Sydney Infrastructure Plan, a 10 year, $3.6 billion road investment program for western Sydney. The Plan will deliver new and upgraded roads to support integrated transport in the region, and capitalise on the economic benefits from developing the planned western Sydney airport at Badgerys Creek.

As part of the plan, NSW Roads and Maritime Services (Roads and Maritime) is proposing to build the M12 Motorway to provide direct access to the planned western Sydney airport at Badgerys Creek and Sydney's motorway network. The proposed M12 Motorway would run east-west between the M7 Motorway, Cecil Hills and The Northern Road, Luddenham: a distance of about 16 km.

The preferred route corridor passes through the southern portion of a former Commonwealth Scientific and Research Organisation (CSIRO)/University of Sydney research site. The Fleurs field site was the location of four innovative antennas that were an integral part of Australia's post-war leadership in the then new field of radioastronomy; these were the Mills Cross, Chris Cross, Shain Cross and Fleurs Synthesis Telescope (FST). Fleurs is listed in the Penrith Local Environment Plan as a site of local significance.

A survey of non-Aboriginal heritage, conducted as part of the route options study in 2016, identified the Fleurs site as potentially having significance at a State or National level and recommended further investigation. The survey reported herein was undertaken on 20–21 October 2017 to contribute to a Statement of Heritage Impact (SOHI), in support of an Environmental Impact Statement (EIS) being prepared for the M12 Motorway by the Jacobs-Arcadis Joint Venture.

The following features belonging to the various antennas were identified in the survey:

- *Mills Cross*: no intact structures remain, but materials from the telescope are likely distributed between the Rubbish Mounds RB1, RB2, RB3, RB5 and RB9;
- *Chris Cross:* no intact structures remain, but materials from the telescope are likely distributed between the Chris Cross artefact scatter, RB1, RB6 and RB9;
- *Shain Cross*: SC01–SC07 are intact elements of the Shain Cross in their original location. Further elements are likely present in the Rubbish Munds RB8 and RB9; and,
- *Fleurs Synthesis Telescope*: three antenna locations and two extant antennas were identified at South Creek 1 and 2 Antenna Complexes and the North Antenna Complex.

The survey found that one element of the Shain Cross (SC01) may be impacted by the Motorway development. A set of installations at the South Creek 2 Antenna Complex, including an antenna from the FST, are also within the corridor. Other remaining antenna infrastructure is not directly impacted but requires further consideration, including a standing FST antenna in the north of the site (North Antenna complex) and an intact portion of the Shain Cross (SC02–SC07). Both FST antennas are in situ but in poor condition.

The site is considered to have State and potentially National significance demonstrating ground-breaking scientific discoveries, leading to revisions of our understanding of the origins of the universe, and as evidence of locally designed instruments contributing to Australia's pre-eminence in the international development of radioastronomy. While the elements are in poor condition, they are rare surviving examples of cross antenna types. There is renewed interest in the history of radioastronomy due to Australia's key role in the Square Kilometre Array, to which the Fleurs antennas can be considered historical precursors. The elements are considered to have outstanding interpretive potential.

It is recommended that:

- All extant elements of the radiotelescopes and associated infrastructure, including rubbish mounds, are to be left intact;
- SC01 should be left in situ and a buffer 50 m in diameter maintained around it. No vehicle entry or road construction activities should take place within this zone;

- At South Creek Antenna Complex 1 the signal box, trench, plinths and cables are not disturbed and left in situ. A 25 m buffer zone should be maintained around the site. No vehicle entry or road construction activities should take place within this zone;
- At South Creek Antenna Complex 2, the power structure, signal box and antenna are not disturbed and left intact. A 25 m buffer zone should be maintained around the site. No vehicle entry or road construction activities should take place within this zone;
- Ground penetrating radar, or other remote sensing survey techniques, should precede any ground disturbance;
- A heritage sub-plan should be prepared to describe how the heritage values of the site will be conserved and managed during the construction of the road;
- Contractors and subcontractors working in the area must be informed of the buffer zones, the elements and their significance, in order to prevent accidental damage or encroachment;
- A Conservation Management Plan should be made for the entire Fleurs Field Site; and,
- The University of Sydney seek advice about the process of nominating the site to the State Heritage Register.

Recommended whole-of-site heritage conservation and management issues are as follows:

- This technical heritage assessment is to be shared with other owners of the former Fleurs site;
- A Conservation Management Plan for the entire Fleurs site should be prepared;
- Urgent assessment of the structural condition of the North Antenna is required;
- The North Antenna and Shain Cross are preserved as a significant scientific cultural landscape;
- The rubbish mounds should NOT be cleaned up without an assessment and attempt to relate materials to the different antennas. The 'rubbish' is significant fabric, and could be used to reconstruct parts of the antennas for educational or interpretive purposes;
- The antenna fabric preserved in the rubbish mounds should be considered for re-use within new residential or business developments;
- Social significance to the local community and to the astronomical community should be further explored through an oral history program, for example, with scientists such as John Bunton who worked on the FST;
- Further work should be undertaken at the ATNF Historic Photograph Archives, which contains approximately 50,000 images from 1939 onwards (Orchiston 2001:12);
- Consultation should occur with the International Astronomical Union Working Group on Historic Radio Astronomy as a group which represents stakeholders with a close relationship to the Fleurs site; and,
- Assessment be undertaken to determine if Fleurs meets the criteria for National Heritage Listing.

INTRODUCTION

The M12 Motorway Development

The Western Sydney Infrastructure Plan (WSIP), a joint initiative between the Australian and NSW governments, is a 10 year, $3.6 billion road investment program to support economic benefits arising from the construction of a new airport at Badgerys Creek. As part of the plan, Roads and Maritime Services (RMS) is proposing a new motorway, the M12, to provide direct access between the new airport and Sydney's motorway network. The draft airport plan has the M12 Motorway as the main access route for a predicted 47,000 passenger and employee trips a day (Australian Govt et al. 2016:5–6).

In addition to the increased traffic arising from the airport, future development in the Western Sydney Priority Growth Area (WSPGA) and South West Priority Land Release Area (SWPLRA) is anticipated to generate higher traffic and freight requirements (Australian Govt et al. 2016:5). Over the next 30 years, the WSPGA is expected to provide 57,000 new jobs. The SWPLRA consists of 18 residential precincts with 110,000 new dwellings and a predicted further 20,000 jobs (Australian Govt et al. 2016:5).

The M12 motorway will replace Elizabeth Drive as the main arterial corridor for the area (Australian Govt et al. 2016:8). The proposed route runs 16 km east-west between the M7 Motorway, Cecil Hills and The Northern Road, Luddenham (Australian Govt et al. 2016:i). The motorway is planned to have four lanes with the scope to upgrade to six lanes as required (Australian Govt et al. 2016:5), with a corridor of 100–150 m (Australian Govt et al. 2016:iii).

The preferred corridor route passes through the south of the former Fleurs radiotelescope site immediately to the east of South Creek (Australian Govt et al. 2016:iii). Fleurs is located at 885(a) Mamre Road, on Lot 21 DP 258414. This specialist technical heritage assessment contributes to the Statement of Heritage Impact (SOHI) being prepared to support the M12 Motorway Environmental Impact Statement (EIS).

The Study Area

Environment

The study area is located on the Cumberland Plain and is dissected by creeks and minor channels that flow from south to north (Australian Govt et al. 2016:55). The channels and floodplains of the Cumberland Plain are mostly South Creek alluvial soils, often several metres deep. Leaching has also created red and yellow podzolic soils in the floodplain terraces (Australian Govt et al. 2016:55).

The topography of the Fleurs site is predominantly floodplain bordered by South Creek and Kemps Creek, a major tributary of South Creek (Australian Govt et al. 2016:10, 60). The area is subject to localised flooding (Australian Govt et al. 2016:60). Flood mitigation measures have reduced the impacts of local flooding of South Creek.

Land Use History

Land use in the broader area is semi-rural and residential, with agricultural, recreational, commercial and industrial activities. Agricultural and commercial activities include poultry farming, cattle and sheep grazing, horticulture and commercial nurseries (Australian Govt et al. 2016:10). Recreational land use includes sporting clubs, bike trails and nature reserves. Landfill and quarry sites are located near Fleurs on Elizabeth Drive.

The area around the Fleurs site is predominantly grazing and farmhouses (Figure 3-4 in Australian Govt et al. 2016:36). Land use is zoned LCZ3 – Low lying rural/commercial (Figure 3-11 in Australian Govt et al. 2016:72).

Fleurs was originally part of Bayly Park, established in the early 1800s by Rum Corps officer Nicholas

Bayly, who cleared the property of vegetation (Stacker 2002). In 1823, part of the original property was sold to merchant Richard Jones, who named it Fleurs. A full historical background of the Fleurs site is given in Australian Govt et al. (2016:21–23).

In World War II (WWII) the Royal Australian Air Force (RAAF) Station Fleurs aerodrome was constructed at the southern end of the area. From 1949–1956 the aerodrome was used by the NSW Gliding Association.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO; formerly CSIR or Council for Scientific and Industrial Research) acquired the Fleurs property in 1954 as a scientific field site for radioastronomy. Subsequently it was purchased by the University of Sydney in 1963. Mr James Rendall (University of Sydney) advised that the land had recently been ploughed and sown, and cattle and sheep grazing is ongoing. Horses from the nearby stud farm also sometimes grazed there (illegally).

Previous Heritage Studies

Heritage assessments in the region have been carried out since the late 1970s, but Australian Govt et al. (2016:24) noted that few have focused on non-Aboriginal heritage. The most relevant are described below.

South Creek Valley Heritage Study by Perumal Murphy (1990)

The South Creek Heritage Study by Perumal Murphy (1990) included the Fleurs site in the L27 Heritage Landscape (Figure 1). Australian Govt et al. (2016:27) noted that the values of heritage landscapes in the study:

> … relate to the presence of remnant native vegetation, habitat quality, and aesthetics. As such, their status as items of cultural heritage remains largely unstated, though pinned on their aesthetic role within what is a broader cultural landscape.

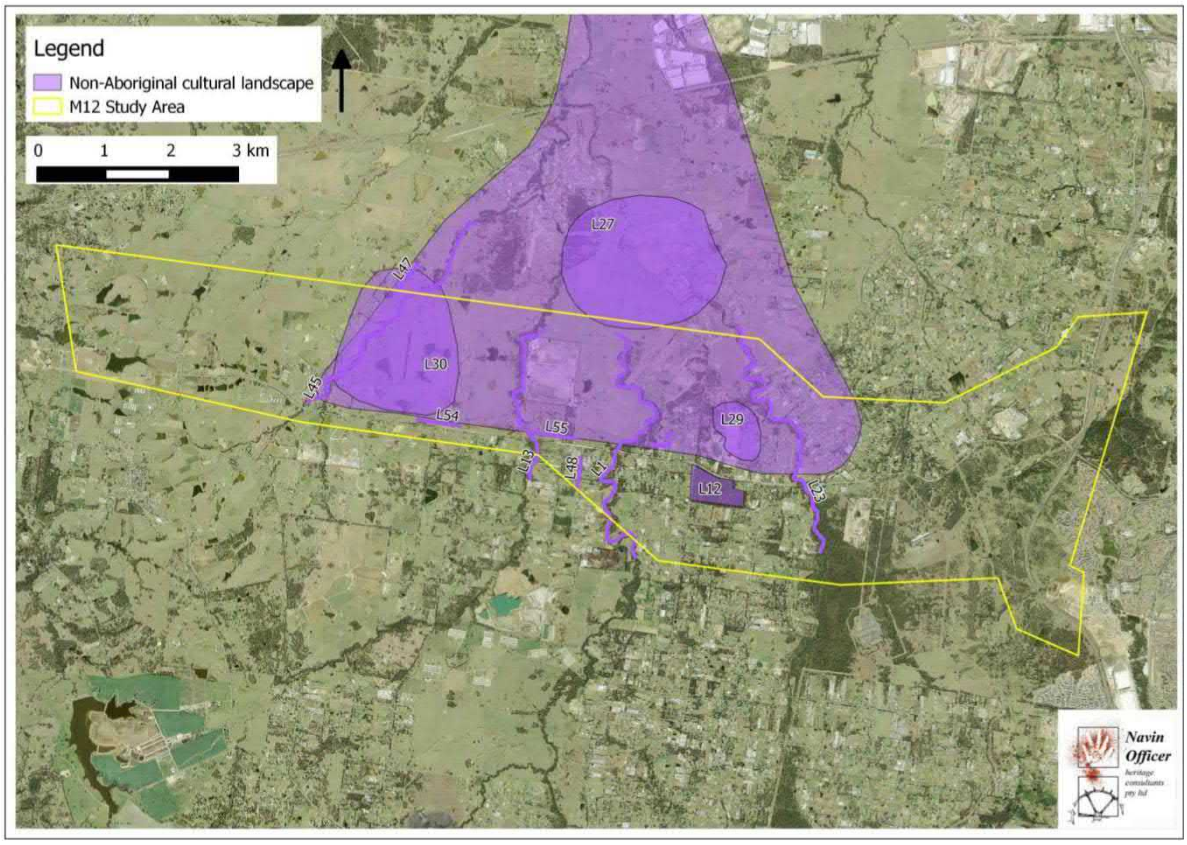

Figure 1 Map of L27 Heritage Landscape (purple area) from Perumal Murphy (1990).

The L27 Heritage Landscape incorporates weirs at the confluence of Badgerys, Kemps and South Creeks as part of a scenic landscape. Although the L27 area in Figure 1 incorporates Fleurs, the study did not identify any infrastructure related to the Fleurs radiotelescopes as contributing to the values of the landscape.

Australian Govt et al. (2016)

As part of the M12 Motorway Strategic Route Options Analysis, a desktop study and field validation of Aboriginal and non-Aboriginal heritage was carried out by Travis Gottschutzke and Rebecca Varto from Navin Officer Heritage Consultants (NOHC) and included as an appendix in Australia Govt et al. (2016).

To identify non-Aboriginal heritage in the shortlisted route alignments for the M12 Motorway the following relevant heritage lists were searched:

- Roads and Maritime s170 Heritage and Conservation Register
- World Heritage List (sourced from Australian Heritage Database)
- National Heritage List (sourced from Australian Heritage Database)
- Commonwealth Heritage List (sourced from Australian Heritage Database)
- NSW State Heritage Register (sourced from State Heritage Inventory)
- Penrith Local Environment Plan (LEP) 2010 (sourced from State Heritage Inventory)
- Register of the National Trust of Australia NSW
- Royal Australian Institute of Architects 20th Century Register of Significant Buildings
- Heritage Study of the City of Penrith (1991) (sourced from the National Library of Australia, ACT)
- The South Creek Valley Heritage Study (1990).

Fleurs was listed on the Penrith Local Environment Plan (LEP) 2010 but does not appear on any other registers. Table 3.4 in Australian Govt et al. (2016:31) identified Fleurs as a scientific/educational property of local significance within the Penrith Local Government Area (LGA).

Part of the brief for the Australian Govt et al. (2016:iii) study was to "If impacted undertake a detailed assessment of the heritage significance of the Fleurs Radio Telescope Arrays".

The field survey for non-Aboriginal heritage was undertaken in March 2016. Gottschutzke and Varto targeted only areas likely to be impacted by the preferred M12 Motorway options (Australian Government et al. 2016:57; Figure 2). They found that:

> Only the southern extent of the telescopes fall within one of the options for the motorway, the other parts of this telescope are outside the footprint. However, a dish, possibly belonging to the Shain Cross' western extent, falls within the northern option. Structures were observed within the space outside the footprint option for the motorway, but due to limitations about access these were not further investigated. It was unable to be confirmed that they were telescope related infrastructure at the time …

They noted that a standing dish antenna was fenced off (Australian Govt et al. 2016:57) and also observed a fallen dish, mistakenly attributing it to the Shain Cross.

The survey also identified the World War II Fleurs aerodrome as a potential heritage site (Australian Govt et al. 2016:32). Some 'rudimentary structures overgrown with vegetation' were observed, but it was not clear if they were associated with the aerodrome or with the Fleurs radiotelescopes (Australian Govt et al. 2016:64).

As the integrity of the site and the condition of the telescopes had deteriorated since the closure of the facility, and the limited time available did not allow a full assessment, Australian Govt et al. (2016:58) recommended further archaeological and historical research to establish the significance of the site and future options. Their provisional significance assessment was that the site may have

State or National level but the poor condition of the remains is problematic (Table 4-3 in Australian Govt et al. 2016:72).

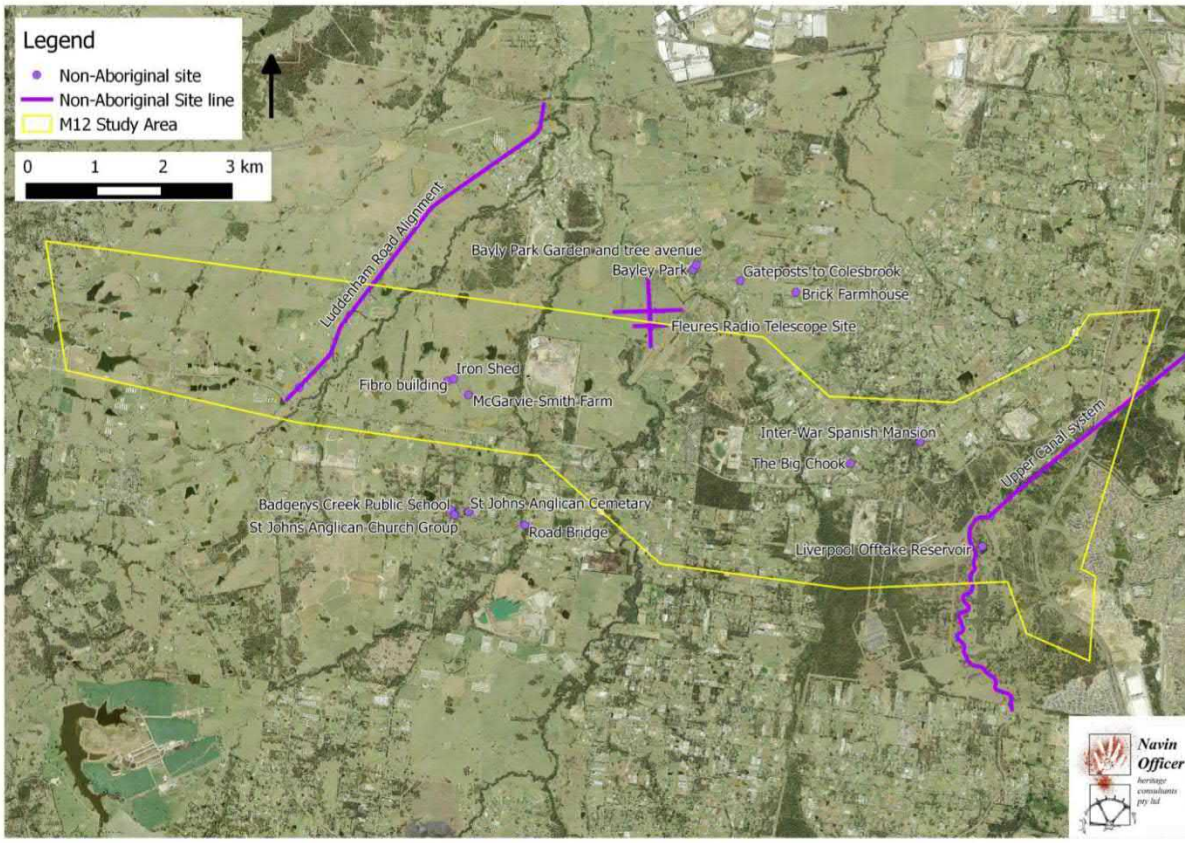

Figure 2 Antenna arrays in relationship to the M12 corridor (from Australian Govt et al. 2016).

NOHC (2016) concluded that:

> Although the site of the Fleurs radio telescope arrays is listed on the Penrith Local Environmental Plan 2010 and recognised for its local significance, it may be of greater historical significance. Between 1954 and 1963, Fleurs was the leading field station of the CSIRO's Division of Radiophysics, and was home to three innovative cross-type radio telescopes, the Mills Cross, Shain Cross and the Chris Cross. The Chris Cross was the world's first cross-grating interferometer and the first radio telescope to provide a two-dimensional daily map of the Sun (Orchiston 2004a). Members of the Australian astronomical community consider the site to be historically important. It is likely that the site is of national significance, and it therefore requires further assessment. (Australian Govt et al.2016:30)

Relevant recommendations from Australian Govt et al. (2016:97–98) were to:

- Conduct a comprehensive archaeological field survey across the preferred route alignment with emphasis on areas not included in the coverage achieved in the shortlisted route survey;
- Undertake significance assessment and potential impact assessments of each heritage recording that may be impacted by the project. Based on these assessments, determine appropriate strategies for the avoidance and/or the mitigation of those impacts;
- If impacted undertake a detailed assessment of the heritage significance of the Fleurs Radio Telescope Arrays; and,
- Conduct a program of further historical background research, as necessary, on heritage items subject to potential directly impact by the project.

Current Legislative Requirements

Fleurs is listed in Schedule 5 Environmental Heritage Part I Cultural Heritage of the Penrith LEP 2010 (under the *Environmental Planning and Assessment Act 1979*). Development consent from Penrith Council is required to alter or demolish places in Schedule 5 of the Penrith LEP.

The Penrith Development Control Plan (DCP) 2014 applies to heritage items on Schedule 5 of the Penrith LEP and land in the vicinity of these heritage items (2014:C7-2). The Penrith DCP notes that:

> … a heritage building does not have to be completely intact or in good condition for it to be of heritage significance. Rather, it is the building's ability to demonstrate the above criteria and historical themes that is important (2014 C7-2).

As the M12 Motorway Project is being assessed under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (as State significant infrastructure), the provisions of the Penrith LEP are superseded by the requirements of the Infrastructure State Environment Planning Policy (ISEPP).

Definition: antenna

An antenna is a metallic structure that captures and/or transmits radio electromagnetic waves (NASA 2012).

HISTORICAL BACKGROUND: FLEURS AND THE DEVELOPMENT OF RADIOASTRONOMY

For most of human existence, light visible to the naked eye was the principal means of studying the heavens. When radioastronomy emerged after World War II in 1945, it redefined not only astronomy, but also what we think of as telescopes (Munns 2013:2) and how we understand the cosmos. Australia was, and remains, a world leader in radioastronomy.

Origins of Radio Astronomy

The field of radioastronomy originated in 1932 when Karl Jansky, a researcher at Bell Telephone Company in the USA, designed a unique antenna array (Figure 3) and discovered the galactic background radio emission, establishing for the first time that significant components of the universe lay outside optical wavelengths (Garcia et al. 2006:21). His early results in 1931 showed that the sun was emitting radio waves (Grant 1950:7).

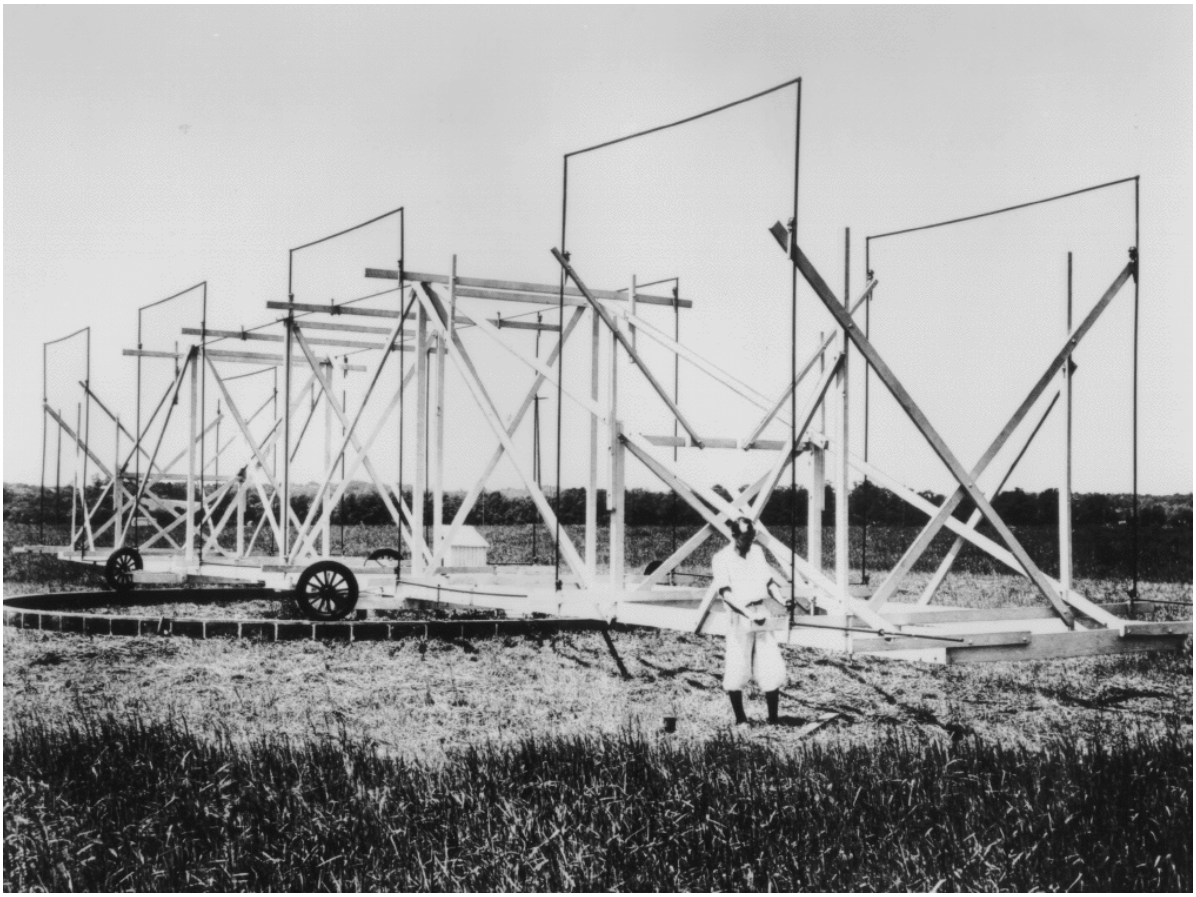

Figure 3 Jansky's original antenna at Bell Labs, Holmdel.

However, by 1932 his observations appeared to show that some radio signals of unknown origin were from the centre of the Milky Way galaxy in the region of Sagittarius. His results were published in 1933 as 'Electrical disturbances apparently of extra-terrestrial origin' (Jansky 1933). This paper demonstrated, as Australian physicist Kerr Grant put it, 'the hitherto unsuspected fact that our planet receives continuously a stream of wireless signals from the world beyond, the study of which opens a new window to our vision of the cosmos' (1950:7). The impact of this discovery was:

> … sudden and spectacular. The eminent Dutch astronomer Jan Oort announced in his lectures that he considered the opening of the heavens by the radio telescope to be as revolutionary as Galileo's first observations with an optical telescope. (Munns 2013:2)

Inspired by the possibilities, in 1937 Grote Reber pioneered another antenna type that would come to play a dominant role in radioastronomy: the parabolic dish, so familiar to us now through telescopes like Parkes, Jodrell Bank and even domestic satellite dishes (Gorman 2009:175).

The onset of World War II in 1939 put a halt to the pursuit of celestial radio waves, but added a significant new strand to the technology and expertise available to do it. The development of radar, together with the researchers and technicians who pioneered this technology, would play a key role in spectacular development of the new discipline of radioastronomy in the 1940s and 1950s.

The movement of astronomy beyond optical wavelengths led to the realisation that the universe contained far more than had ever been suspected. The early radioastronomers discovered new cosmic features such as 'radio stars'. At first, these radio stars did not seem to correlate with any visible celestial body. Eventually it was determined that many corresponded to distant galaxies, too far away to be visible through existing telescopes. Thus radioastronomy radically extended our knowledge of the extent of the universe, and contributed to cosmological theories about its origins and ultimate death. By 'listening' to radio waves, astronomers discovered 'the eruptive solar corona, radio galaxies, the structure of the Milky Way, quasars, black holes, pulsars, dark matter and the relic radiation from the big bang' (Frater et al. 2013:2).

Radioastronomy offered another possibility too. In 'Searching for Interstellar Communications', published in *Nature* in 1959, the physicists Cocconi and Morrison (1959) reflected on the reception of natural radio signals from space and argued that sentient beings would likely transmit messages for others using the hydrogen frequency of 1420 MHz, as this was the frequency other radioastronomers would be monitoring (Kaplan 2009). At this time Frank Drake was helping establish the National Radio Astronomy Observatory at Green Bank, Virginia, with its 26 m dish. His experiment, using the new dish to look for hydrogen, was the origins of the program now known as the Search for Extraterrestrial Intelligence (SETI; Kaplan 2009), of which Carl Sagan was the most renowned proponent.

The new generation of radio telescopes didn't look like their optical cousins, with lenses, reflectors and domes. They didn't need clear skies, as they could operate through rain and shine. Their relationship was more with the radio antennas previously used for terrestrial and domestic radio reception. The antennas were metal constructions, often tall, spidery and spiky. Sometimes they used the surface of the Earth itself as part of their structure, and even the surface of the sea, to reflect and focus the radiowaves from outer space. The movement of the Earth was also incorporated into the data collected and analysed. Hence these antennas were much more complex than the visible infrastructure alone.

As a result of its involvement in radar research, Australia was at the forefront of global radioastronomy, developing new antenna types that were adopted internationally, and contributing data to the great debates about the origins of universe. Much of this happened in odd corners and small paddocks scattered about the greater Sydney region.

The Division of Radiophysics and Early Antennas

Radar research was the foundation of the new field of radioastronomy and many of the early Australian radioastronomers came from this background. The Commonwealth Council for Scientific and Industrial Research (CSIR; later CSIRO) established the Radiophysics Laboratory immediately prior to WWII at the University of Sydney, to develop radar for use in the Pacific region (Davies 2009:4). Its staff included J.L. Pawsey, Ruby Payne-Scott and Charles (Alex) Shain, all of whom would go on to conduct ground-breaking research in radioastronomy. Pawsey and Payne-Scott made the first radioastronomical observations in Australia in 1944 (Goss 2011:13).

In 1945, Pawsey, Payne-Scott and L.L. McCready used the RAAF radar unit at Collaroy to detect solar radio emissions, and this was a critical factor in continuing the Radiophysics Laboratory at the end of WWII (Davies 2009:9). In 1946 the group created a radio interferometer using the surface of the sea as a reflector at Dover Heights. Their second critical breakthrough was suggesting 'for the first time,

the principles of aperture synthesis using the method of Fourier summation' (Goss 2011:12). This formed the mathematical underpinnings of the field of radioastronomy.

In 1946, Bruce Slee joined the Division of Radiophysics (Orchiston 2004b:24) and the Welsh radar pioneer Edward 'Taffy' Bowen was appointed its Chief. Bowen continued the focus on solar radio emissions, which were critical in understanding the ionosphere. In the meantime, Pawsey and his team were looking further afield, locating, in addition to Jansky's radio source in the centre of the Milky Way, several other powerful sources.

The Division operated from a number of field stations around the Sydney and broader region (Figure 4). These included Dover Heights, Potts Hill, Dapto (near Wollongong), Badgerys Creek, Georges Heights (on Middle Head), Hornsby Valley, Murraybank and Penrith (Orchiston 2001:12). A three-dish interferometer was located at Badgerys Creek, but the field station was short-lived (Orchiston 2001:13).

Shain, Payne-Scott, Frank Kerr and Charlie Higgins were working at the Hornsby Valley field site in 1947–1948, bouncing radio signals off the Moon (Orchiston and Slee 2005:14). An unexpected result was demonstrating that the surface of the Moon was rough rather than smooth (Orchiston and Slee 2005:14). In 1949 Shain and Charlie Higgins built an 18.3 MHz antenna using 'eight half-wave dipoles strung between four rows of telegraph poles with the ground serving as a reflector, and used this novel radio telescope to investigate galactic emission' (Orchiston and Slee 2005:14). Unbeknownst to them, the antenna was picking up radio emissions from Jupiter; but these were dismissed as terrestrial interference until Burke and Franklin reported their detection of Jupiter radio waves in 1955 (Orchiston and Slee 2005:15). Shain's array was expanded and rearranged at least twice, and re-configured from 18.3 MHz to 9.15 MHz.

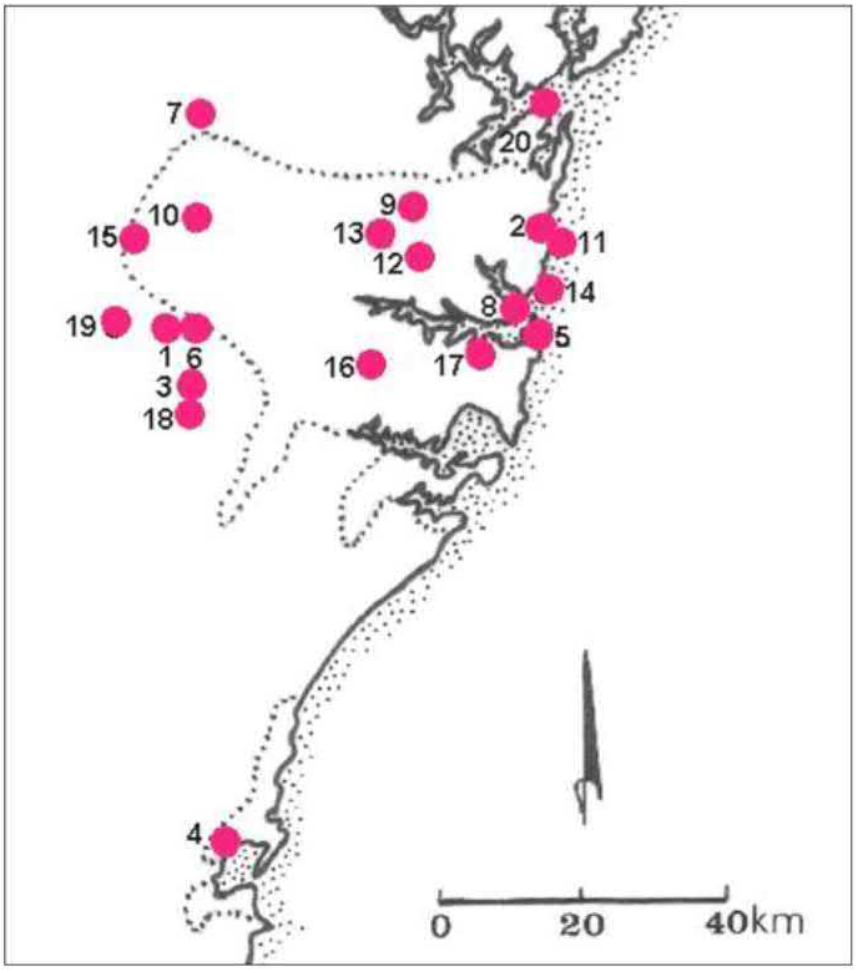

Figure 4 Locations of field sites 1945–1965, including Fleurs at 6 (from Orchiston et al. 2015).

In 1948, W.N. 'Chris' Christiansen from Amalgamated Wireless (Australasia) Pty Ltd, where he was a specialist in aerials, joined the team. Bernard Mills, studying for his Masters degree at the University of Sydney, also arrived this year. Christiansen's initial project in 1948–1949 was observation of partial solar eclipses with Mills and D.E. Yabsley (Frater and Goss 2011:218; Orchiston and Mathewson 2009:11). The shortcomings of the old wartime equipment available for the experiment led him to develop a 'grating array' in 1951 (Frater and Goss 2011:218).

CSIR became CSIRO in 1949. From the 1950s, Pawsey was Assistant Chief of the Division. In this role he supervised construction projects across the field sites (often bringing lamingtons for his staff; Davies 2009:5). There were innovative antenna constructions happening at several field sites, initiated by Shain, Christiansen and Mills.

Christiansen developed a cross grating array for solar research at Potts Hill in 1952–1953 (Orchiston and Mathewson 2009:11). Its purpose was to map the distribution of radio emissions across the face of the sun at 1420 MHz (Orchiston and Mathewson 2009:11). The array consisted of 32 parabolic reflectors (dishes) that were steered by hand (Ekers 2011). A Columbo Plan scientist from India, Govind Swarup, worked with Christiansen at this time and spearheaded a long collaboration with Indian radioastronomers (Frater and Goss 2011:218). When the grating array was no longer used, Pawsey and Christiansen arranged for it to be sent to India.

The Mills Cross was the brainchild of Bernard Mills (Orchiston 2004a:157). The cross configuration created the equivalent of a single circular antenna the length of the arms. He built a prototype of his Mills Cross interferometer from chicken wire and wooden posts at Potts Hill (Frater et al. 2013:7; Orchiston 2001:13) and tested it in 1953; it was successful. While the antenna was not used to monitor Jovian emissions, it did play a critical role in that ground-breaking discovery. The Seneca Mills Cross antenna (Maryland, USA) used by Burke and Franklin to identify Jupiter as the source of the mysterious radio noise in 1955, was based on Mills and Little's 1953 description of the Mills Cross principles (Garcia et al. 2006; Mills and Little 1953).

A milestone was the International Union of Radio Science (URSI) 10th General Assembly held at the University of Sydney in 1952, as a result of the remarkable achievements made in radioastronomy in Australia (Goss 2014:412). This was an important conference for the Division of Radiophysics. It was the first time an international scientific union had met outside Europe or the USA, and many leading radioastronomers braved the long ship passage to come over (Orchiston 2004b:67). The delegates visited both Potts Hill, where they saw Christiansen's interferometer and the early Mills Cross, and the Hornsby Valley sites to see Shain's array (Orchiston and Slee 2014:15). As a result, Christiansen was invited to work in France at the Meudon Observatory (Frater and Goss 2011:219).

The success of these prototype antennas created a dilemma, as the existing field sites were not big enough to develop them further. Mills and Shain both needed more flat space to take their antennas to the next level (Frater et al. 2013:8; Orchiston and Slee 2005). Shain suggested Badgerys Creek—but the most suitable site was located at the former Fleurs property.

The Fleurs Field Station

The Fleurs site was established in 1953 (Frater et al. 2013:8). The prototypes tested by Mills, Christiansen and Shain at other CSIRO field sites were developed here as mature technologies. Bruce Slee joined the team working at Fleurs; he was a significant user of the antenna capabilities.

The new Mills Cross was constructed during 1953–1954, supervised by Mills' colleague Alec Little. At the time, Mills himself was in the USA at the invitation of the California Institute of Technology and the Department of Terrestrial Magnetism [Carnegie Institute of Washington] (Frater et al. 2013:10). During this visit, he met the astronomer and telescope engineer Howard E. Tatel, who designed the 26 m dish at the Orroral Valley NASA satellite tracking station in the ACT (Gorman 2016). This visit may have been the catalyst for the development of similar cross instruments in the USA, such as the

Seneca Mills Cross in Maryland (Garcia et al. 2006).

The Mills Cross was designed for an all-sky survey at 85 MHz. It picked up radiowaves with metre wavelengths from the Milky Way (Frater et al. 2013:12). Operation started in 1954, observing the Magellanic Clouds, and radio emissions from our own and other galaxies (Frater et al. 2013:11). A photograph taken at this time showed that the antenna was alone at the site (Figure 5). A receiving hut/instrumentation hut stood near the centre of the two arms; the termination of the antenna arm was finished by a wooden structure. The chicken wire reflecting surface was supported by metal struts.

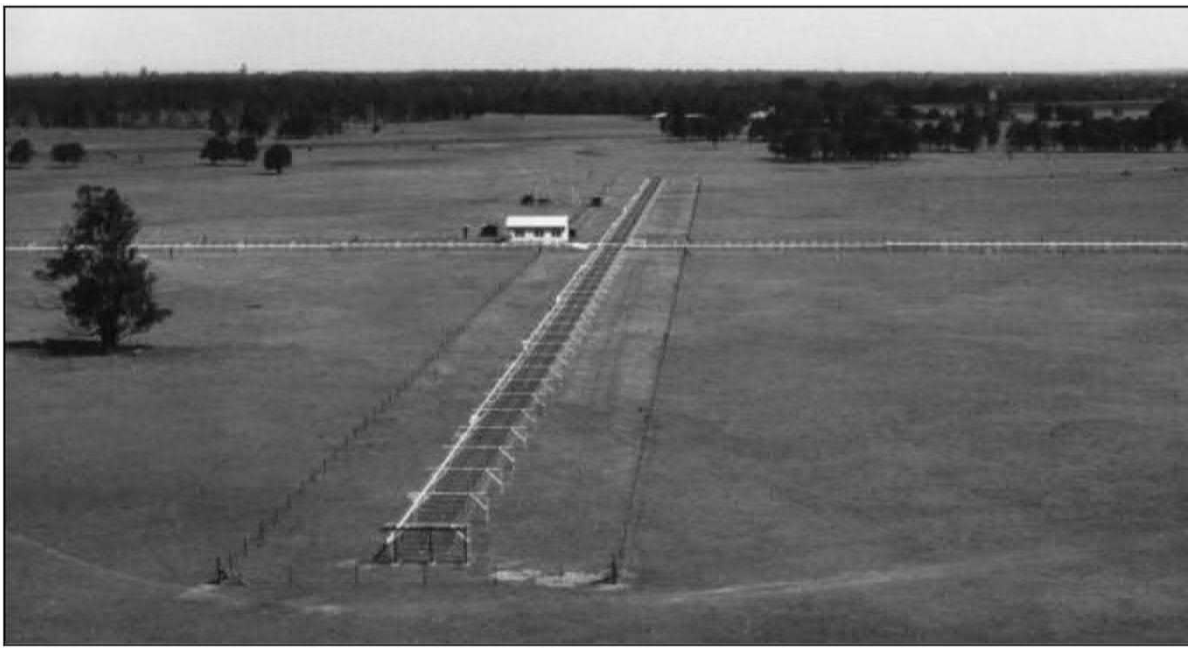

Figure 5 Mills Cross antenna, 1954 (CSIRO Radio Astronomy Image Archive 3476-3).

When the Hornsby field station was closed in 1955, Shain moved to Fleurs. He wasn't interested in the Mills Cross, however, preferring to follow up his Jupiter observations (Orchiston et al. 2015:7). Initially, he built three small telescopes to accomplish this:

> A 19.6 MHz two element E-W interferometer and a 14 MHz and 27 MHz single in-line arrays of four and eight half-wave dipoles, respectively.

While this research was going on, Shain was constructing the second largest antenna on the Fleurs site, the Shain Cross, which was completed in 1956 (Figure 6). It operated at 19.7 MHz with E-W and N-S arms approximately 1000 m in length. It differed from the prototype at Hornsby Valley in its cross structure, influenced by the Mills Cross (Orchiston et al. 2015:7). Its purpose was to survey the galactic plane and Jupiter radio emissions (Orchiston 2004a:158).

Figure 6 Shain Cross looking south (CASS RAIA B3868-19).

The Chris Cross, designed for solar radio astronomy, was constructed in 1957 (Figure 7). It was the world's first cross-grating interferometer (Orchiston and Mathewson 2009:11), based on the cross-grating solar array that Christiansen had trialled at Potts Hill, combined with the interferometry principles of the Mills Cross (Frater and Goss 2011:219; Orchiston 2004a:158). The Chris Cross operated from 1957–1988, mapping solar emissions at 1423 MHz and producing a detailed map of the sun every day (Orchiston and Mathewson 2009:11).

A 1958 newspaper report described the operation of the antennas:

> The individual aerials turn so that they always face the sun, and are arranged and connected in such as way they 'see' only a very small area of the sun at a time. The part of the sun which is being 'looked at' is changed progressively so that it whole surface is 'scanned' (in much the same way as a television picture is produced) and so gives a 'radio' picture of the sun in just over half-an-hour. (Biz 1958)

The radio map included sunspots, areas of radio quietness and solar bursts. These solar maps were distributed to observatories across the globe (Orchiston 2004a:158). Christiansen's research was one of Australia's contributions to the International Geophysical Year of 1957–1958, the same year that the launch of Sputnik 1 heralded the beginning of the Space Age. By 1957, the Fleurs site hosted three significant arrays (Figure 8).

Figure 7 Chris Cross, 1958 (National Archives of Australia 7572991).

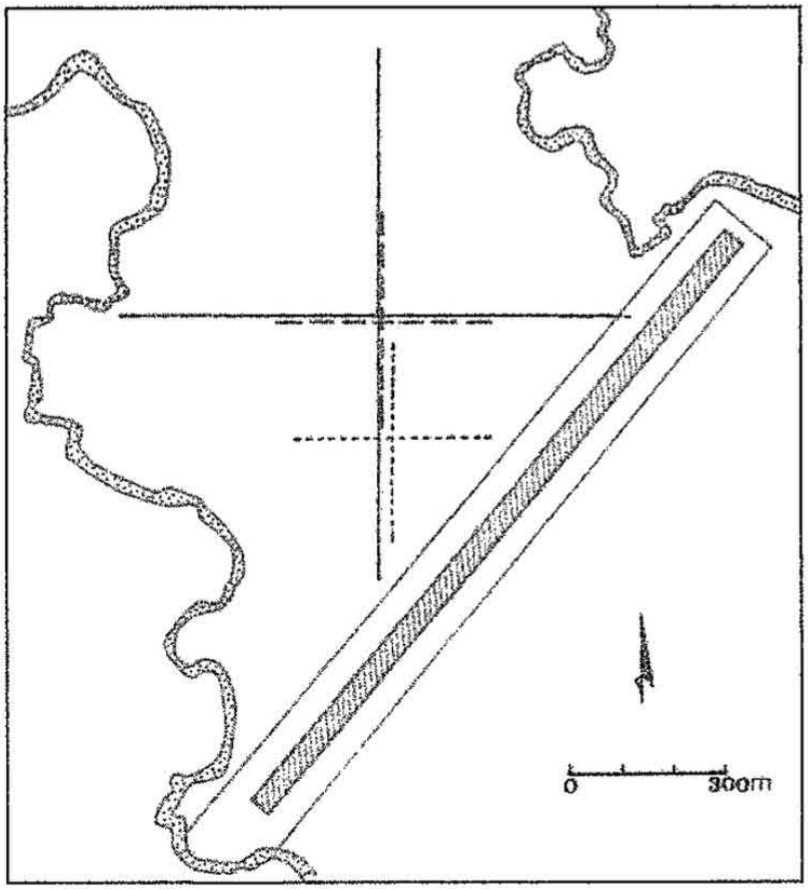

Figure 8 Arrays at Fleurs (from Orchiston 2004a:157), showing the disused WWII air strip extending from Kemps Creek in the east to South Creek in the west, and the Mills Cross (dashed lines), Shain Cross (solid lines) and Chris Cross (dotted lines).

The Mills Cross was used by Mills, Slee and Eric Hill from 1954–1957 to carry out an all-sky survey for discrete radio sources (Orchiston and Slee 2002). At the same time, the Cambridge radioastronomy group at the Cavendish Laboratory were carrying out a similar survey that was published in 1955 as the 2C catalogue (Shakeshaft et al. 1955). In 1957, the results of the complete Mills Cross survey at 88.5 MHz, cataloguing 2270 radio sources, were published as the MSH (Mills, Slee and Hill) catalogue. The differences between the 2C and MSH catalogues led to an international controversy about the nature of the cosmos (see the following section for more information on this). As well as providing the catalogue, the MSH survey mapped some radio sources onto known optical objects, such as spiral, elliptical, and irregular galaxies, clusters of galaxies, and nebulae (Orchiston 2004b:31).

Outside the all-sky survey, Slee used the Mills Cross data to study the relationship between radio sources and the Earth's magnetic field (Orchiston 2004b:28). In 1956 he used the E-W arm to observe Taurus A, a supernova remnant (SNR) in the Taurus constellation. In 1957–1958 he was observing the Crab Nebula with the Mills Cross, as well as two helical aerials located east of the Cross (Orchiston 2004b:32). He also collaborated with Shain to study the comet Arend-Roland (C/1956 RI), discovered just the year before by Belgian optical astronomers, using the Mills Cross while Shain used the Shain Cross (Figure 9). Radioastronomers were very keen to detect the radio signature of a comet, but none were successful as the antennas were not yet sensitive enough; it would not be until 1973 that cometary radio emissions were detected (Orchiston 2004b:35).

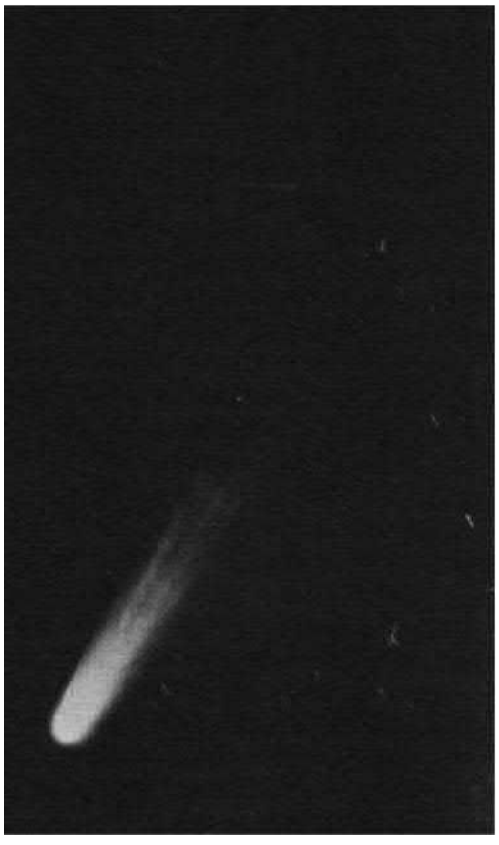

Figure 9 Comet Arend-Roland, 1956 (from Wikimedia Commons).

In 1958, Mills attended the Paris Symposium on Radio Astronomy and the International Astronomical Union General Assembly in Moscow where he presented the MSH results. Mills' PhD on the Mills Cross was awarded in 1959 (Frater et al. 2013:13).

At this stage in post-war astronomy, the now-familiar parabolic dish had not achieved the dominance it would come to assume. But in 1953, Taffy Bowen began planning for a Giant Radio Telescope

(GRT). As Frater et al. (2013:13) noted, 'the era of large parabolic dishes had already begun in England' with the 76 m Jodrell Bank radio telescope. Bowen sourced funding for the GRT from the Carnegie Corporation and the Rockefeller Foundation. Construction began on what would become the Parkes telescope in 1956 (Frater et al. 2013:13). The Parkes antenna was aimed at high frequencies, rather than the low frequencies received by the Fleurs cross antennas. Ironically, Mills and Christiansen were responsible for choosing and breaking ground at the new site. The start of Parkes heralded the closure of the CSIRO's field stations around Sydney (Orchiston 2001:12).

The year 1960 was a watershed for the fortunes of Fleurs. By this time, the Division of Radiophysics was pouring its resources into Parkes and Paul Wild's solar radioheliograph at Culgoora in northern NSW. There were no resources for Mills to continue radio interferometer research at low frequencies. Pawsey supported the construction of a new 'Super-Cross' with higher resolution and sensitivity, but funding was not forthcoming. Stymied, Mills accepted a Chair in the Physics Department at the University of Sydney in 1960 (Frater et al. 2013:14). The Super-Cross was eventually built—but at the site of Molonglo near Canberra. Another astronomer was lost to Fleurs when Shain, who had suffered from cancer, died that year.

Christiansen left CSIRO to become Chair of Electrical Engineering at the University of Sydney in 1960. In this role, he developed the Chris Cross into the Fleurs Synthesis Telescope (FST) (Davies 2009:8). The CSIRO had planned to bulldoze the site, but Christiansen got wind of it and asked for the Chris Cross to be donated to the University (Frater and Goss 2011:221). In 1963, the University of Sydney took over the Fleurs site and equipment. At this time Martin Ryle in Cambridge, and others, were starting to develop synthesis telescopes and Christiansen saw a similar potential for the Chris Cross. Six stand-alone 13.7 m parabolic antenna dishes were added at the east and north ends of the cross, and to the north and west (Orchiston 2004a:159). These additions made it the most powerful radiotelescope in the Southern Hemisphere at the time. The six added antennas were fully automated (Batty et al. 1986: 346). The new array was used to study southern radio galaxies, supernova remnants (SNRs) and emission nebulae. Under Christiansen's direction, the FST was an important instrument for training astronomy students (Frater and Goss 2011:222).

Slee continued to actively use all the antennas. In 1960, he used the E-W arm of the Mills Cross, and a small array of dipole antennas 10 km to the west, to study the solar corona. In 1961–1962, Slee and Peter Sheuer, visiting from Cambridge, used the E-W arm of the Mills Cross to conduct a further study of MSH sources (Orchiston and Slee 2002). He and Scheuer used 'barley-sugar' antennas to study source sizes; Orchiston described these antennas as 'enigmatic' (2004b:65). Slee conducted a second solar corona survey in 1962 with the E-W arm and a temporary array 'at a remote site' (Orchiston 2004b:33).

Between 1960–1962, Slee worked with Higgins to monitor flare stars—a type of non-stellar 'radio star'. They mainly used the N-S arm of the Mills Cross, but also did some work using the N-S arm of the Shain Cross (Orchiston 2004b:37; Orchiston et al. 2015:10). Orchiston (2004b:65) noted that Slee was 'instrumental in maintaining and modifying the Mills and Shain Cross telescopes at Fleurs'.

Slee was also interested in Jupiter's radio emissions, which, as we have seen, were picked up by the prototype Shain Cross at Hornsby Valley, before being identified by Burke and Franklin in 1955. Jupiter was in opposition in 1962, so Slee and Higgins used long baseline array interferometry to investigate it. The baseline was created from a square array of 19.7 MHz half-wave dipoles at Fleurs—this was the frequency of the Shain Cross, which may have formed part of this array—and another array 32 km away (Orchiston 2004b:34). Jupiter research continued in 1963–1964 with another long baseline array, using 'simple arrays of dipole antennas at Fleurs and three other sites: Dapto, Jamberoo and Heaton' (Orchiston 2004b:34).

The 1970s appear to have been quiet years, with no record of major observation campaigns, although Slee and others continued to maintain and use the instruments. Slee's work with the FST, however, led to Fleurs' participation in an international network in the 1980s. Radioastronomy was nothing if not collaborative, and the principle of long baseline interferometry meant that the array

elements did not have to even be on the same continent—producing very long baselines indeed. The Southern Hemisphere VLBI (Very Long Baseline Interferometry) Experiment, or SHEVE, created nine usable baselines extending from Australia to South Africa. Six antennas constituted the network: the 64 m dish at Tidbinbilla, the Parkes dish, one of the 13.7 m antennas at Fleurs, a 14 m antenna in Hobart, a 9 m dish in Alice Springs, and finally the 26 m antenna at Hartebeesthoek in South Africa. The aim of the 1982 project was to study radio galaxies, pulsars, quasars and galactic nuclei (Orchiston 2004b:53; Preston et al. 1984). This was an historic precursor to the largest radioastronomy project in the world, the Square Kilometre Array, which is similarly shared between Australia and South Africa. Frater and Goss (2011:224) saw the FST as the ancestor of the Square Kilometre Array, both in its technology and the importance of Fleurs-trained astronomers 'playing key developmental work'.

In particular, the SHEVE team were interested in the Vela pulsar. This pulsar, associated with a supernova remnant in the constellation of Vela, emitted in the radio, optical X-ray and gamma ray wavelengths. It was, in fact, Bernard Mills (after he had moved to the University of Sydney) who was responsible for making the connection between the Vela pulsar and the Vela SNR in 1968, using the Molonglo array (Large et al. 1968).

After studying flare stars, Slee turned his attention to radio emissions from other active stars. In 1985–1986, he and a team of seven radioastronomers, including John Bunton (who had joined Fleurs in 1983), used the FST to observe an RS CVn star, HD22468 (also known as V711 Tauri; Figure 10). RS CVn stars are a binary system of two cool stars rotating around each other, with each spinning at a high velocity itself. HD22468 is described as 'a white to yellow eclipsing binary system sub-giant star that can be located in the constellation of Taurus' (Universe Guide nd). The FST was one of a number of instruments that Slee and colleagues used to observe these stars from high or microwave frequency, to the low frequency range of the FST (Orchiston 2004b:42).

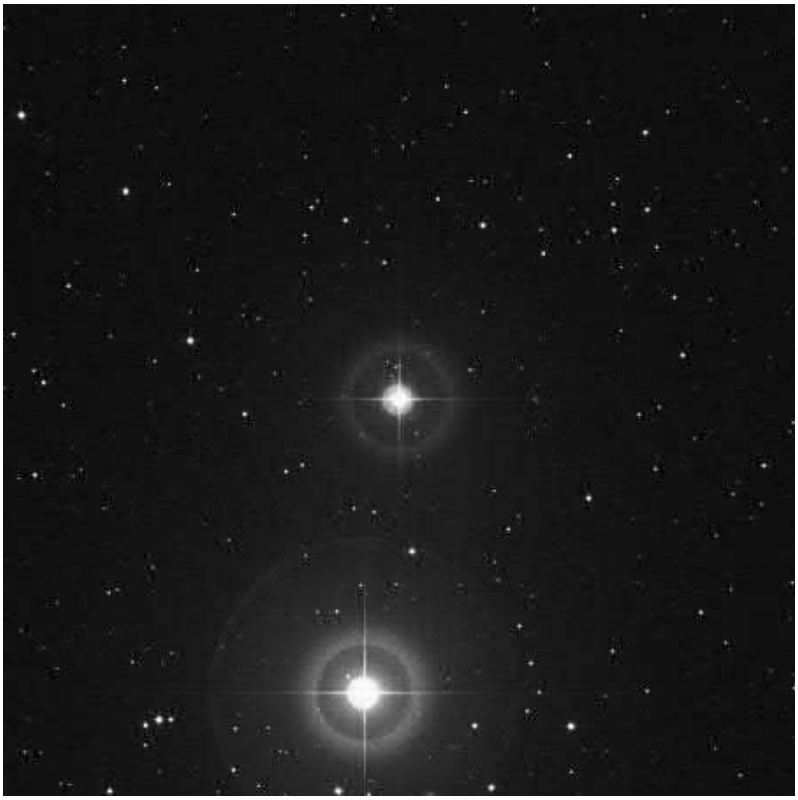

Figure 10 HD2246 (image courtesy of In-The-Sky.org.).

The FST operated until 1988 when the University of Western Sydney negotiated to use the site for teaching. The functions of the FST were replaced by the Australia Telescope National Facility (ATNF) which opened in the same year.

The Mills Cross and the Origins of the Universe

In his conclusion to the 2017 ICOMOS/IAU Thematic Study on heritage sites of astronomy and archaeoastronomy, Ruggles (2017:291) stated that 'From a heritage perspective it is clear that astronomy must always be considered in its social context: all astronomy is ultimately cultural astronomy' and 'all tangible astronomical heritage must relate to the intangible heritage of astronomical knowledge itself'.

Taking this perspective, part of the cultural significance of the Mills Cross is its role in one of the biggest 20th century debates about the origins of the universe: Steady State vs Big Bang. The Mills Cross data contributed to this debate, which was at the heart of the 'Cambridge controversy'. The dispute was over whether certain radio sources came from inside or outside our galaxy, and how this related to the rival theories.

At this time, it was known that the universe was expanding, due to Edwin Hubble's measurement of the Doppler shift. What this meant, however, was open for interpretation. There were two principal competing theories: the Big Bang and the Steady State (Bondi and Gold 1948; Hoyle 1948). British astronomer and science fiction writer Fred Hoyle (he also popularised the notion of hyperspace), was a leading supporter and theorist of Bondi and Gold's Steady State model. While the Big Bang theory held that the universe began as a sort of 'explosion' that led to its expansion, the Steady State model proposed that the expanding universe was the result of the continual creation of new material at a steady rate. At stake was not just the origin of the universe, but whether it was Euclidean (Newtonian) or non-Euclidean (Einsteinian).

At the same time that Mills and Slee (1957) were conducting their all-sky survey in 1954–1955, a group at the Cavendish Laboratory in Cambridge, UK, was also using an interferometer array built by Martin Ryle and Anthony Hewish for solar and galactic surveys. The results were published as the 2C catalogue in 1955 (Shakeshaft et al. 1955).

Ryle was a late convert to the idea of extra-galactic radio emissions. Originally, he believed that 'radio stars' came from within the Milky Way rather than representing sources much further away. Ryle's group used the 2C survey to test a hypothesis about the Big Bang and Steady State theories. The logarithm of the number of radio sources (N) and the logarithm of the flux density (S) would produce a slope when plotted against each other. If this slope was -1.5, the data would support the Steady State theory. If it was steeper than -1.5, it ruled out the Steady State theory.

The results produced a slope of -3 and, in 1955, Ryle discussed the implications for cosmology at his Halley Lecture at Oxford (Frater et al. 2013:11), arguing that the 2C data did not support the Steady State theory. Hoyle saw the writing on the wall. He wrote to Bernie Mills to ask his opinion of the 2C data and Ryle's interpretation of the results (Mills 1984). Mills noted that there were serious discrepancies between the Fleurs data and the Cambridge data, and the slope could not be as steep as -3. There was a problem with the 2C survey, and Mills and Slee concluded that it was a result of differences in the antennas themselves—and that the MSH data was correct (Orchiston 2004b:30). They published the full MSH catalogue in 1957.

The corollary of this, however, was the MSH data supported the Steady State model. Mills, Slee and Hill were reluctant to commit to such an interpretation, writing that:

> ... the statistics of the source counts, with due allowance for instrumental effects, show no significant departures from those expected with a random distribution of sources in a static Euclidean universe. They are also not inconsistent with the counts expected in a relativistic expanding universe. The sensitivity of the instrument is inadequate for a definitive result in cosmology based on source counts alone: it seems likely that this method will require numbers of well-determined radio sources approaching 10,000 per steradian, at least, to succeed. (Mills et al. 1961:505–506)

In the meantime, Ryle's team commenced the 3C survey at 178 MHz, which was nearly complete by the end of 1956, and their results confirmed Mills' criticism of the source confusion in the 2C survey. Ryle, however, refused to concede that the 2C data was flawed and the controversy was a source of acrimony between the two radioastronomy groups at a time when the international radioastronomy was an exemplar of international cooperation and community building, against the background of Cold War divisions, competitiveness and military control of research. The issue was not laid to rest until the confirmation of the cosmic background microwave radiation in 1965 by Penzias and Wilson (using a horn antenna) unequivocally supported the Big Bang theory.

A legacy of the MSH survey remains in the celestial catalogues, where, despite more than one rationalisation of object names since the 1950s, some MSH prefixes on identifiers reveal that they were first recorded on the Mills Cross antenna (Jonathan McDowell, Harvard-Smithsonian Center for Astrophysics, pers. comm.). The MSH catalogue made the Mills Cross an internationally visible antenna (Orchiston 2004b:65).

THE ANTENNAS

All components of the antennas appear to have been constructed locally, in the Radiophysics Workshop in Epping (Orchiston 2004b:27) or on site.

Mills Cross

The Mills Cross was an array of dipole antennas in a wire mesh reflector, 450 m in length, with one N-S arm and one E-W arm (Orchiston and Slee 2002). Each row contained 250 elements. The arrays had a fenced easement of approximately 10 m on either side (Figure 5). This was presumably to keep stock and/or casual visitors out. There was a small receiver hut near the centre of the cross (Figure 5, Figure 11 and Figure 12).

A review of the literature has not so far produced a detailed description of the materials and construction of the Mills Cross; however, this may be rectified with further archival research. The disposition of the cross is discernible from images in the ANTF archive, as reproduced in various works by Orchiston and others. Images such as those shown in Figure 12 and Figure 13 show the main structures were Y-shaped metal supports, strung with chicken wire.

Shain Cross

The Shain Cross was constructed in 1956 alongside the Mills Cross, and was itself a Mills Cross configuration. It was a series of dipoles strung between power-pole sized posts with the ground used as a reflector (Orchiston and Slee 2002). Figure 6 and Figure 14 show the configuration of the poles. Shain described it as a N-S array of 3625 ft (~1200 m) and an E-W array of 3400 ft (~1100 m) (Shain 1958:85). A 'feeder' made of polythene-insulated coaxial cable ran along each arm, coupled to the dipole antennas, which were supported by the wires connecting the poles (Shain 1958:86). The dipole connections in the N-S arm were grouped in threes. The dipole connections in the NS arm were grouped in threes, which can be seen in Figure 16. Fifty-one boxes containing phase switches were attached to poles in the N-S arm (Shain 1958:86)

In the 1960s a staff member at the University of Sydney School of Electrical Engineering refurbished the E-W arm of the Shain Cross and used it in conjunction with two small N-S arrays to do a sky survey (Orchiston and Slee 2002); this was likely Slee but this is not confirmed.

Figure 11 Aerial view of Mills and Chris Crosses looking north with instrumentation buildings (image courtesy of ANTF).

Figure 12 Mills Cross (foreground) and Chris Cross (background) looking south towards the airstrip (image courtesy of ANTF).

Figure 13 Mills Cross, 1958 (National Archives of Australia 7572988).

Figure 14 Shain Cross, with Mills and Chris Cross in background (image courtesy of ATNF).

Chris Cross

The arms of the cross were oriented N-S and E-W. Each arm had 32 parabolic dish antennas made of wire mesh, 5.8 m in diameter, making a total of 64 antennas. They were equatorially mounted so as to track the Sun (Orchiston and Slee 2002). The dishes, 'tubular aluminium covered in chicken wire', were manufactured in the CSIRO workshops (Tribune 1957:7), probably located at the Epping headquarters (Encyclopedia of Australian Science nd). The dishes were made of concentric circles of pipes and balanced with a counterweight (Figure 7). There was a receiver hut, roofed with corrugated iron, located near the centre of the cross.

In 1959, the addition of an 18.3 m telescope beyond the end of the eastern end of the E-W arm transformed the Chris Cross into the world's first high-resolution compound interferometer. This antenna was transferred to Parkes in 1963 (Orchiston 2001:13; Orchiston and Mathewson 2009:11; Figure 15).

Figure 15 The 18.3 m FST antenna at Parkes (right of image) (image courtesy of ANTF).

Fleurs Synthesis Telescope (FST)

Christiansen led the FST project from University of Sydney. The base of this telescope was the Chris Cross, with the addition of six 45 ft or 13.7 m parabolic dishes (Orchiston et al. 2005:68). Four 13.7 m antennas were added in the 1960s at the ends of the original cross. In 1975, these antennas were augmented with more sensitive receivers (Frater and Goss 2011:222). Two further 13.7 m dishes were added in 1984 (Frater and Goss 2011:222).

After the initial installation of the Chris Cross, a structure of corrugated iron sheeting was built under the antenna footings along the entire length of the arms. These can be seen in Figure 17. This addition may have happened when the Chris Cross was converted into the FST but the timing is unclear. It may also be related to automating the antennas.

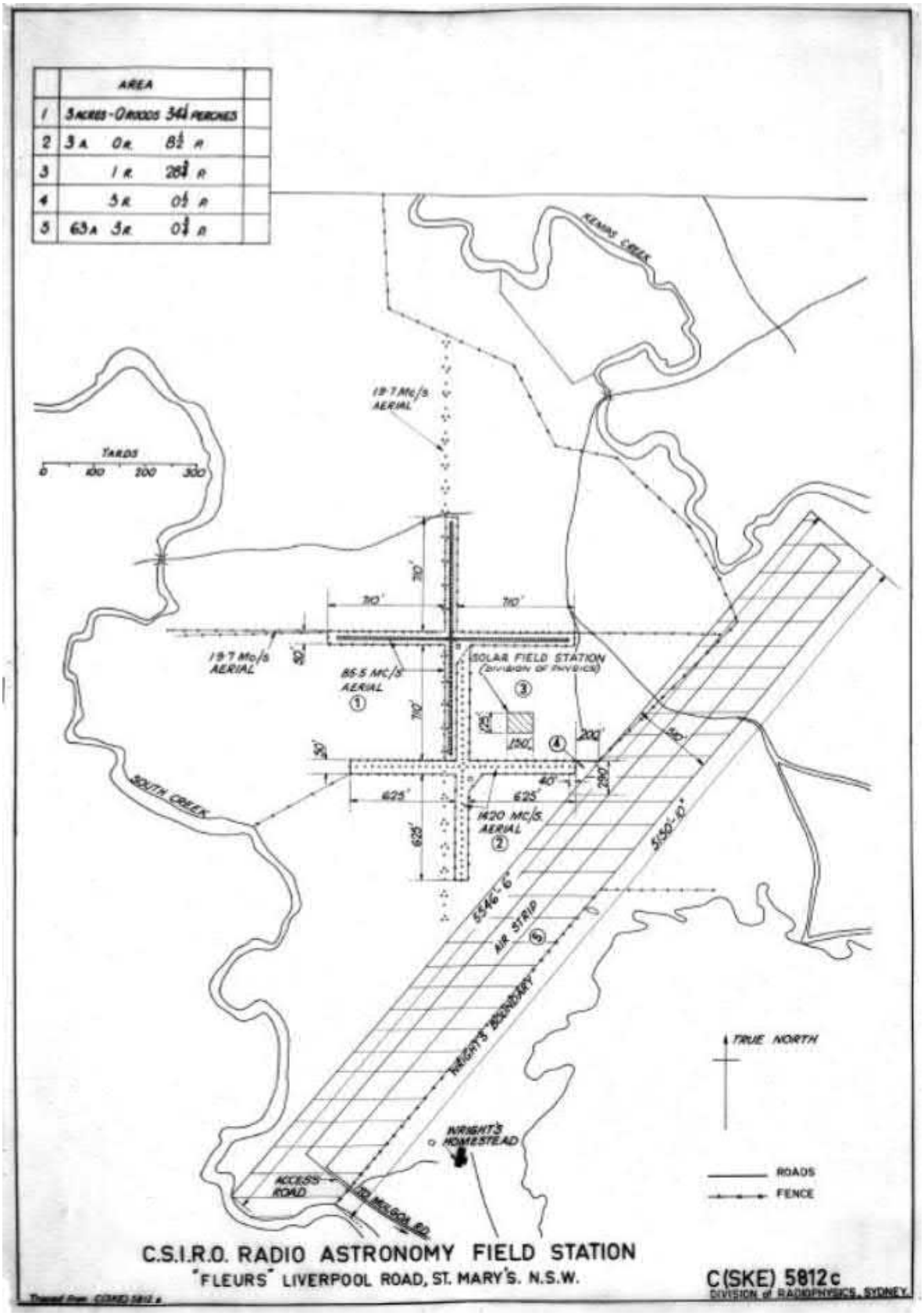

Figure 16 Layout of the three cross antennas (image courtesy of ATNF).

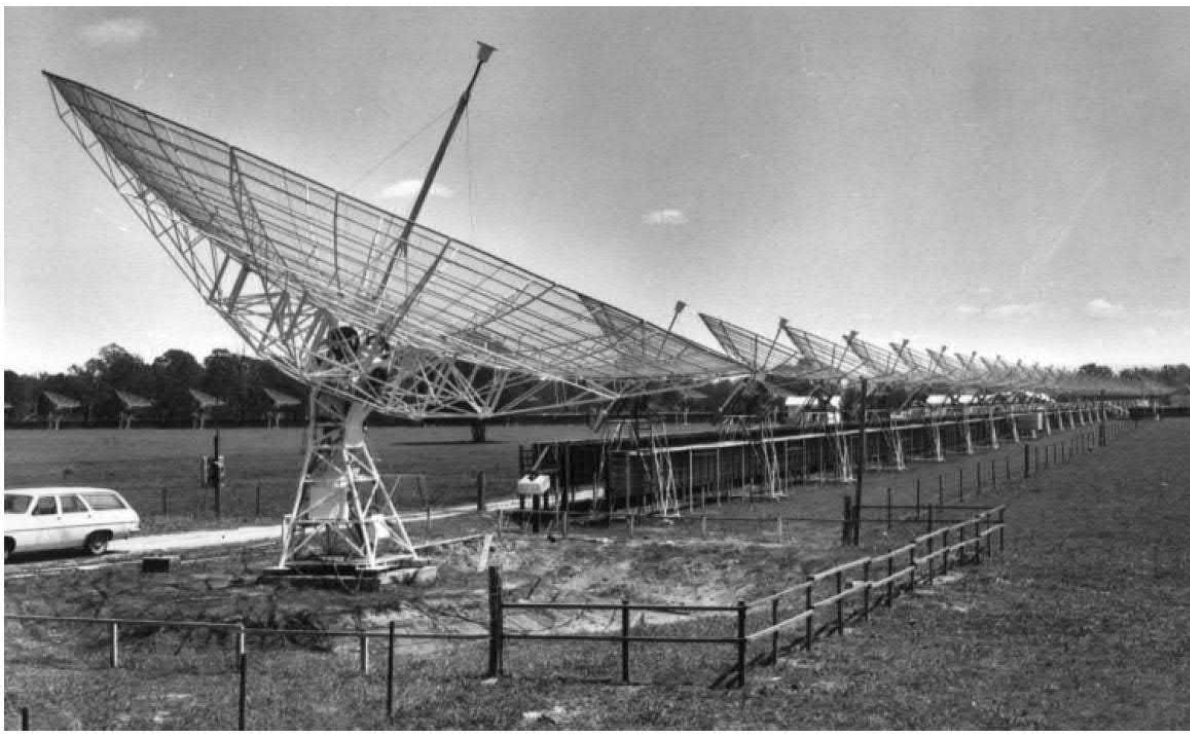

Figure 17 Fleurs Synthesis Telescope in 1973 (ATNF, Historic Photographic Archive, 9097-11).

Decommissioning and Abandonment

After 1988, the Mills and Shain Cross 'rapidly deteriorated' and the Chris Cross/FST antennas started to rust (Orchiston 2004a:157, 160). In 1990, it was decided to keep the six FST 13.7 m antennas and 12 smaller Chris Cross antennas (Orchiston et al. 2005:68). The remaining Chris Cross antennas were offered to local astronomical societies and four were taken away (Orchiston et al. 2005:68). All others, including the superstructure linking them, were removed and/or bulldozed (Orchiston 2004a:157, 161). While not stated explicitly by Orchiston, it is presumed that the Mills Cross and most of the Shain Cross were also demolished at this time. Undergraduate students from the University of Western Sydney cleaned and painted the remaining Chris Cross antennas and one of the FST antennas in 1991, and a ceremony was held to commemorate them.

In this state the Chris Cross/FST survived another 14 years, though rust continued to be a problem. In 2002, local historian Lorraine Stacker (2002) observed that the antennas were standing unused. In 2005, a local farmer expressed concerns to the University of Sydney that the antennas were a hazard to children playing on them. This suggests that children from the small properties surrounding the Fleurs site were using it as an 'adventure playground' (see Gorman 2018 for an account of space-themed playgrounds in Australia), possibly even the farmer in question's own children.

As Orchiston tells the story, the University of Sydney manager of farm operations approved this request without any further consultation and authorised the demolition. CSIRO staff discovered the destruction in early 2005 (Orchiston et al. 2005:68). The six large antennas of the FST were still standing in 2005, however, and 'efforts were being made to ensure that two of these are preserved' (Orchiston et al. 2005:68). Two were removed to CSIRO Marsfield (John Bunton pers. comm.). At this time, Orchiston was concerned about the future of the site, stating that 'the very survival of remaining elements of this pioneering radio telescope is in jeopardy' (Orchiston 2004a:157).

It appears no further attention has been paid to the astronomical heritage of the site until the present development proposal.

THE FIELD SURVEY

A survey of the Fleurs radiotelescope site was undertaken on 20–21 October 2017. Wallis Heritage Consulting (WHC) staff present were Dr Alice Gorman, Specialist Heritage Advisor, and Ms Chantal Wight, Archaeologist. Mr Tim Colman from Jacobs, Mr James Rendall from the University of Sydney and Mr Yujin Song from RMS were present in the field on 20 October 2017. Mr Yujin Song attended the survey on 21 October 2017. Access to the site is gained on dirt tracks through paddocks on the adjacent properties.

Methods

The survey consisted of targeted and systematic pedestrian transects over the area, combined with vehicle transects. The aim was to identify remains of the three arrays and any other associated infrastructure and artefacts, in order to assess their significance and identify impacts from the M12 Motorway corridor.

The survey targeted visible remains. The coordinates of each feature were taken using a hand-held Garmin GPS unit, in order to tie it in with existing aerial and ArcGIS maps; each was photographed and described in field notes. Description included:

- Materials, dimensions and structure of the remains;
- Condition of the remains;
- Vegetation, ground cover, visibility and other environmental factors;
- Associated artefacts; and,
- Disturbance factors, such as livestock and agricultural activities.

The survey started from the antenna complexes on South Creek, identified Shain Cross elements and recorded the North FST antenna, followed by pedestrian transects on the Kemps Creek side of the site. The instrumentation buildings and associated rubbish mounds were then recorded.

As time did not allow a detailed recording of rubbish mound contents, the co-ordinates of each mound were taken, along with photographs and an estimation of its principal contents. The images may reveal which antenna or associated infrastructure the contents derive from, but this may require additional assessment from a radioastronomer such as Dr John Bunton.

Limitations

Fieldwork was disrupted on 20 October 2017 due to heavy rain. This decreased visibility and prevented the use of digital recording equipment. Instead, a reconnaissance was carried out on the site. This established that there was a complex of antenna remains, instrumentation and residential buildings, and numerous rubbish mounds which likely contained the remnants of the antenna arrays. When rain became too heavy to continue reconnaissance, Gorman and Wight visited the Liverpool Library local history collection to undertake additional research.

With clear weather on 21 October 2017, the survey proper commenced. The ground was sufficiently dried to take a vehicle into the site. Time constraints, however, meant that one complex of buildings, installations and rubbish mounds was not fully inspected (see red square outline in Figure 18).

Environment and Site Disturbance

Recent ploughing created high surface visibility over much of the site. Cow dung was widespread. Ground cover was dry and dominated by tussock grasses. In unploughed areas, and particularly around rubbish dumps, there are blackberry infestations. A number of fences throughout the site appear to be related to grazing and other agricultural activities.

RESULTS

This section describes the results of the field survey.

A number of buildings are associated with the three cross antennas. Some of these were abandoned with materials still inside. A series of distinct rubbish mounds, frequently infested with blackberry, are associated with each building. In general, the rubbish mounds are sorted into similar material types. It seems likely that most of these relate to the 1990 demolition phase, although there must also be some from the 2005 demolition of the remaining Chris Cross antennas. The farmer or contractor took some effort to sort and stockpile materials. This may have been for re-sale or re-use purposes; if either took place, then it appears it did not seriously diminish the amount of material remaining.

Figure 18 shows the location of all remains recorded during the field survey.

FST

Three antenna locations and two antennas remain from the FST (Figure 18). South Creek 1 is located on the western bank of South Creek, but the antenna has been removed, likely to CSIRO Marsfield (further consultation with CSIRO staff could confirm this). South Creek 2, where the antenna has collapsed, is located on the eastern bank of South Creek (Figure 23). The North antenna is still standing and is located at the north end of the site in a fenced enclosure.

South Creek 1 Antenna Complex

Located and on the west bank of South Creek, this site consists of four components:

- 1 ‘signal box’;
- 1 set of three plinths;
- 1 cable trench with exposed cables and associated cable fragments; and,
- 1 antenna footing trench.

The ‘signal box’ is a 127 cm high hollow cylinder with a 45 cm high lid, containing cables (Figure 19A). The lid is a sub-angular dome, hinged on the western side, with hand-holds cut out in order to open it. Lichen is growing on the lid. The lid rests on a metal plate with a square cut out of the centre, covering a deep square cavity enclosed by the cylinder. The metal plate is bolted to the top of the cylinder. The height of the lid encloses a raised board to which cables are attached, running into the hollow core of the cylinder and presumably continuing into subterranean trenches leading to the antenna (Figure 19C). The cables are secured with cable ties. Cable ties were invented in 1956 (Gorman 2016) but may not have been widely adopted in Australia until the 1960s.

The cylinder is painted white and has been plastered into a smooth exterior, leaving brush marks which are differentially weathering. Damaged and chipped areas reveal the interior core is constructed of concrete with ‘blue metal’ dolerite aggregate, likely from the nearby Prospect Quarries (Denis Gojak pers. comm.).

At the base, there are circular holes 12 cm in diameter, which have been filled in. There are three in one location and two in another. These may be service openings for the cables or indicate some repair work (Figure 19B).

An examination of the ground in an approximately 20 m radius around the signal box revealed no traces of artefacts or further infrastructure.

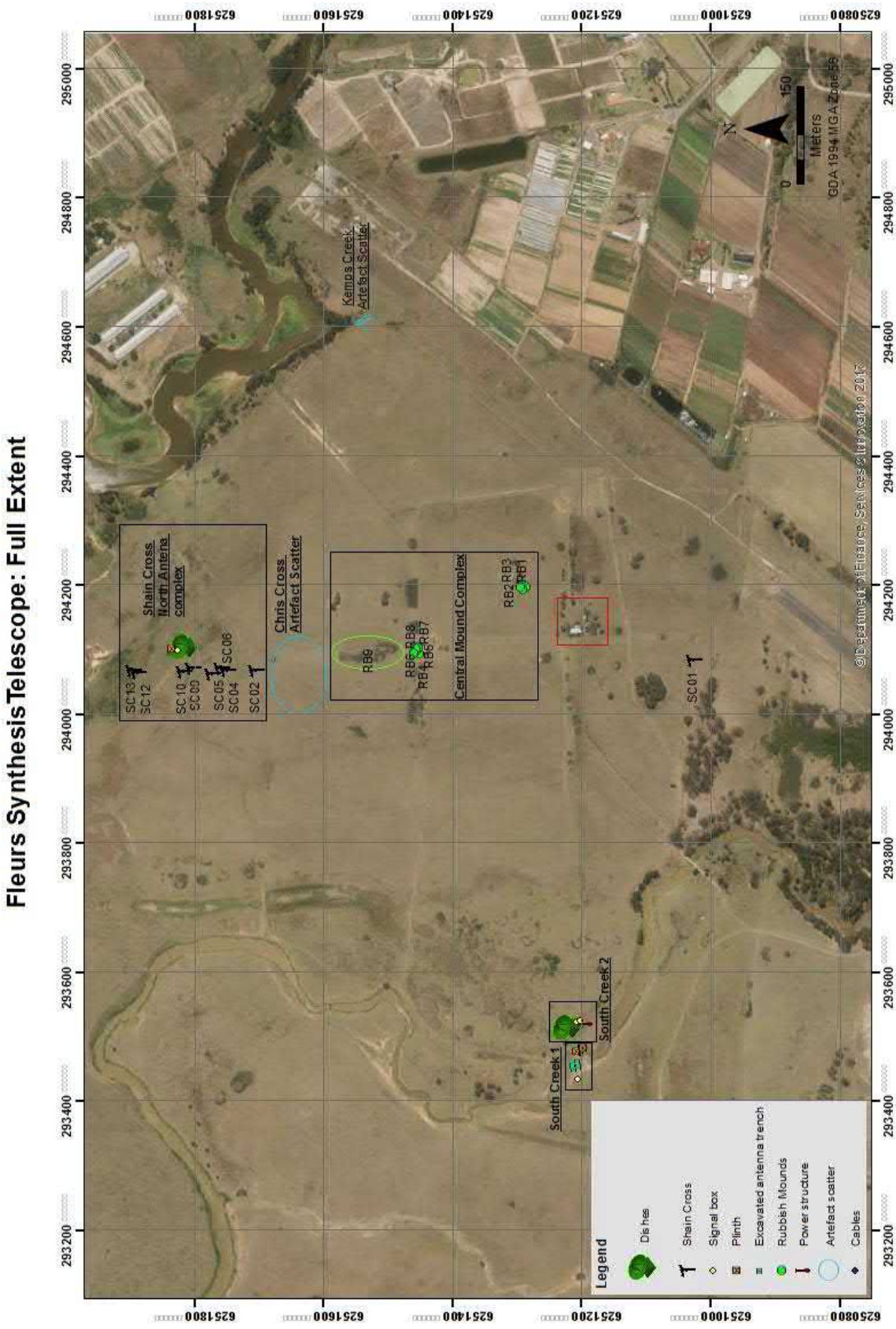

Figure 18 Map showing location of recorded material.

A

B

C

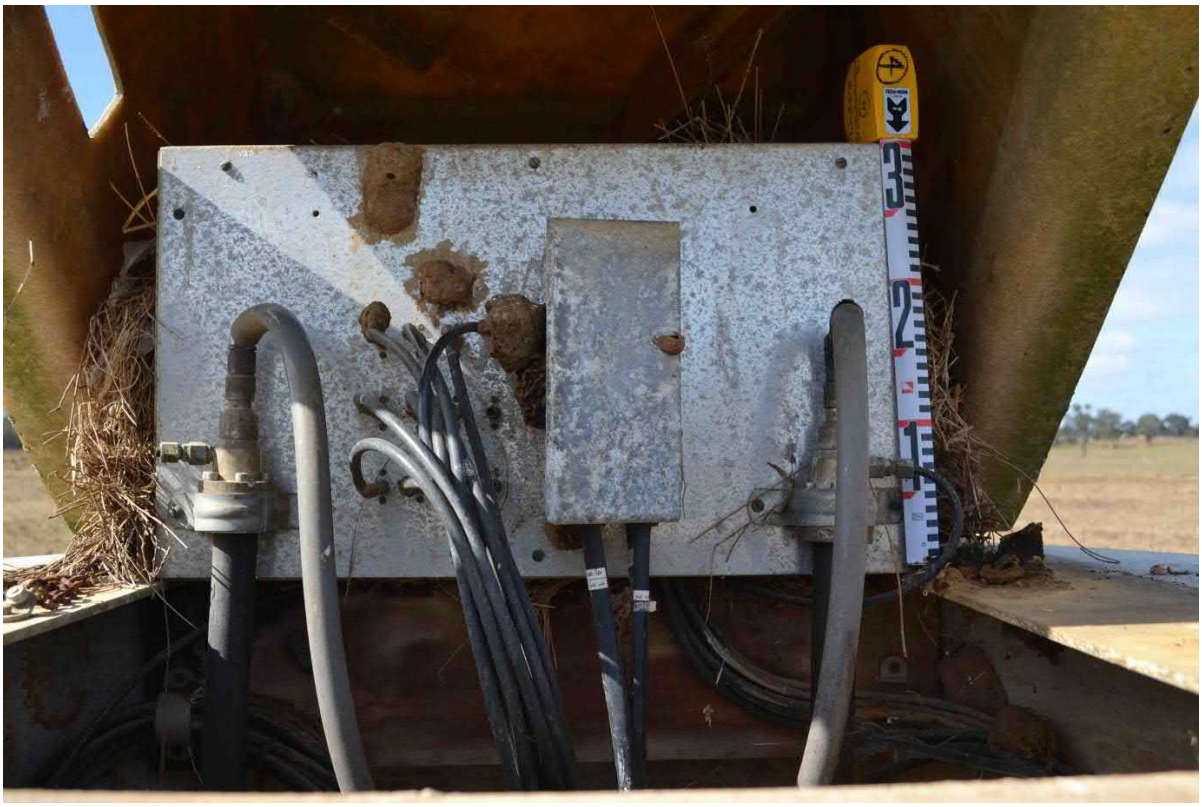

Figure 19 South Creek 1 Antenna Complex signal box. A: box looking east. B: possible service openings C: cable harness inside signal box.

On a lower terrace of the creek, approximately 10 m from the current water level, below the signal box, are the traces of a rhomboid-shaped trench approximately 8 x 8 m. The trench is identifiable by the visible difference in ground cover. On the east side it is approximately 60 cm deep but becomes shallower towards the west side. Tussock grasses grow on the perimeter of the trench while the centre is covered in low flat grass (Figure 20).

The trench likely relates to the removal of an FST antenna. Based on descriptions by Dr John Bunton of CSIRO (pers. comm.), one of the Fleurs antennas currently located at CSIRO Marsfield derives from this location. Bunton described excavating the antenna from a creek where it was surrounded by thick bulrushes. Dr Phil Crosby (CSIRO) noted that the 'W' letter painted on the base of one of the Marsfield legacy antennas refers to the west bank of South Creek (pers. comm.). As there had been no major rainfall on the Cumberland Plain for the previous three months, the creeks were low

despite the heavy rainfall of the previous day. The height of the creek bank indicates that at a higher water level, the base of the antenna could easily have been partially submerged. While the trench may also be a small stock watering dam, its spatial relationship to the signal box, plinths and exposed cables (see following sections) suggests the original location of an antenna.

Figure 20 South Creek 1 Antenna Complex: antenna trench looking east.

A bundle of cables, exposed by erosion on the banks on either side of the creek, is aligned with the antenna trench (Figure 21). The cables emerge from the western bank, run along the creek bed and vanish into the opposing bank on the eastern side in the direction of the South Creek 2 antenna complex. Components include a black (perhaps PVC) pipe 2.3 cm or 1" in diameter, a twisted bundle of cables now unravelling, with a narrow twine rope amidst them. Some short planks are visible on the creek bed as if a foundation or crossing had been constructed.

The cables are exposed in the grass further up the eastern bank. Apart from this small area or exposure, approximately 15 cm in length, ground visibility was nil due to thick grass cover. The cables appear to run in the direction of the power structure (see South Creek 2 Antenna Complex).

Three concrete plinths are located in the creek channel. The plinths are made from the same blue metal concreted aggregate as Signal Box 1 but without a rendered surface. One appears to be in situ as the plinth is upright; the other two are at an angle, suggesting that they have been tumbled in a flood or high water event, or in demolition of the superstructure. The creek appears to be actively eroding. Plinths 2 and 3 are adjacent to the cable creek crossing, with Plinth 1 located some metres north (Figure 22).

Figure 21 South Creek 1 Antenna Complex: cables.

Figure 22 South Creek 1 Antenna Complex: plinths.

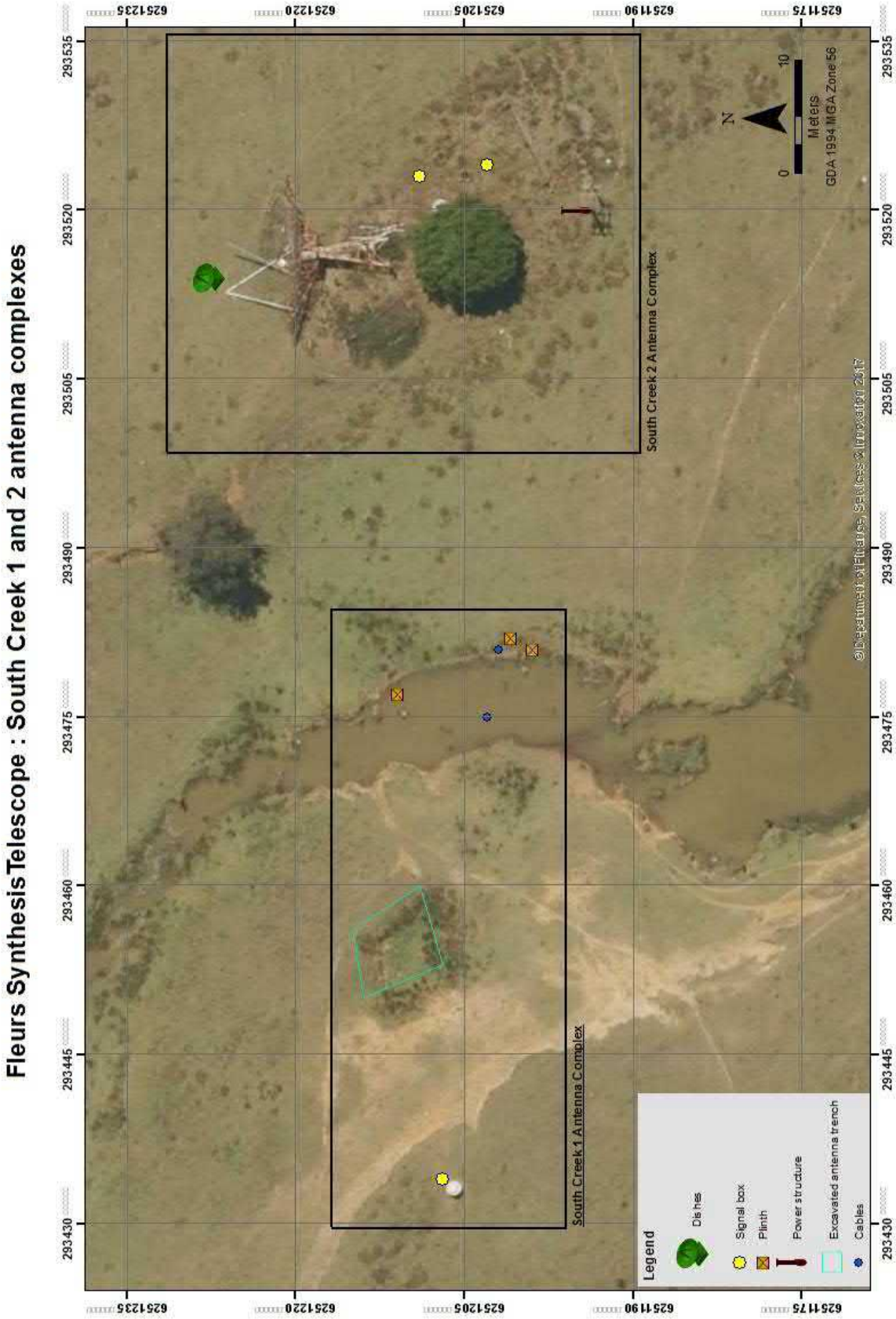

Figure 23 Map showing South Creek 1 and 2 Antenna Complexes.

South Creek 2 Antenna Complex

On the east bank of South Creek (Figure 23), this area contains:

- 1 dish antenna from the FST, collapsed;
- 1 'signal box';
- 1 power structure; and,
- 1 fenced enclosure.

The antenna is one of the 13.7 m FST antennas, possibly from the 1984 phase of refurbishment (Figure 24). The antenna is fenced off but part of the fence was destroyed when the antenna collapsed onto it. The lower rim of the dish is crushed against the ground. The dish is constructed from 11 concentric circles of pipes and lined with a small mesh chicken wire cut into blunt triangular panels. The panels have been hand-laced together and attached to the dish structure with a thin wire. The mesh is rusting in numerous places.

The feed antenna is supported by four thick, hollow pipes, which have collapsed. Unlike other pipes in the antenna structure, these are rust-free. The support structure has the highest degree of rust and the dish pipes the least.

There are a few cut cable ties lying on the ground under the dish. The cables ties are likely to come from the cables rather than the dish, as they are used to bundle cables in the signal boxes.

Figure 24 South Creek 2 Antenna Complex: antenna looking east.

The antenna base is a square A-frame made of welded pipes on a track which was bolted at four points at the ends (Figure 25). The bolted bases are approximately 3 m apart and the tracks are an estimated 4 m in length. The square bolt plates are embedded in concrete footings. There is a metal mesh platform attached to the base. The condition of the base suggests that a bolt came loose, causing the antenna to topple forward, bending the track in the process.

Intact cables run from the dish through the legs. All cables and cable boxes in the antenna structure are intact. The motor mechanism for moving the antenna is intact. It is engraved with degree/ protractor markings (Figure 26).

A short section of iron pipe was observed on the slope towards South Creek, between the creek and the power structure. This seems likely to be part of the dish structure which has rolled down, and suggests some dispersal of antenna components. A brick and a wooden post were also present in this area.

Figure 25 South Creek 2 Antenna Complex: antenna showing base.

Figure 26 South Creek 2 Antenna Complex: detail of antenna mechanism.

Blackberry grows thickly around the base and artefacts are scattered around. These include antenna components and large green and white glass bottles, of which three are resting near the antenna base.

The signal box at South Creek 2 Antenna Complex (Figure 27) is identical to that located at South Creek 1 in dimensions and materials. However, Signal Box 2 has a shorter rim on the circular top plate. It is located inside the fence approximately 10 m from the antenna. The lid is discarded nearby. The cavity inside the cylinder is filled with water and leaves. Both cylinder and lid are painted white. The weathered remnants of an angular black painted pattern are visible on one side, but weathering makes it difficult to discern—it could be geometric, lettering or graffiti.

There are pieces of cable on the ground in the area around the signal box. The cables are all severed, but are intact inside their casing or tubes.

Figure 27 South Creek 2 Antenna Complex: signal box.

Two wooden power poles, topped by a metal cap, are located outside the antenna fence near the east bank of South Creek (Figure 28). One pole (approximately 10 m) is slightly higher than the other (approximately 8 m). The poles are approximately 2 m apart. A perpendicular cross bar is situated close to the top of each pole. Glass insulators and wires are attached to the cross-bars.

A short distance below the cross-bars, a wooden grid structure connects the poles. The distribution of nails in the grid indicates that it may once have been a solid wooden platform. The grid and cross-bars are attached to the poles by rusting metal struts. The wires are fixed to the cross-bars by rusting metal attachments. The ends are severed, and it is presumed that they would have extended to a lone power pole to the east of the structure.

Two floodlights are attached to the grid. One is suspended by a wire facing towards the ground while the other is mounted on a strut of the grid and points towards the antenna.

A plastic or PVC cable tube runs up the side of the tallest pole and a cable emerges from the top. The cable is capped. The shorter pole has a thin dual cable of one red and one black plastic coated cable enclosed in a white plastic coating which has decayed to reveal the interior, attached to its length.

While the structure cannot be definitively tied to the antennas, its proximity to two of them makes it a possibility. It could also be argued that the structure is an element of the Shain Cross, the E-W arm of which terminates close to the creek (Figure 14). However, its purpose seems more electrical in nature.

Figure 28 South Creek 2 Antenna Complex: power structure.

North Antenna Complex

The North Antenna complex consists of an antenna, a fenced enclosure and a set of three plinths. It is located in a swampy area with thick ground cover offering zero visibility. Remnants of the Shain Cross stand to the east of the antenna (Figure 36).

The North Antenna is a 13.7 m dish from the FST (Figure 29 and Figure 30). A small fence has been built around the antenna. The dish has a four-pole feed antenna configuration, identical to the South Creek 2 antenna, that has fallen into the centre of the dish. There is, however, no cylindrical signal box associated with this antenna. The same function was performed by a metal box, lined with chipboard, mounted adjacent to the base of the antenna on a metal mesh platform. The box has fallen off the platform. Inside are circuit boards, switches and cables (Figure 29).

Figure 29 North Antenna showing fallen signal box.

The antenna legs are bolted into plates in the ground. Cable tubes are still intact. A rubber coated cable tube feeds through the centre of the antenna. A short section of this cable tube can be seen in the blackberry clump to the immediate north of the antenna. A twisted red, green and black coloured cable bundle hangs from one of the focal points to nearly reach the ground. The red cable has faded almost to white.

While there are some differences with the South Creek 2 Antenna structure, the dish itself is identical in configuration with 11 concentric circles and hand-laced chicken wire.

The antenna is in extremely poor condition from rust, perhaps arising from the low-lying and swampy nature of the landscape. One main vertical leg is nearly rusted through and two horizontal cross-bar similarly rusted. There is some evidence of charring on the most rusted parts of the structure, but it is unclear if this is chemical or fire-related (Figure 31 and Figure 32). The chicken wire mesh is starting to detach from the dish structure. The seams are coming undone, and the panels are breaking in the middle. The turning mechanism appears to be tilting and possibly becoming detached. It is in worse condition that the South Antenna. Remnants of white paint can be seen on the structure.

Figure 30 North Antenna (FST).

Figure 31 North Antenna showing rust damage.

Figure 32 North Antenna showing an area of severe rust damage.

Outside the fence, approximately 15 m from the base of the antenna on the north side, three plinths are set into the ground but still visible through the thick grass (Figure 33). They are constructed from the same blue metal aggregate as the plinths at South Creek 1 antenna complex. The black chips are visible where the surface has been damaged. The damage occurs on the same face of all plinths, suggesting it was related to the removal of the structure they supported.

Figure 33 North Antenna: plinths.

Shain Cross

One Shain Cross element (SC01) remains within the motorway corridor, close to the Fleurs aerodrome at the south end of the site (Figure 34). It is distinguishable from a power pole, which it resembles in height and thickness, by the distinctive structure at the top. Two short planks are nailed to opposite sides of the pole. Each is surmounted by a metal attachment with two vertical knobs. Wire is attached to each knob. The configuration suggests that it may have been a terminal element in the N-S arm. It contains nail holes as if a plaque or number had been attached; this could also be the attachment of the phase switch box (Figure 35). The wood of the pole is rotting and weathering.

While this could also be a power structure, its proximity to the airstrip and previous identification by Gottschutzke and Varto suggest it is indeed part of the Shain Cross array. The location of the pole corresponds with the southern extent of the mapped Shain Cross, and when a compass bearing was taken, aligned with the Shain Cross elements near the northern antenna. Images of the Shain Cross consulted so far show a plain pole with no attachments such as those seen here. It seems reasonable to suggest that this may be related to later changes made by Slee during his observation campaigns.

Figure 34 Shain Cross SC01: (left) genera view; (right) detailed view.

Figure 35 Shain Cross SC01 showing possible switch box attachments.

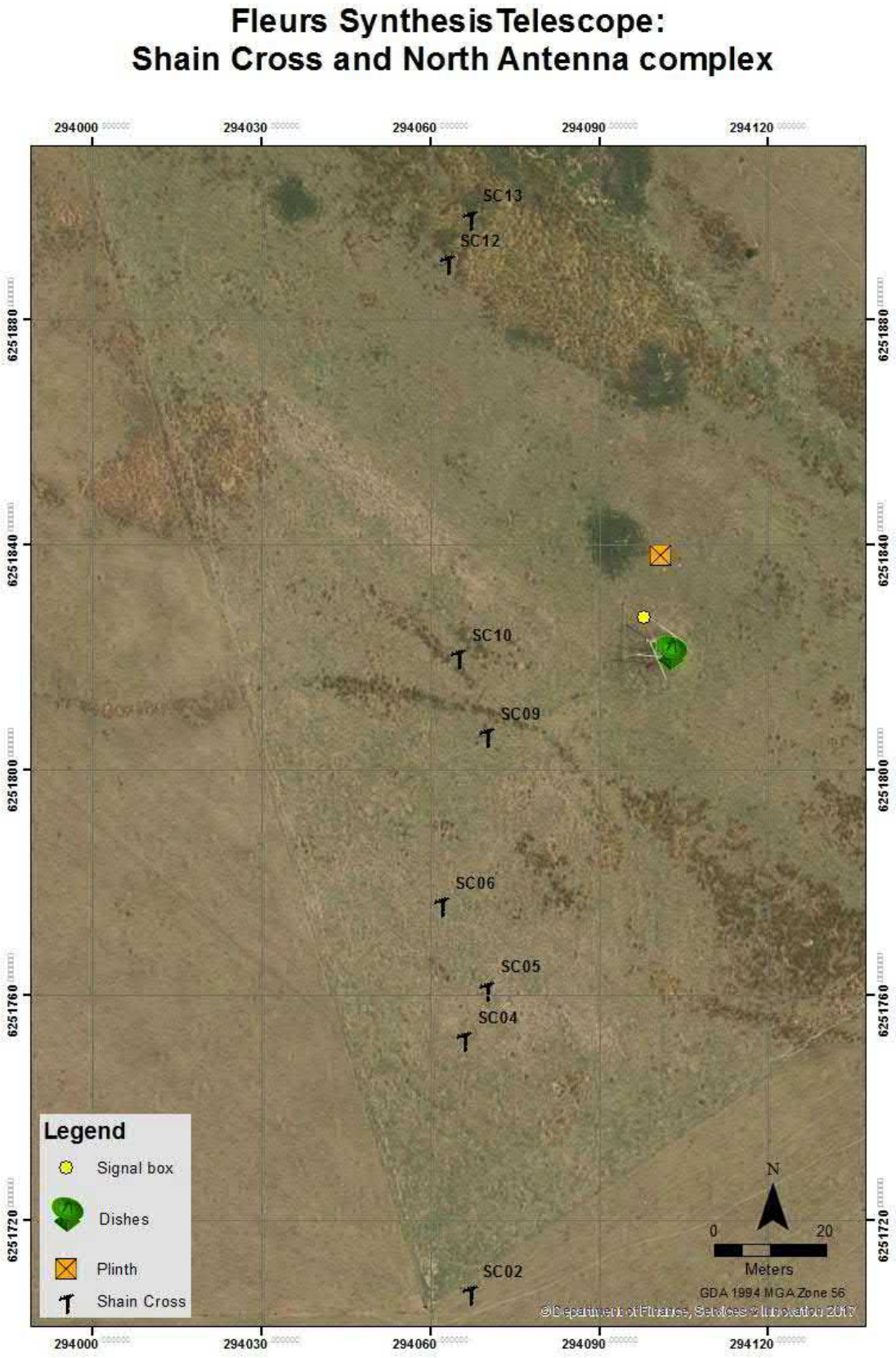

Figure 36 Map showing location of the Shain Cross and Antenna Complexes.

Further Shain Cross (SC02-SC07) elements survive near the North Antenna. SC02 is located in the south of Figure 36, with SC07 in the north.

SC02 (Figure 37) is located outside an internal fence line which appears to enclose a stock route or livestock easement (James Rendall pers. comm.). It is at the northern end of a series of rubbish mounds culminating in the Chris Cross artefact scatter, which implies the remainder of the N-S arm was a victim to demolition at the same time. There is a cable at the foot, and one attachment similar to SC01 at the top. The pole is leaning at an angle and the wood is weathering.

Figure 37 Shain Cross SC02: (left) genera view; (right) detailed view.

On the other side of the fence is an area that has been subjected to a different management regime. It has not been cleared or ploughed, with long grass and swamp vegetation intersected by narrow channels. Vegetation includes blackberry, scotch thistle, tussock grass, wild oats, reeds and other grasses. Ground surface visibility is nil. Grazing has occurred in the paddock, however, as evidenced by the frequency of cattle dung. The survival of Shain Cross elements and the North Antenna in this part of the Fleurs site seems due to an approach of benign neglect. There are six remaining elements, identical in dimensions and construction to SC01, standing near the North Antenna. None are now connected by wire.

A few posts in this section show evidence of reconfiguring, with the height of the pole extended by additional short wooden posts as seen with SC01 (Figure 38). One still has the wires and insulators that were part of the dipole. Some posts have evidence of what may be charring. At least one post has fallen.

Figure 38 Two Shain Cross elements with the North Antenna in the background.

Central Mound Complex

The Central Mound Complex is based around the former centres of the cross antennas and the instrumentation buildings, roughly in the centre of the site aligned with the N-S axes of the arrays (Figure 50). It consists of a two sets of buildings and associated rubbish mounds, and a wide area of artefact scatter which seems to be principally remains of the Chris Cross.

For each rubbish mound, GPS co-ordinates were recorded, photographs taken, and a general description of the contents of the mound made. The mounds are separated into different types of refuse. Each was assigned a number. It was not always clear what the source of the debris was. Chicken wire was widely scattered between the mounds.

Chris Cross Artefact Scatter

On the south side of the stock easement separating the North Antenna Complex from the main site, an extensive artefact scatter is visible in ground that has been recently ploughed. This artefact scatter is represented by a blue outline in Figure 50. Remains present in this area include a metal ladder structure, fragments of blue metal concrete as used in the plinths, segments of circular antenna dish structure, dish support structure, squashed chicken wire, and cable segments (Figure 39 and Figure 40). As shown in Figure 50, the scatter is aligned with the instrument hut and other rubbish mounds. The artefacts suggest that they derived from the demolition of the Chris Cross/FST, with further segmentation and damage from ploughing. Visibility is relatively high at 40–50% owing to recent ploughing, which has turned up artefacts.

Other Chris Cross elements are distributed among the other rubbish mounds in the complex.

Figure 39 Chris Cross artefact scatter: (left) ladder; (right) antenna dish segments looking south.

Figure 40 Chris Cross artefact scatter: artefact.

Instrumentation Complex 1 and Rubbish Mounds RB1, RB2 and RB3

At this location there are two huts and three rubbish mounds (Figure 50). One hut has a kitchen with an intact curtain in the window. At the back of this hut, close to the three rubbish mounds, are the foundations and remnants of a toilet and shower block. A small garden bed has been constructed using a bush rock edging along the kitchen (north) side of the hut. A stone path leads between the kitchen hut and the second smaller hut. The huts were not entered or inspected in detail owing to asbestos risks. On the east side of the smaller hut is a stockpile of wooden fence posts. The three rubbish mounds are at the back or south side of the buildings.

RB1 contains metal pipes and metal strips, some flat, and some staple-shaped in cross-section (Figure 41). Some have chicken wire attached; however, this is a larger mesh than that seen on the FST antennas. It may represent Mills Cross and Chris Cross infrastructure.

Figure 41 RB1: (left) looking east; (right) looking north with RB2 and huts in background.

RB2 consists of mostly rusted star pickets (Figure 42). They could be Mills Cross elements or fencing; however, the presence of wire mesh suggests Mills Cross, in which this wire was used as a reflector.

RB3 consists mostly mesh and barbed wire (Figure 43). This also suggests Mills Cross.

Figure 42 RB2, with RB3 in the background.

Figure 43 RB3 looking south.

Instrumentation Complex 2 and RB4, RB5, RB6, RB7 and RB8

Instrumentation building 2 was the original control building for the Mills Cross (Figure 5). Scattered documents and manuals are inside the building. The building was not recorded due to asbestos hazards as advised by James Rendall. It is associated with a long line of rubbish mounds extending to the north, terminating just prior the Chris Cross artefact scatter. These mounds are numbered RB4 to RB8.

RB4 is a miscellaneous stockpile of pipes, a tall turnstile antenna, a corrugated iron tank and a hinged structure which may be an antenna base. The turnstile antenna is a 5 m long pipe inserted through eight rings, each supporting four antennas perpendicular the central pole (Figure 44). Some rings have slipped with two against each other; it seems originally they were equally spaced. Nothing in the literature reviewed for this project positively identifies which antenna this turnstile belonged to.

Figure 44 RB4 with turnstile antenna.

RB5 consists of star pickets, barbed wire, white-painted square tubes, amorphous metal and miscellaneous metal strips (Figure 45). It may be related to the Mills Cross.

Figure 45 RB5.

RB6 consists of at least 30 pyramid-shaped concrete plinths with metal poles inserted. These are the weights on the Chris Cross antennas visible in Figure 7. They almost certainly derive from the 1990 demolition of the Chris Cross, as there were 32 dishes in each arm.

Figure 46 RB6.

RB7 consists of three concrete footings with metal protrusions that appear to have been excavated from the ground (Figure 47). They are likely the foundations of an installation.

RB 8 consists of wooden fence posts, barbed wire, and long poles, some of which may be from the Shain Cross (Figure 48 and Figure 49).

Figure 47 RB7.

Figure 48 RB8 including possible Shain Cross elements.

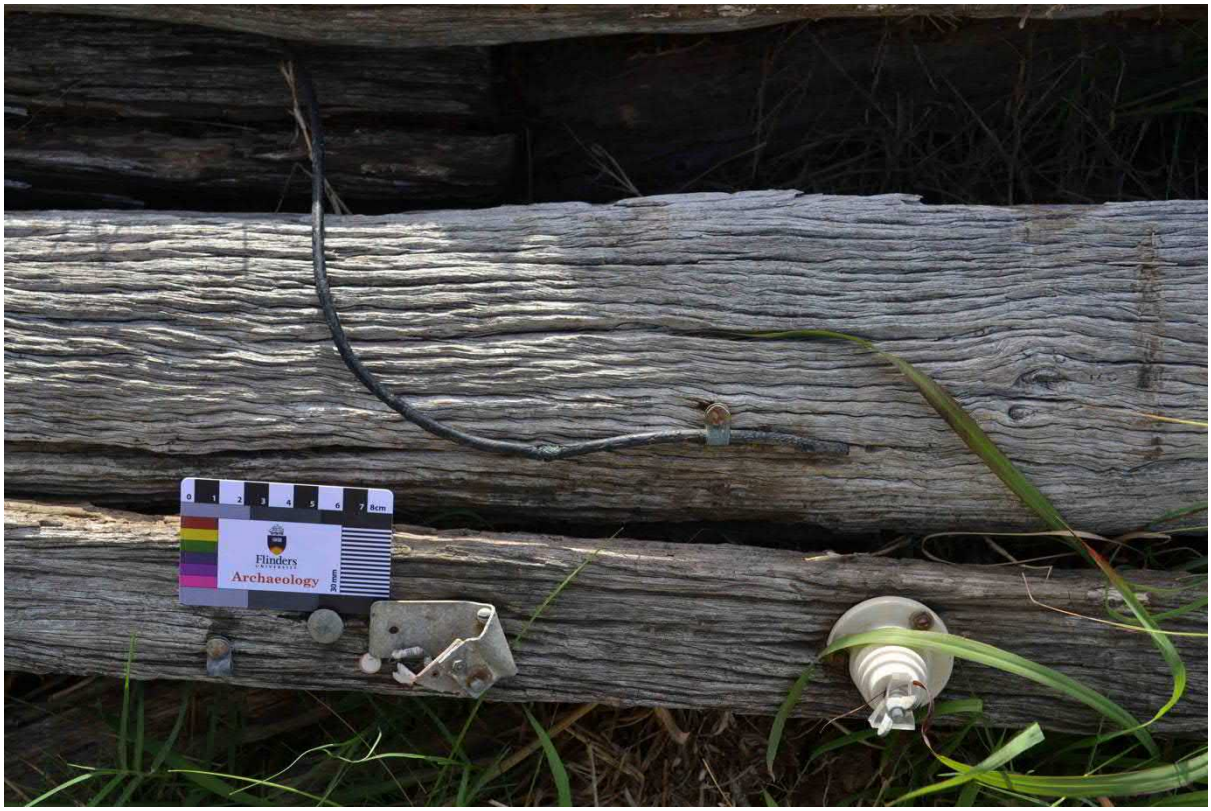

Figure 49 RB8 Shain Cross element.

Thirty metres from RB 8, a further series of rubbish mounds extend to the north, ceasing before the Chris Cross scatter; these are labelled RB9 (Figure 50). All are heavily infested with blackberry. These were not recorded in detail owing to time constraints. They include:

- Four ridged metal cylinders with short rods extruding from the upper surface;
- Long flat corrugated iron on wooden bases from the Chris Cross;
- Angular metal lengths similar to those in other mounds, likely from the Mills Cross; and,
- Wooden poles from the Shain Cross.

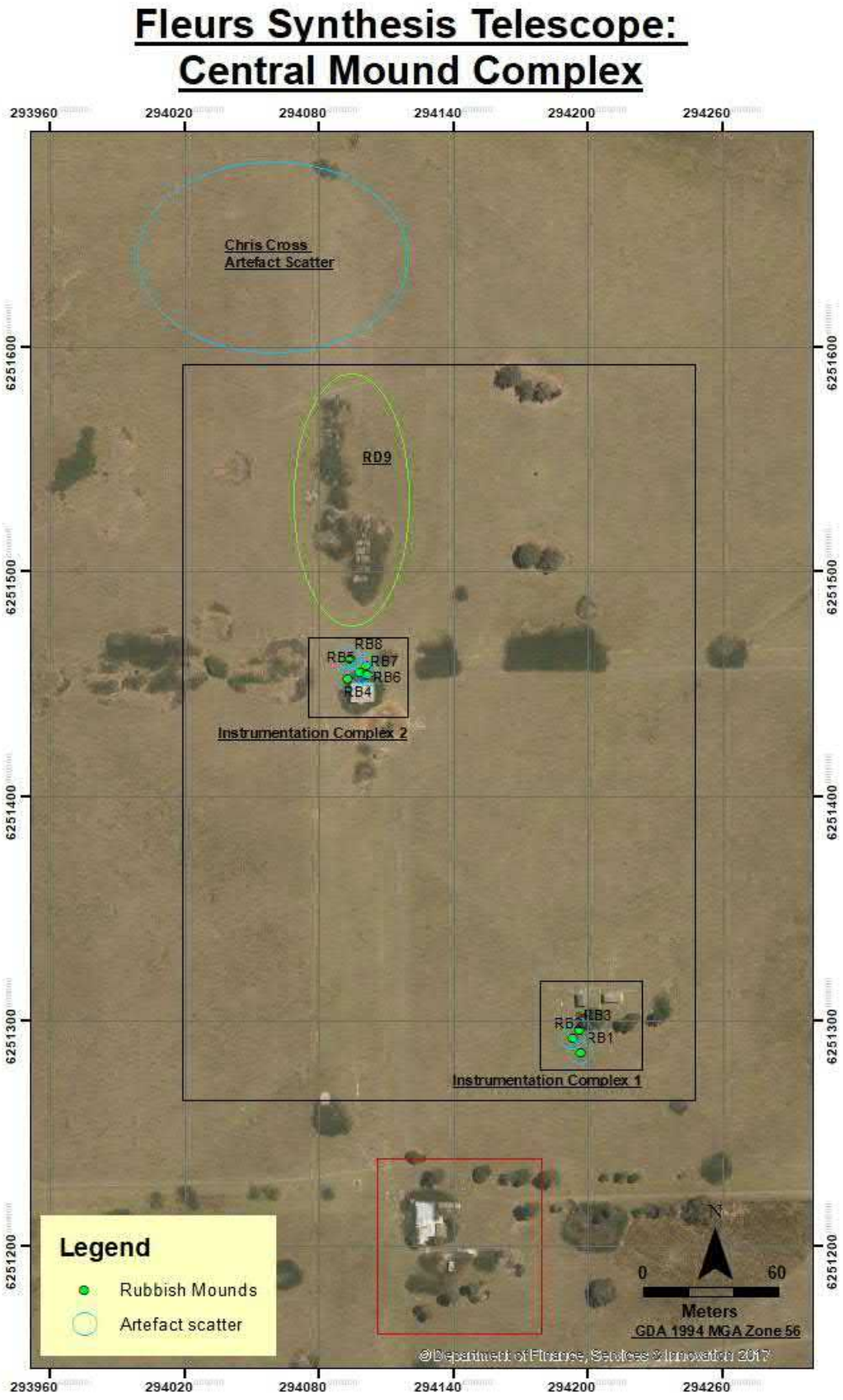

Figure 50 Map showing the Central Mounds Complex.

Kemps Creek Artefact Scatter

This artefact scatter was identified during a vehicle transect of the eastern portion of the site. It is located in the south-east corner of the site on the banks of Kemps Creek, adjacent to the Fleurs aerodrome. The scatter contains parts of possible antenna structure (Figure 51). Chicken wire, a broad mesh wire with 2 cm squares, metal and wooden struts, a 1 m concrete plinth (although not of the blue metal construction), modern ten-holed bricks, glazed ceramic roof tiles, and tin are present both in a mound and scattered over the area. This appears to be a combination of antenna and building remains; it is possible, however, that the artefacts relate to the aerodrome.

Figure 51 Kemps Creek artefact scatter.

DISCUSSION

Working at the Site

The Instrumentation Complex 1 includes a small building containing a kitchen, and toilet and shower facilities. A decorative curtain and small flower bed implies some care to make the building 'homely'. Although not mentioned in any of literature reviewed so far, the building provided a place where food could be prepared and possibly overnight accommodation for one or two staff. This suggests there were times when people were living on site; this may have been the caretaker who is mentioned in a couple of publications, or technical staff when antenna orientations needed to be changed manually. The domestic nature of the kitchen building reminds us that scientific instruments are not disembodied technology but are enmeshed in the lives of those who designed and used them.

The Significance of Cables

Cables are exposed or evident at most parts of Fleurs, e.g. at South Creek 1 and 2, on some Shain Cross elements, and the North Antenna. It is worth noting that some of the most intact parts of the site might be sub-surface in the form of buried cables, which connected the antenna elements to the signal processing units. Later they would also have fed into the computing facilities[1]. While a less visually exciting antenna component than the dish and cross receivers, nonetheless cables were an indispensable part of the antenna operation. Cables relate to the quantity of data received and processed, and the automation of the Chris Cross/FST antenna receivers. The cable infrastructure would have changed several times over the lifetime of the Fleurs antennas as systems were upgraded, extended or reconfigured, particularly when the Chris Cross was transformed into the FST.

Gorman (2016) surveyed the former Orroral Valley NASA satellite tracking station in the ACT. As at Fleurs, the antennas had been removed, leaving only footings. A geophysical survey revealed a number of intact cable trenches and highlighted the role of data processing and cable technology in the development of modern antennas. Like Orroral Valley, subterranean infrastructure may be the most substantial remaining fabric after the removal of the above-ground antennas and associated buildings. Further archival research could produce diagrams of the cable trench layouts at various stages of use and maintenance. Geophysical survey (such as using ground penetrating radar) could verify what, if any, sub-surface cables remain at the present time.

Unknown Antennas

The literature review identified a number of other antennas which were used at various times as part of the main Mills Cross and Shain Cross, or as stand-alone antennas. They are described in Table 1. Given the degree of disturbance at the site, it is not surprising that none of these antennas were identified in the survey, if they indeed survived beyond the 1960s. However, it is possible that some of the material in the rubbish mounds derives from them.

The turnstile antenna in RB4 is not mentioned in literature reviewed to date and its function is currently unknown. Further historical research, oral history and site survey may resolve the identification of the unknown antennas.

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1 In the early days of Fleurs women 'computers' were used as they were at so many other space and astronomy sites, such as Woomera, in the 1950s and 1960s. Before computers came into more common use, women were employed to manually calculate results in aerospace and astronomy facilities across the world.

Date	Description	Notes	Source
1955	19.6 MHz two-element E-W interferometer	Shain; Jovian decametric emissions	Orchiston et al. (2015:7)
1955	14 MHz single in-line array of four half-metre dipoles	Shain; Jovian decametric emissions	Orchiston et al. (2015:7)
1955	27 MHz single in-line array of eight half-wave dipoles	Shain; Jovian decametric emissions	Orchiston et al. (2015:7)
1957–1958	Two helical aerials	Slee; Crab Nebula observations; east of the Mills Cross and used in conjunction with them	Orchiston (2004b:32)
1962	Square array of 19.7 MHz half-wave dipoles	Slee; Jupiter observations; Shain Cross?	Orchiston (2004b:34) Orchiston et al. (2015:10)
1963–1964	Simple array of dipoles	Slee and Higgins; Jupiter observations; Shain Cross?	Orchiston (2004b:34) Orchiston et al. (2015:10)
1963	'Barley-sugar' antennas	Slee and Sheuer	Orchiston (2004b:65)
Unknown	Broadside array	Used to investigate angular sizes of discrete sources	Orchiston et al. (2015:9; Fig. 7)

Table 1 Antennas with unknown locations at Fleurs.

Heritage Landscape Values

From Radar to Radiotelescope

While the Fleurs area forms part of the L27 Heritage Landscape identified by Perumal Murphy (1990), more comprehensive landscape elements have not previously been integrated into the values and definition of this landscape, including the Fleurs telescope infrastructure and the WWII Aerodrome.

Construction on the aerodrome began in 1942. One airstrip was built (Department of Defence 1975), with associated aircraft dispersal hideouts (Australian Govt et al. 2016:64). The 2016 survey (Australian Govnt et al. 2016:64) designated this site M12 H3 and recorded a bitumenised portion of the strip 300 x 25 m, with the remainder of the 1.6 km grassed. They noted that 'Comparatively speaking, however, Fleurs may be of greater intactness than other parent aerodromes developed during the Second World War in Sydney' (Australian Govt et al. 2016:64).

Figure 8 shows the Fleurs antennas in relation to the airstrip. It can be assumed that the presence of gliders in the early years of operation must have been a distinctive visual and aesthetic aspect of working at Fleurs. In terms of the history of technology, the adjacent location of a military airstrip and a radiotelescope site demonstrates the connection between the development of radar in WWII, particularly in relation to air power, and radar as the foundations of post-war radioastronomy. However, the airstrip is likely to be heavily impacted by the motorway development.

The land itself was much more than a setting for the antennas, as the Shain Cross used the ground as a reflector (this role was performed by the chicken wire mesh in the other antennas). While heavily disturbed through ploughing and other agricultural activities, the ground surface can be considered another surviving element of the Shain Cross even where the poles are missing. In this sense, the Shain Cross could be argued to be the most intact array remaining at the site.

The layout of the cross configurations is distinctive. Arrays of receiving elements can be arranged in lines, rows, crosses or circles. Two rows crossing at the midpoints of each to create a square cross was an innovation of Bernard Mills, and the form of the cross arrays at Fleurs shows the mutual influence and feedback between the three astronomers Shain, Christiansen and Mills. The arrangement of three nested cross antennas is even more unusual and does not seem to have occurred at any other location. Without the majority of the antennas present it is difficult to gain a sense of the 'density' of the site which can be seen in photographs, but some elements remain. The

north and south antennas show the orientation of the Chris Cross E-W and N-S arms and the full extent of the FST as it was until the early 1990s. Standing at the SC01 Shain Cross element near the former airfield in the south of the site, you can sight across to the northern surviving elements and experience some sense of the scale of the cross.

Contrasts: From Local to Galactic, Technology and Decay

While individual elements of the remaining antennas are in poor condition, as a landscape the relationship between these elements is significant, particularly in the northern portion of the site where Shain Cross and Northern FST antenna are still intact. The juxtaposition of a dipole array with a dish array is uncommon at contemporary astronomical sites. The northern group of Shain Cross elements and one FST dish shows a contrast between wooden and metal supports, the different technology of the dipole and dish antennas, and a period where both overlapped.

As a cultural landscape encompassing Aboriginal occupation, European settlement and 20th century scientific endeavour, the Fleurs landscape is unusual within the State context. This was not science carried out by 'boffins' sequestered in a laboratory but in the midst of a rural and residential community. The contrast between scientific and rural activities, local and galactic scales, and high technology falling into gentle ruin as the world moves on, imparts a unique aesthetic to this landscape. Such contrasts have been explored by Jenkins and Schofield (2015) in their study of the multi-national super-science research facility at CERN in Switzerland, famous for the discovery of the Higgs-Boson in 2012. Jenkins and Schofield noted the scale of research at CERN—spanning from fundamental particles to deep space galactic mapping, coalesced around an environment which also contains shabby office chairs and abandoned courtyards.

The interpretation potential of the scientific elements of the landscape with the current public interest in Indigenous sky knowledge should be explored.

Issues in Astronomical Heritage

Orchiston (2004a:157, 161) has noted that there is a tendency to favour the heritage of optical telescopes, overlooking the technology and contributions of radiotelescopes. These arrays are often regarded as engineering tools rather than instruments with heritage value in their own right. However, there has been a movement at the international level to recognise the heritage of radioastronomy.

In 2003, a Historical Radio Astronomy Working Group was formed during the International Astronomical Union (IAU) General Assembly in Sydney, to identify, document and preserve historically significant radiotelescopes. Its aims were to:

- assemble a master list of surviving historically-significant radio telescopes and associated instrumentation found worldwide;
- document the technical specifications and scientific achievements of these instruments;
- maintain an on-going bibliography of publications on the history of radio astronomy; and,
- monitor other developments relating to the history of radio astronomy (including deaths of pioneering radio astronomers) (Orchiston et al. 2005:65).

Also in 2003, UNESCO created the Thematic Initiative on Astronomy and World Heritage:

> … to establish a link between Science and Culture towards recognition of the monuments and sites connected with astronomical observations dispersed throughout all the geographical regions, not only scientific but also the testimonies of traditional community knowledge (UNESCO 2012).

In 2017, ICOMOS and the IAU collaborated on a thematic study on astronomical heritage. Among the aims of the study were to 'identify and clarify some of the key issues that arise when assessing astronomical heritage' (Ruggles and Cotte 2017:1) through extended case studies. It includes consideration of the representation of astronomical heritage on national heritage lists.

A proposal of these thematic studies is the idea of 'windows to the universe' (Cotte 2017:7). This theme incorporates:

- The sky or physical universe, as what is observed;
- The place or site, incorporating the atmosphere as the 'glass' through which observations are made and the natural and cultural features of the place including landscape and architecture; and,
- The human eye and brain as the receiver and interpreter of the data – the instruments and artefacts of observation.

Cotte (2017:7) noted that the presence of human observers gives meaning to the place.

While the 'window' can be applied to any instrument, the emphasis on optical data noted by Orchiston is evident here (e.g. Cotte 2017:10). However, the 'window in the sky' theme provides a model for understanding the landscape of Fleurs as a network operating between human workers, the instruments and landscape, and places as close to us as the Sun, and as far away as the Crab Nebula (which is 6523 light years from Earth).

As evidenced by these initiatives from UNESCO and the IAU, there is an increased interest in the history of radioastronomy worldwide. For example, in 2016 a workshop on the history of Canadian radioastronomy was held at the Dominion Radio Astrophysical Observatory in Penticton, BC (Herzberg Astrophysics 2016). In 2018, a book on the lives of four key radioastronomers, including Mills and Christiansen, is being launched in Sydney. The University of Canberra is proposing to carry out a community and science project at Mills' super-cross, the Molonglo array, in 2018. There is increased interest in the life and work of Ruby Payne-Scott as a pioneering Australian scientist, although she did not work directly at Fleurs.

Documenting the fabric and assessing the significance of Fleurs thus becomes part of this international initiative to contextualise the heritage of astronomy with human understandings of their place in the cosmos.

SIGNIFICANCE OF THE FLEURS RADIOTELESCOPE SITE

Fleurs in International and National Context

This section looks at heritage-listed astronomical sites at World Heritage and Commonwealth heritage level to provide context to understanding unique or common features of the Fleurs site.

While it is highly unlikely that the Fleurs site can be argued to have 'outstanding universal significance', it is nonetheless instructive to review the kinds of astronomical values that the World Heritage List (WHL) represents. As summarised in Table 2, there are 20 sites inscribed on the WHL for their astronomical heritage, with a broad chronological spread from 7000 years ago to the 20th century. Of these, six are ancient sites which have astronomical or cosmological associations in their layout and architecture. Nine sites have observatories or instruments which are identified as part of a broader landscape or place. The observatories are all optical, dating to before Jansky's 1932 discovery of extraterrestrial radio signals, and frequently are part of a broader heritage landscape rather than being the focus of the listing. Jantar Mantar is the only site listed for its astronomical heritage alone. The Struve Geodetic Arc and the Varberg Radio Station are the only 20th century sites with astronomical significance represented on the WHL.

The statement for the Struve Geodetic Arc, which crosses the territory of 10 nations, emphasises international scientific collaboration. The Varburg Radio Station features a number of radio antennas used for transatlantic communication, as well as the associated residential and technical buildings. Its original layout is intact and the facilities in excellent condition. It has rarity value as the only surviving site of its kind. The focus is on the entire site including support infrastructure, rather than just the instruments and aerials.

Overall, the WHL properties relating to astronomy reflect Orchiston's (2004a) observation that radioastronomy is underrepresented, as is contemporary scientific heritage.

Site Name	Location	Values	Date
Maya Site of Copan	Honduras	'Major cultural developments took place with significant achievements in mathematics, astronomy and hieroglyphic writing'. Listing does not explicitly identify astronomical features at the site but the architecture and symbolic language reflects Mayan concepts of time and cosmology.	300–900 CE
Jantar Mantar	Jaipur, India	Astronomical observatory with over 20 instruments for naked eye observation. Monumental masonry, Ptolemaic positional astronomy. 'An expression of the astronomical skills and cosmological concepts of the court of a scholarly prince'. Protected under *Rajasthan Monuments Archaeological Site and Antiquities Act 1961*. It was designated a monument of national importance in 1968.	18th century CE, Mughal Period
Pre-Hispanic Town of Uxmal	Yucatan, Mexico	'Unlike most other prehispanic towns, Uxmal is not laid out geometrically. Its space is organized in relation to astronomical phenomena, such as the rising and setting of Venus, and adapted to the topography of the site, made up of a series of hills'. Protected by *1972 Federal Law on Monuments and Archaeological, Artistic and Historical Zones*.	700–1000 CE, late Mayan
Stonehenge, Avebury and Associated Sites	UK	Provides an insight into the mortuary and ceremonial practices of the period, and evidence of prehistoric technology, architecture and astronomy.	Neolithic and Bronze Age (from 5000 BCE)

Table 2 Astronomy-related heritage on the World Heritage List (source: UNESCO). Continued overleaf.

Site Name	Location	Values	Date
Maritime Greenwich	UK	Includes Royal Observatory founded 1675. 'The Royal Observatory's astronomical work, particularly of the scientist Robert Hooke, and John Flamsteed, the first Astronomer Royal, permitted the accurate measurement of the earth's movement and also contributed to the development of global navigation. The Observatory is now the base-line for the world's time zone system and for the measurement of longitude around the globe.'	17th–18th centuries CE
Struve Geodetic Arc	Belarus, Estonia, Finland, Latvia, Lithuania, Norway, Republic of Moldova, Russian Federation, Sweden, Ukraine,	'The Struve Arc is a chain of survey triangulations stretching from Hammerfest in Norway to the Black Sea, through 10 countries and over 2820 km. These are points of a survey, carried out between 1816 and 1855 by the astronomer Friedrich Georg Wilhelm Struve, which represented the first accurate measuring of a long segment of a meridian. This helped to establish the exact size and shape of the planet and marked an important step in the development of earth sciences and topographic mapping. It is an extraordinary example of scientific collaboration among scientists from different countries, and of collaboration between monarchs for a scientific cause. The original arc consisted of 258 main triangles with 265 main station points. The listed site includes 34 of the original station points, with different markings, i.e. a drilled hole in rock, iron cross, cairns, or built obelisks'.	1816–1855 CE
Historic Monuments and Sites in Kaesong	Korea	Includes Kaesong Chomsongdae, an astronomical and meteorological observatory; protected by *Law of the Democratic People's Republic of Korea on the Protection of Cultural Property (1994) and its Regulations (2009)*.	10th–14th centuries CE, Koryo Dynasty
Historic Monuments of Dengfeng in 'The Centre of Heaven and Earth'	Mount Songshang, China	Includes Dengfeng Observatory, named after an early capital city, 'associated with an area to the south of Mount Shaoshi and Mount Taishi, two peaks of Mount Songshan'. These peaks are considered 'the centre of heaven and earth—the only point where astronomical observations were considered to be accurate'.	11th century BCE – 13th century CE
El Tajin, Pre-Hispanic City	Mexico	'The 'Pyramid of the Niches', a masterpiece of ancient Mexican and American architecture, reveals the astronomical and symbolic significance of the buildings'.	9th–13th centuries CE
Archaeological Monuments Zone of Xochicalco	Mexico	Pyramid of the Plumed Serpents has high relief sculptures with figures interpreted as astronomers.	650–900 CE
Aflaj Irrigation Systems of Oman	Oman	'The fair and effective management and sharing of water in villages and towns is still underpinned by mutual dependence and communal values and guided by astronomical observations'.	2500 BCE–present
Lines and Geoglyphs of Nasca and Palpa	Peru	'The geoglyphs depict living creatures, stylized plants and imaginary beings, as well as geometric figures several kilometres long. They are believed to have had ritual astronomical functions'.	500 BCE–500 CE
Medieval Town of Toruń	Poland	Includes house of Copernicus: 'A fine example is the house in which Nicolaus Copernicus was reputedly born in 1473; it has been preserved as a museum devoted to the famous astronomer's life and achievements'.	13th–15th centuries CE
Cahokia Mounds State Historic Site	USA	'The mounds served variously as construction foundations for public buildings and as funerary tumuli. There was also an astronomical observatory ("Woodhenge"), consisting of a circle of wooden posts'.	800–1400 CE, Mississippian period

Table 2 continued. Continued overleaf.

Site Name	Location	Values	Date
Tiwanaku: Spiritual and Political Centre of the Tiwanaku Culture	Bolivia	Includes 'the Kalasasaya, a large rectangular open temple, believed to have been used as an observatory'.	500–900 CE
Palaces and Parks of Potsdam and Berlin	Germany	'With 500 ha of parks and 150 buildings constructed between 1730 and 1916, Potsdam's complex of palaces and parks forms an artistic whole, whose eclectic nature reinforces its sense of uniqueness' includes Babelsberg Observatory.	1730–1916 CE
Gyeongju Historic Areas	Republic of Korea	Includes the Cheomseongdae Observatory.	7th–10th centuries CE
Samarkand – Crossroad of Cultures	Uzbekistan	'The major monuments include the Registan Mosque and madrasas, Bibi-Khanum Mosque, the Shakhi-Zinda compound and the Gur-Emir ensemble, as well as Ulugh-Beg's Observatory'.	7th–14th centuries CE
Varberg Radio Station	Grimeton, Sweden	'The Varberg Radio Station at Grimeton in southern Sweden (built 1922–1924) is an exceptionally well-preserved monument to early wireless transatlantic communication. It consists of the transmitter equipment, including the aerial system of six 127 m high steel towers. Although no longer in regular use, the equipment has been maintained in operating condition. The 109.9 ha site comprises buildings housing the original Alexanderson transmitter, including the towers with their antennae, short-wave transmitters with their antennae, and a residential area with staff housing. The architect Carl Åkerblad designed the main buildings in the neoclassical style and the structural engineer Henrik Kreüger was responsible for the antenna towers, the tallest built structures in Sweden at that time. The site is an outstanding example of the development of telecommunications and is the only surviving example of a major transmitting station based on pre-electronic technology'.	1920s CE

Table 2 continued.

The Australian Commonwealth Heritage List (http://www.environment.gov.au/heritage/places/commonwealth-heritage-list) lists six places with astronomical heritage, ranging in time period from the early 1800s to the 1970s. As with the WHL, with three of these places (Davis Station, Fort Gellibrand, King Family) the astronomical features are one component of a broader heritage landscape and are not the primary focus of the listing. The remaining three are Mt Stromlo, the Microwave Landing System at Tullamarine airport, used for aircraft, and the Canberra Deep Space Communications Complex (Tidbinbilla), which is based around radiotelescopes but only an indicative place at this stage.

Mt Stromlo is primarily an optical observatory, but Professor Bart Bok, Director of Mt Stromlo 1957–1966, was a prominent supporter of radioastronomy in Australia. He 'forged close links with the Sydney radio astronomers' (Robertson 2007), recognising the importance of integrating optical and radio observation data. However, it does not seem that radioastronomy was ever actively pursued at Mt Stromlo. The Commonwealth Heritage Listing notes that the layout of the precinct contributes to its significance (Table 3).

In 2003, Mt Stromlo was devastated in the Canberra firestorm. Five telescopes, workshops, residences and the heritage-listed administration building were destroyed. While most instruments have been replaced, and the site returned to full operation, the approach to the affected infrastructure reflects more contemporary heritage philosophies. Rather than remove all traces of the fire, burnt telescope domes have been left as memorials (Australian National University 2015). This approach involves 'embracing the scars and ruins as an integral part of Canberra's heritage values—making the Mount Stromlo Observatory available to the public for reflection and

appreciation of the devastation that is embedded in the landscape' (Jackson 2015). Heat-affected artefacts from the fire are held in the collections of the National Museum of Australia (NMA). They include 'one molten telescope mirror; one molten optical glass (flint); one burnt auto collimator from late 1950s; one yellow pyrex mirror blank; one teacup with molten aluminium roof attached' (NMA catalogue). Destruction and decay are increasingly seen as a feature of the heritage values of a place, rather then necessarily detracting from it (e.g. De Silvey 2017).

The Microwave Landing System Antennas (INTERSCAN) at Melbourne Airport are directly related to radioastronomy research carried out by CSIRO. The antennas are no longer used, but they were a prototype of a technology which was adopted around the world. NASA incorporated a version of the Microwave Landing System at the Wallops Flight Facility in Virginia and at the Space Shuttle Landing Facility in Florida (Engineers Australia 2013). The system was designed by the Division of Radio Physics at CSIRO, led by Dr Paul Wild, and the antennas were constructed by AWA Ltd. Part of the technology had originally been developed at Parkes (Engineers Australia 2013).

In 2013, when the site was nominated, several components of the system were still in their original location; however, many had been exposed to the elements without maintenance and were in poor condition (Engineers Australia 2013:17). One transmitter, used for the guidance signal, is currently held at the Airways Museum in Victoria.

Dr Paul Wild was a member of the Division of Radiophysics from 1947, working on solar research with Lindsay McCready under Pawsey's direction. He did not use the Fleurs antennas, but was involved at projects at other field sites in the Penrith area (Engineers Australia 2013:32) and later at Dapto. His research led to the establishment of the Culgoora Heliograph antenna array, which replaced some of the capacity formerly invested in Fleurs. In 1971, Wild became the Director of CSIRO's Division of Radiophysics, succeeding Taffy Bowen. He saw the INTERSCAN project as a natural direction to take the expertise gained in radioastronomy (Engineers Australia 2013). Hence this CHL site has a direct link to the technology and heritage of Fleurs.

The Canberra Deep Space Communication Complex (CDSCC; Tidbinbilla) is an active NASA spacecraft tracking station that is part of a global network including stations at Goldstone in the US and Madrid in Spain. The antennas are parabolic dishes, which listen to spacecraft such as the Voyager deep space probes. The CDSCC was commissioned and paid for by NASA and is operated by Australian staff. The technology is similar to Fleurs, although the targets are different. The CDSCC also participates in VLBI astronomy (Ed Kruzens, Director, pers. comm.).

At the National/Commonwealth level, radioastronomy is again underrepresented, but the themes present in the sites in Table 3 show the significance of Australian technological innovation and international cooperation.

Name	Location	Values	Date
Microwave Landing System Antennas	Melbourne Airport, Tullamarine Freeway, VIC	'The INTERSCAN project was Australia's response to the International Civil Aviation Organization's challenge for member States to develop a microwave landing system to replace the many non-standard ILS installations at civil airports around the world. INTERSCAN was the Australian name patented for its version of MLS. The name is a neologism, derived from the words Time INTERval SCANning system. It was the result of collaboration between science (The Commonwealth Scientific and Industrial Research Organisation - CSIRO), design and precision manufacturing (Amalgamated Wireless of Australia Limited - AWA) and civil aviation navigation aids engineering (Department of Civil Aviation until 1973, and then the Department of Transport - Air Transport Group [DCA/DoT])'. The signal format and antenna design were based on CSIRO Radio Astronomy research work.	1972
Mt Stromlo Observatory	ACT	'Mount Stromlo Observatory Precinct, an optical astronomical research complex arranged across the ridge of a mountain, is a significant cultural landscape with a surviving richness of features including the mountain top landscape setting. Despite serious damage by the January 2003 bushfire, significant elements continuing to contribute to the heritage values of the place include the standing and remnant structures of the telescope dome building, the administration buildings, housing, gardens, workshop, the Duffield grave, utility structures, remaining landscape features, and the layout pattern of the complex'.	1911–present
Davis Station Group	Antarctica	'A temporary camp was established and work commenced on the first station building on January 13. When the Kista Dan departed on 20 January, Davis station consisted of seven buildings—a Sleeping Hut, Community Hut, combined Engine Room/Workshop/Bathroom building, an Auroral Observatory, a Store Hut, a Balloon Filling Hut and a Theodolite Shelter'.	1957
Fort Gellibrand Commonwealth Area	Morris Street, Williamstown, VIC	'In the 1830s, when the Port Phillip area was still part of the colony of New South Wales, Governor Bourke ordered that part of Gellibrand's Point (as it was then known) be reserved for navigational aid and military defence purposes. A beacon for shipping was constructed in 1839, and the settlement of Williamstown developed nearby. In the 1850s the Point Gellibrand area became the site of the first Government Observatory, a port, a temporary prison, and rail and telegraph links were built'.	1830s
King Family Farm Sites and Trees	Links Road, North St Marys, NSW	'The King family were free settlers and in 1806 Governor Philip Gidley King granted his legitimate children Elizabeth, Maria, Mary, Philip Parker and his wife Anna Josepha, some thousands of acres in the area. The Kings constructed two homesteads on their grants. Dunheved was constructed on land granted to the wife of the Governor, Anna Josepha King and situated to the east of South Creek and Elizabeth Farm was located west of the creek. Both dwellings date from c 1807, although it is likely that two homestead dwellings were built during the life of Dunheved. The second Dunheved homestead appears in a 1920s photograph showing a corrugated iron roof, front verandah, side timber wall, French doors at front and double hung six pane windows on the side. On the Dunheved archaeological site the homestead appears to be a brick building on stone foundations that was surrounded by a verandah. The Dunheved complex included an observatory, stables and coachhouse'.	1806

Table 3 Astronomy-related sites on the Commonwealth Heritage List (source: Australian Heritage Inventory). Continued overleaf.

Name	Location	Values	Date
Tidbinbilla Tracking Station	ACT; Indicative place	In the 1960s NASA established three space tracking and communication networks each of which were supported in Australia. Manned Space Flight Network (MSFN), Satellite Tracking and Data Acquisition (STADAN) and Deep Space Network (DSN). The first MSFN station in Australia was Carnarvon (WA) 1963-75. The second was Honeysuckle Creek which opened in 1965 and provided additional tracking and communications support for the Apollo program from 1968-72, and Skylab from 1973-74. During the late 70s the workload at Honeysuckle Creek decreased and the station ceased operation in December 1981 and residual tasks were transferred to Orroral and CDSCC, Tidbinbilla. In October 1962 a team from NASA's Jet Propulsion Laboratory (JPL) together with Australian Government experts, identified the site in Tidbinbilla Valley for a space tracking station as best satisfying the specified criteria: (i) protection, in the form of hills, from city radio interference and from other stations to be established in the area, and a level valley floor of stable bedrock, and (ii) to be within 240 km of a major support centre with international airport, and within 30 to 50 km of a local support centre (for workforce).	1962–present

Table 3 continued.

Appendix A is a survey of radio antennas in Australia, from the most recent to the earliest (from the 1940s). The table states the date of construction where this is presented, and the current status of the site or antennas if known. The information is compiled from easily accessible sources and is far from complete; however, it does serve to illustrate the general historical trajectory of this technology, and the changing functions of radio antennas in Australia. It could be outlined thus:

- 1940s: WWII radar technology, establishment of early radioastronomy principles;
- 1950s: Many former WWII radar stations are co-opted into radioastronomy by CSIR. Development of innovative new antenna types; Australia assumes international prominence in radioastronomy. Antenna types include crosses and arrays; Yagis, interferometers, broadsides, parabolic dishes, and turnstiles. There is a diversity of antenna types frequently combined into novel arrangements. New configurations are being devised and tested. The Sydney region is the major hub of technology and science;
- 1960s: 'Big Science' with the construction of the Parkes dish and Molonglo Mills Cross; radio antennas applied to satellite tracking and human spaceflight programs in the USA. The dominance of the dish antenna emerges in Australian science and satellite programs;
- 1970s: Radio antennas become a key element in satellite-based telecommunications and in defence signal intelligence;
- 1980s: the launch of the Aussat telecommunications satellites leads to the construction of numerous ground stations. National rather than state-based radiotelescope facilities such as ACTA;
- 1990s: more diverse industries around defence and commercial operations, e.g. Lockheed Martin; and,
- 2000s: Mopra, VBLI and a return to arrays with the Murchison Widefield Array as planning for the Square Kilometre Array commences.

While the current status of all the antennas in Appendix A is not known, it is clear that many key antenna sites from the 1940s–1960s have been destroyed, cannibalised or allowed to decay. Of 13 radioastronomy facilities from the 1940s–1950s, remaining structures are :

- Receiver hut at Potts Hill (NSW);
- Radar building on North Head (NSW);
- Grote Reber's radio shack at Bothwell (Tas);
- A shed at the Llanherne array site (Tas); and,
- 'Some relics' at Kempton (George et al. 2015:20) (Tas).

The Fleurs antennas, materials and infrastructure are thus rare surviving elements of low frequency radioastronomy.

The antennas of comparable age in Tasmania were dipoles and dipole arrays, similar to Shain's Potts Hill array. The cross configuration invented by Mills is distinct to the NSW radioastronomy group shows that the cross arrays developed by Mills, Shain and Christiansen, while foundational in the growth of Australian radioastronomy, were superseded by a reliance of smaller numbers of antennas which were more usually parabolic dishes. Of the two arrays that succeeded Fleurs, Culgoora (circular) and Molonglo (cross), only one arm of the Molonglo array is still operational. The other cross interferometer type, the NASA Minitrack antenna, was used for early satellite tracking. There was one in Australia, originally located at Island Lagoon and subsequently removed to Orroral Valley. Of this array, only the footings survive (Gorman 2016).

Within Australian radioastronomy, the cross arrays are a unique instrument type invented here, from a period of experimentation when the potential of radioastronomy to answer the big questions of the universe was being established. There are no equivalent antennas in other states, nor a site which contains multiple and successive examples of radiotelescopes as the field grew from wartime radar to international collaboration, a trajectory culminating in the Square Kilometre Array.

The Burra Charter

Article 1.2 of the internationally recognised Burra Charter (Australia ICOMOS 2013) defines cultural significance as:

> … aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.

The practice note on cultural significance elucidates these values (Table 4), which are incorporated into the NSW State Heritage significance criteria. The criteria and their application to Fleurs are discussed in the following section.

NSW State Heritage Significance Criteria

An item is considered to be of State (or local) heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the criteria described below, as outlined by the Office for Environment and Heritage guidance on inclusions and exclusions (Office of Environment and Heritage 2001). For each criterion, the value assigned in the preliminary assessment by Australia Govt et al. (2016) is followed by a revised assessment based on the present research and survey. For each criterion it is stated whether Fleurs meets State and/or Local significance thresholds.

Value	Definition
Aesthetic	The sensory and perceptual experience of a place—that is, how we respond to visual and non-visual aspects such as sounds, smells and other factors having a strong impact on human thoughts, feelings and attitudes.
Historic	Includes the history of aesthetics, art and architecture, science, spirituality and society. A place may have historic value because it has influenced, or has been influenced by, an historic event, phase, movement or activity, person or group of people. It may be the site of an important event. For any place the significance will be greater where the evidence of the association or event survives at the place, or where the setting is substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of such change or absence of evidence.
Scientific	The information content of a place and its ability to reveal more about an aspect of the past through examination or investigation of the place, including the use of archaeological techniques. The relative scientific value of a place is likely to depend on the importance of the information or data involved, on its rarity, quality or representativeness, and its potential to contribute further important information about the place itself or a type or class of place or to address important research questions.
Social	The associations that a place has for a particular community or cultural group and the social or cultural meanings that it holds for them.
Spiritual	The intangible values and meanings embodied in or evoked by a place which give it importance in the spiritual identity, or the traditional knowledge, art and practices of a cultural group. Spiritual value may also be reflected in the intensity of aesthetic and emotional responses or community associations, and be expressed through cultural practices and related places. Spiritual values may be interdependent on the social values and physical properties of a place.

Table 4 Burra Charter (2013) types of significance.

Themes

Fleurs relates to a number of historic themes at National and State level. They are:

Australian Historic Themes Framework

Theme 3, Developing Local, Regional and National Economies

- 3.14 Developing an Australian engineering and construction industry
  - 3.14.2 Using Australian materials in construction
- 3.17 Inventing devices

NSW Historical Themes

Theme 3, Developing Local, Regional and National Economies

- Exploration. Activities associated with making places previously unknown to a cultural group known to them, e.g. maps;
- Science. Activities associated with systemic observations, experiments, and the processes for the explanation of observable phenomena, e.g. experimental equipment, observatory, research station, university research reserve;
- Technology. Activities and processes associated with the knowledge or use of mechanical arts and applied sciences, e.g. computer, telegraph equipment;
  - Labour. Activities associated with work practices and organized or unorganized labour, e.g. staff change rooms, servants quarters, kitchen; and,
  - Education. Activities associated with teaching and learning by children and adults, formally and informally, e.g. university campus, field studies centre.

Criterion (a) an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)

Assessment by Australian Govt et al. (2016)

Fleurs was 'historically important at periods of the State's history—in the development of radiophysics during the 1950s and 1960s'. It has potential historical significance at a local or State level. However, the low to moderate intactness of the site may reduce it to local significance (Australian Govt et al. 2016:77).

Revised 2018 Assessment

While radioastronomy has been practiced at other scientific sites in Australia (Appendix A) the CSIRO field sites around Sydney were the location of the major developments in the field of radioastronomy following WWII. These were the places where Mills, Christiansen, Payne-Scott, Pawsey and others established some of the fundamental principles of radioastronomy. This work established the CSIRO as a world leader, as evidenced by the 1952 URSI conference taking place here. Fleurs was significant as the field site which hosted the mature technologies of the interferometer, Mills Cross and cross grating antennas. Hence it can be argued that Fleurs represents a period, prior to the development of the ATNF, where state-based research was leading the way.

Tangible elements relating to state significance are standing elements of the Shain Cross and the FST, and the materials of Mills Cross, Chris Cross and FST located in rubbish mounds scattered across the site. While the telescopes are not in good condition and are completely dismantled in some cases, intactness is not a reason for exclusion (OEH 2001:12).

At the local level, Fleurs is one site of a number of research stations in the area, including the University of Sydney McGarvie Smith Farm, established in 1936 for veterinarian studies (Australian Govt et al. 2016:139–146), and the CSIRO McMaster Animal Health Research Farm (M12 H4; Australian Govt et al. 2016:124–127). It forms one component of a wider landscape of institutional research facilities interspersed with small scale pastoral and horticultural industries— science at local scale.

Intrusive values are associated with agricultural activities such as pasture, fencing, and ploughing, which have contributed to the erasure of the original ground reflecting surfaces and obscured the visibility of the Shain Cross.

Inclusion Guidelines Satisfied

1. Shows evidence of a significant human activity; and,
2. Is associated with a significant activity or historical phase.

Level of Significance: Local and State

Criterion (b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area);

Assessment by Australian Govt et al. (2016:78)

Not assessed.

2018 Assessment

Fleurs is associated with pioneering radioastronomers Bernard Mills, Bruce Slee, Alex Shain, Chris Christiansen, Charlie Higgins and J.L. Pawsey. It represents a significant chapter in the history of the CSIRO's Division of Radiophysics, which was the foundation of the CSIRO's continuing work in radioastronomy. The ground-breaking scientific contributions of these astronomers has been extensively researched by scholars such as Orchiston (see References). Both Mills and Christiansen became professors at the University of Sydney, which supported Christiansen's continued work on the Chris Cross and FST. As a school of radioastronomy, these men were technological innovators, dedicated teachers and pioneers of Australian science with international reputations, who launched Australian science onto a world stage.

Mills, Shain and Christiansen were each primarily responsible for the design, construction and operation of the antenna which bears their name, although there was clearly also much cross-fertilisation of ideas. The final configuration of the arrays indicates both individual achievement and the impacts of working in a close-knit research group which fostered innovation and experimentation.

The astronomers of Fleurs are associated with State, National and International networks of scientists. Their integration into, or participation in, the local community is not known.

Inclusion Guidelines Satisfied

1. Shows evidence of a significant human occupation
2. Is associated with a significant event, person, or group of persons

Level of Significance: State

Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

Assessment by Australian Govt et al. (2016:78)

Not assessed.

2018 Assessment

The antennas demonstrate a high degree of both creative and technical achievement by prominent NSW scientists and technicians. Radioastronomy is now an integral part of astronomy, with a multitude of telescopes worldwide. However, in the 1940s and 1950s, it required true creativity and imagination to devise innovative instruments and visualise their signals to portray a 'vision' of the universe which barely existed before. These antennas were integral to the global effort to map the radio universe and understand its relationship to the optical universe. The surveys carried out at Fleurs from the 1950s to the 1980s resolved many of these disparate data sources, enabling us to more fully understand the structure of the universe. The construction and design of the antennas is directly related to a way of perceiving the universe.

While scientific instruments are not always associated with aesthetic values, there are some themes that emerge from Fleurs (Table 5). The selection of Fleurs for the siting of the arrays was due to the availability of a sufficiently large area of flat ground in a radio-quiet area, thus relating to local topography. The repetition of modular elements in all three crosses also lends a distinctive appearance, although this is now only evident in the remaining Shain Cross elements.

The individual elements of the telescopes are in various states of decay. Further elements have been dismantled and are stockpiled in the rubbish mounds. As noted for the management of heritage values at Mt Stromlo following the 2003 fires, in recent years such decay and destruction are being recognised as having social and aesthetic value in their own right. While nothing as dramatic as a firestorm occurred at Fleurs, there was nonetheless at least two moments of destruction, in the 1990s and in 2005 when the bulk of the site was bulldozed and the materials stockpiled. The demolition created dis-array of the arrays, disrupting the careful geometry that listened to the sky. The antennas have not entirely left the site: they are simply deconstructed, re-arranged from an organic assemblage forming a complete unit, into a bricolage of body parts and groupings defined by material and form.

With the exception of the two FST dishes, the remainder of the antenna parts are not sufficiently different from average rural construction materials to be immediately identifiable as scientific instruments. The dishes are an unusual and uncommon feature in the local landscape, where nothing else like them exists; however, due to the flat topography and degree of vegetation along the creek lines, they are not easily visible from surrounding roads and properties.

Unlike many dish antennas at major astronomical and satellites tracking stations in Australia, which imported their antennas from the USA, the Fleurs antennas were all manufactured in NSW. Further research could identify how distinctive their style is in comparison to imported antennas.

Inclusion Guidelines Satisfied

1. Shows or is associated with creative or technical innovation or achievement
2. Is aesthetically distinctive
3. Exemplifies a particular taste, style or technology

Exclusion Criteria

1. Has lost its design or technical integrity
2. Its positive visual or sensory appeal or landmark and scenic qualities have been more than temporarily degraded

Level of Significance: Local and State

Element	Theme	Notes
South Creek 2 Antenna and North Antenna	Decay, ruin	'Ruin porn' theme in contemporary archaeology and urban design; evokes sadness, sympathy, the passing of time.
Shain Cross	Bush, electricity	Construction uses elements of and resembles power lines; 'low tech' aesthetic to achieve 'high tech' effects. Visually, the Shain Cross blends in with the landscape among other wooden posts relating to power structures and fences. The Shain Cross footprint is indistinguishable from a generic cleared bush landscape, despite listening to the universe.
Mills Cross	Texture: metal struts and chicken wire	Chicken wire mesh used as reflectors in all three of these antenna arrays gives a distinctive appearance: the sky can be seen through the mesh and the antennas appear 'light' in contrast to more solid dishes. This appearance is reinforced by the open structure of the Chris Cross/ FST antenna bases, which resemble legs able to be pulled from the earth to stalk through the landscape. Chicken wire provides an aesthetic continuity with the small-scale agricultural and residential landscape of the surrounding area, where chicken wire would be used for fencing, animal and enclosures etc. The metal struts of the Mills Cross resemble fence elements. The geometric pattern of the Chris Cross/FST dishes is enhanced by the transparence of the chicken wire which enables the interplay of the circular and angular pipe structures to be clearly seen.
Chris Cross	Texture: metal struts, pipes and chicken wire	
FST	Texture: metal struts, pipes and chicken wire	

Table 5 Aesthetic themes at Fleurs.

Criterion (d) an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

Assessment by Australian Govt et al. (2016:78)

Not assessed.

2018 Assessment

The associations with the site for the local community at the present time would require further consultation. However, it is clear that there has been an interest in Fleurs in the past. For example, local historian Stacker (2002) included the Fleurs antennas in her 2002 pictorial history of Penrith and St Mary's. The 2005 demolition of the Mills Cross and Chris Cross antennas were, as reported by Orchiston et al. (2005:68), a result of concerns about children playing in the structures. This implies it was frequent enough an activity to warrant concern, and speaks to the re-purposing of the antennas into an informal playground for local children—a charming (albeit alarming from the safety perspective) image. The feelings of the children deprived of their cosmic playground are unknown. However, the ease with which the process of demolition was suggested and approved suggests that the local adult community did not have strong associations with the science or aesthetic qualities of the Fleurs infrastructure.

The site has very strong associations for the NSW, national and international astronomy community, including people who worked on the various antennas, former students at the University of Sydney and University of Western Sydney, and historians of astronomy. Numerous works by Orchiston and others, and the continued concern of the IAU radioastronomy working group, emphasise that the physical infrastructure of antennas is meaningful for them, as demonstrated in this quote from Orchiston (2004b:68) prior to the final destruction of the Chris Cross:

> … a visit to Fleurs reveals that the novel Mills Cross and Shain Cross antennas are no more, having long ago rotted, rusted and disintegrated. Thus, to track Slee's initial exploits in radio astronomy is to explore the early history of these Radiophysics field stations and to mourn the loss of so much of our pioneering radio astronomical heritage. We can but hope that reason will prevail and that those early radio telescopes that have survived, including the 18-m Kennedy parabola at Parkes, parts of the Chris Cross and the Fleurs Synthesis Telescope at Fleurs, and the Radioheliograph and Radiospectrograph at Culgoora, will be restored and preserved for posterity.

With increased interest in the life and work of Ruby Payne-Scott and Australian women scientists generally, the community of women involved with the Fleurs site should not be forgotten. A footnote in a published research paper acknowledges the work of two women who performed calculations for the antennas before computers were installed. The work of women 'computers' is increasingly being highlighted at places like the Defence space launch site of Woomera, and further research would undoubtedly lead to the identification of more women involved with science at Fleurs.

Inclusion Guidelines Satisfied

1. Is important for its associations with an identifiable group.

Level of Significance: Local and State

Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

Assessment by Australian Govt et al. (2016:78)

'Inherent to most of the sites inspected as part of the March 2016 survey, is a level of research significance. This is largely attributable to the moderate intactness of most of these items. Ranging from the nature of historical community social hubs such as those at Cecil Park, through to the experimental undertakings of institutions in the twentieth century across domains as diverse as radiophysics, animal husbandry, and military defence.'

Australian Govt et al. (2016:78) concluded that Fleurs has research potential, despite compromised intactness.

Revised 2018 Assessment

The site has the potential to contribute to the understanding of the manufacture, and hence the science and technology 2018, behind the construction of early radiotelescopes. These materials are still present on the site, although the Mills Cross and Chris Cross are mainly represented in the rubbish mounds. As the controversy over the 2C catalogue demonstrates, the nature of the instruments was integrally bound up with what was perceived, and hence the theories the data supported. The antennas and their remains are tangible evidence of two intangibles: the radio waves they were designed to pick up, and the cultural context of how the universe was understood in the 1950s and 1960s. The changing configurations of the antennas reflect a positive feedback loop whereby data from one iteration led to the refining of hypotheses and redesigning of the antenna configurations to validate new theories. Without the (admittedly compromised) physical remains at the site, it would not be possible to pursue research into the social context of the technology. Subterranean evidence of cable infrastructure may reveal successive phases of development such as automation, the move from employing women 'computers' to electronic computers, and increased power demands as the sophistication of the capacity of instruments increased.

Inclusion Criteria Satisfied

1.Has the potential to yield new or further substantial scientific and/or archaeological information
2. Is an important benchmark or reference site or type
3. Provides evidence of past human cultures that is unavailable elsewhere

Level of Significance: State

Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

Assessment by Australian Govt et al. (2016:78)

The Fleurs Radio Telescopes are rare examples of early radiophysics technology in Australia, providing the lead in this field during a narrow window of innovation between 1954 and 1963. Further historical and archaeological research is required to determine whether significance is at State or local level due to various compromises to the site's integrity.

Revised 2018 Assessment

There are few extant remains at other Division of Radiophysics field sites around Sydney. An antenna footing survives at Dover Heights along with a replica antenna created as a memorial. Orchiston notes that of all these significant sites, including Badgerys Creek and Penrith (Figure 4), only the 12 Chris Cross antennas survived in 2004 (Orchiston 2004a:161); four were removed to unknown locations, and none now survive at the site. Fleurs appears to be all that remains as physical fabric in its original location.

In the Australian context, the only comparable antenna arrays were built by Grote Reber in Tasmania (see Appendix A); his square kilometre dipole array at Bothwell and other non-dish antennas no longer exist. The Molonglo Mills Cross, the technological successor of the Fleurs Mills Cross, is still in operation using one arm.

Appendix A shows that there are no other cross antennas or low frequency arrays surviving nationally. Original Mills Cross antennas are rare globally, as the parabolic reflector has superseded cross, horn and other configurations as the most common form of antenna. For example, the Seneca Mills Cross, influential for its role in the discovery of Jovian radio emissions, was destroyed at some point between 1955 and 2005 (however, it is on the Maryland State Heritage Register). The Stanford University (California, USA) Mills Cross antenna at Site 515 was destroyed in 2010, much to the dismay of the IAU's Working Group on Historic Radio Astronomy (Orchiston and Kellerman 2010:246). Orchiston (2004a) pointed to the rapidly disappearing infrastructure of radio astronomy in Australia and the central significance of Fleurs in this history. Hence the remaining Shain Cross and FST antennas, based on Mills' principles, are both rare and endangered.

Inclusion Criteria Satisfied

1. Provides evidence of a defunct custom, way of life or process
2. Demonstrates a process, custom or other human activity that is in danger of being lost
3. Shows unusually accurate evidence of a significant human activity
4. Is the only example of its type
5. Demonstrates designs or techniques of exceptional interest
6. Shows rare evidence of a significant human activity important to a community

Level of Significance: Local and State

Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW's

- cultural or natural places; or
- cultural or natural environments
- (or a class of the local area's cultural or natural places; or cultural or natural environments).

Assessment by Australian Govt et al. (2016:78)

Australian Govt et al. (2016:79) stated that 'In nearly all cases, further historical and/or archaeological research is required to fully assess both the significance and intactness of both the sites identified during this project, and those identified from previous studies.'

Revised 2018 Assessment

The current survey indicates that Fleurs retains portions of the fabric of a scientific field site, in the topography required for the construction of long antenna arrays, and the remnants of the arrays which partially show the original layout in the distinctive cross shape. It demonstrates the characteristics of an early radioastronomy field site, the only one which retains archaeological evidence of the early development of radioastronomy in NSW and nationally.

Inclusion Criteria Satisfied

1. Has the principal characteristics of an important class or group of items
2. Has attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity
3. Is a significant variation to a class of items
4. Is outstanding because of its integrity or the esteem in which it is held

Level of Significance: Local and State

According to the criteria listed in Table 6 Fleurs has moderate heritage value and fulfils the criteria for State heritage listing. It is noted that the site probably has National heritage significance as well, but this requires a separate assessment.

Table 7 grades the significance of Fleurs elements recorded during the survey.

Grading	Justification	Status
EXCEPTIONAL	Rare or outstanding element directly contributing to an item's local and State significance.	Fulfils criteria for local or State listing.
HIGH	High degree of original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfils criteria for local or State listing.
MODERATE	Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.	Fulfils criteria for local or State listing.
LITTLE	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or State listing.
INTRUSIVE	Damaging to the item's heritage significance.	Does not fulfil criteria for local or State listing.

Table 6 Relative heritage value (from OEH 2001).

Site	Element	Grading	Justification
South Creek 1 Antenna Complex	Signal box	High	In excellent condition; demonstrates a key part of antenna operation.
	3 x plinths	Little	Function unknown, position disturbed.
	Cable trench	Moderate	This is the only location at the site where cables are exposed, with the potential for further research on the operation of the FST antennas.
	Antenna footing trench	Little	The trench indicates where an antenna has been removed from the site but provides no further information about its operation or configuration.
South Creek 2 Antenna Complex	FST	Exceptional	One of only two extant antennas remaining on the site. Demonstrates how the Chris Cross was augmented to become the FST. Although collapsed, the dish is sufficiently intact to allow recording of its configuration and allow comparison with the North Antenna and FST antennas located at CSIRO Marsfield and Parkes.
	Signal box	Moderate	Mostly identical to Signal Box 1 but in poorer condition.
	Power structure	Little	The purpose of the structure is unclear.
	Fenced enclosure	Little	A later addition to protect the antenna and signal box from stock and other damage; unrelated to original function.
North Antenna Complex	FST	Exceptional	One of only two extant antennas remaining on the site. Demonstrates how the Chris Cross was augmented to become the FST and the aesthetic impact of the height and texture of the structure within its setting. The antenna is standing although damaged by rust and in a precarious position.
	3 x plinths	Little	Intact position, but function unknown.
	Fenced enclosure	Little	A later addition to protect the antenna and signal box from stock and other damage; unrelated to original function
Shain Cross	SC01	Exceptional	One of seven intact elements of the Shain Cross array in its original location, demonstrating Shain's technological innovation as well as Slee's alterations which continued the active life of the array after Shain's death. Demonstrates an unusual radiotelescope type as used in the early decades of the international development of radioastronomy.
	SC02	Exceptional	As above. SC02-SC07 show how the Shain Cross poles were aligned in offset pairs.
	SC03	Exceptional	As above.
	SC04	Exceptional	As above.
	SC05	Exceptional	As above.
	SC06	Exceptional	As above.
	SC07	Exceptional	As above.

Table 7 Gradings of Fleurs antenna and infrastructure elements. Continued overleaf.

Site	Element	Grading	Justification
Central Mound Complex	Chris Cross artefact scatter	Little	Demolition debris heavily disturbed by ploughing and other agricultural activities.
	Instrumentation complex 1	Moderate	Buildings in poor condition with asbestos contamination issues. Demonstrate data processing aspect of antenna operation and working conditions of Fleurs staff.
	RB1	Moderate	Mills Cross and/or Chris Cross fabric; only extant remains of these arrays. Demonstrates the manufacture and construction of the arrays.
	RB2	Moderate	Mills Cross fabric.
	RB3	Moderate	Mills Cross fabric.
	Instrumentation building 2	Moderate	In poor condition with asbestos contamination. Original instrumentation building for the Mills Cross array. Demonstrate data processing aspect of antenna operation and working conditions of Fleurs staff. Some processing/computing units and documents inside.
	RB4	High	Contains turnstile antenna, which demonstrates additional astronomical activity at the site at a different level to the crosses, perhaps relating to a specialist experiment.
	RB5	Moderate	Possibly related to Mills Cross.
	RB6	High	Counterweights from the original Chris Cross array; the most intact component present on the site; demonstrates the pre-automation configuration of the antennas.
	RB7	Moderate	Not clear which instrument it is related to.
	RB8	High	Includes Shain Cross elements.
RB9 rubbish mound complex		High	Includes Shain Cross antenna elements and Chris Cross infrastructure elements.
Kemps Creek artefact scatter		Little	Low possibility of antenna components; most likely related to non-astronomical activities at the site.

Table 7 continued.

Impacts

A section of the Shain Cross including SC01, and the South Creek 1 and 2 antenna complexes lie within the present road corridor in red (Figure 52). Other elements of the landscape are unlikely to be directly impacted by road construction and operation at this time, subject to recommendations regarding managing heritage.

Figure 52 Fleurs antenna infrastructure in relation to the M12 corridor.

Without a detailed plan of final road design and construction methods, precise impacts are difficult to define. However, common road construction activities such as vegetation clearance, vehicle traverse, plant operation, laydowns and excavation all have the potential to damage or impact on the significant fabric of these sites.

The longer term impacts of the proximity of vibration and traffic fumes on the significant fabric is unknown.

Table 8 outlines the potential impacts and recommendations for the affected elements, and the implications for the significance of Fleurs as a whole if they are impacted by the proposed motorway. The recommended buffer zones are outlined in red in Figure 53.

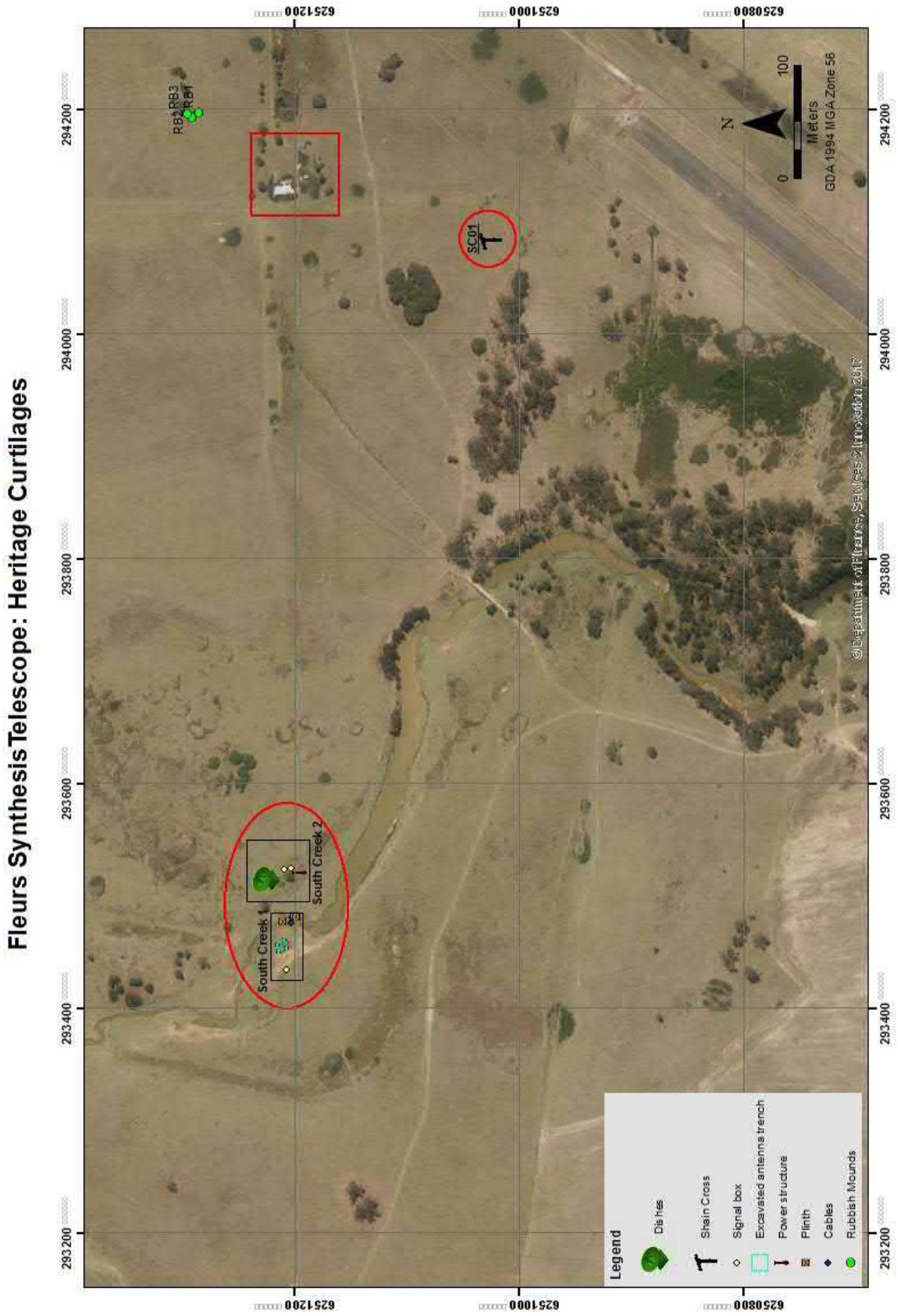

Figure 53 Recommended heritage curtilages.

Element	Condition	Significance	Impact	Recommendation	Effect if Impacted
Shain Cross SC01	Intact but deteriorating	High. This is the terminal element of the N-S arm of the Shain Cross, aligned with several further elements at the northern end of the site.	High, due to its proximity to the proposed road.	SC01 should be left in situ and a buffer 50 m in diameter (i.e. 25 m from the SC01 pole) maintained around it. No vehicle entry or road construction activities should take place within this zone. Archival photographic recording should be undertaken.	SC01 is the southernmost element of the cross demonstrating the scale and original layout of the N-S arm. SC02-SC07 demonstrate the spacing of poles but not the extent of the cross.
South Creek 1 Antenna Complex	Good.	Low, as the antenna has been removed. However, the 'signal box' is intact and in good condition. The plinths have been moved from original location and cables are exposed.	Moderate, due to proximity of creek and distance from motorway.	The signal box, trench, plinths and cables are not to be disturbed and are to be left in situ. A 25 m buffer zone should be maintained around the site. No vehicle entry or road construction activities should take place within this zone. Archival photographic recording should be undertaken	The cables have research potential but there are likely intact cables at other parts of the site. Another 'signal box' is present on site.
South Creek 2 Antenna Complex	Poor	High. This is one of two FST elements remaining on site, and despite having collapsed, the structure is in better condition than the North antenna, (which will not be impacted).	Moderate, due to proximity of creek and distance from motorway.	The power structure, signal box and antenna are not to be disturbed and are to be left intact. A 25 m buffer zone should be maintained around the site. No vehicle entry or road construction activities should take place within this zone. Archival photographic recording should be undertaken	Damage or removal of the antenna impacts on the visual representation of the extent of the FST, in relation to the North Antenna.

Table 8 Condition, significance and impact and recommendations.

Statement of Significance

The Fleurs Radiotelescope Site was a CSIRO facility established in the 1950s for radioastronomy research. Three innovative antenna arrays were designed and built in order to pick up low frequency radio signals from galaxies, the Sun and Jupiter. Radioastronomy was a new area of research emerging from WWII radar technology, and through these antennas, Australia became a world leader, a position it still holds today.

The astronomers Bernard Mills, Chris Christiansen, Alex Shain, Bruce Slee and others used the antenna arrays to map the non-visible part of the universe, made 'visible' for the first time through this technology. The data they gathered contributed to cosmological theories of the origin of the universe, particularly in the Steady State vs Big Bang debate. As a school of radioastronomy, these men were technological innovators, dedicated teachers and pioneers of Australian science with international reputations.

The antennas demonstrate a high degree of both creative and technical achievement by prominent NSW scientists and technicians. In the 1940s and 1950s, it required true creativity and imagination to devise innovative instruments and visualise their signals to portray a 'vision' of the universe which

barely existed before. The construction and design of the antennas is directly related to a new way of perceiving the universe.

The Chris Cross, Mills Cross and Shain Cross were composed of identical antenna elements in long lines forming a symmetrical cross shape. The cross formation created an artificial 'dish' the length of the cross arms. While many antenna types can be grouped together to form arrays, the cross formation was devised and tested by Bernard Mills and is associated with him.

The Chris Cross comprised 64 traditional 'dish' antennas. The Mills Cross was made of 'hurdle'-shaped supports covered in chicken wire which collected the radiowaves. The Shain Cross used wire dipole antennas strung between power poles. In the 1960s, the Chris Cross was extended by adding new dish antennas and became the Fleurs Synthesis Telescope. The Fleurs site was selected because it was both large and flat enough to encompass the long arms of the arrays. As the Shain Cross used the ground as a reflector, the landscape itself can be regarded as a component of the antennas.

The antenna arrays at Fleurs were actively used to gather data about the solar system and distant galaxies until the 1990s, by which time they had been superseded by high-frequency dish antennas. In 2005 large parts of the infrastructure were demolished or removed. Remaining telescope infrastructure at the site is two 13.7 m dishes from the Fleurs Synthesis Telescope, seven intact power poles from the Shain Cross, and elements of the Mills Cross and Chris Cross scattered between stockpiles of demolition material.

The aesthetic qualities of the site contrast high science with a typical rural landscape. The dishes of two remaining Fleurs Synthesis Telescope dish antennas, one of which has fallen, retain their original chicken wire mesh reflecting surfaces and reveal the geometric structure of the dishes. The position of the dishes and several remaining Shain Cross poles show the extent of the original cross arrays placed across the landscape. The state of decay, while diminishing the integrity of the elements, conveys a distinct aura of the passing of time and the integration of the telescopes into the natural environment.

The site has very strong associations for the NSW, national and international astronomy community, including people who worked on the various antennas, former students at the University of Sydney and University of Western Sydney, and historians of astronomy.

The site has the potential to contribute to the understanding of the manufacture, and hence the science and technology, behind the construction of early radiotelescopes. These materials are still present on the site, although the Mills Cross and Chris Cross are mainly represented in the rubbish mounds. The antennas and their remains are tangible evidence of the radio waves they were designed to receive, and the cultural context of how the universe was understood in the 1950s and 60s. Subterranean evidence of cable infrastructure may reveal successive phases of development such as automation, the move from employing women as 'computers' to electronic computers, and increased power demands as the sophistication of the capacity of instruments increased.

There are few extant remains at other CSIRO radioastronomy field sites around Sydney. Fleurs appears to be all that remains as physical fabric in its original location. Nationally, no other cross antennas or low frequency arrays survive. Original Mills Cross antennas are rare globally, as the parabolic reflector has superseded cross, horn and other configurations. Hence the remaining Shain Cross and FST antennas, based on Mills' principles, are both rare and endangered.

Fleurs retains portions of the fabric of a scientific field site, in the topography required for the construction of long antenna arrays, and the remnants of the arrays which partially show the original layout in the distinctive cross shape. It demonstrates the characteristics of an early radioastronomy field site, the only one which retains archaeological evidence of the early development of radioastronomy in NSW and nationally.

These antennas were integral to the global effort to map the radio universe and understand its relationship to the optical universe. The surveys carried out at Fleurs from the 1950s to the 1980s enabled us to more fully understand the structure of the universe. The CSIRO's field sites, including

Fleurs, were the focal point of radioastronomy research in Australia.

The site is considered to have State and potentially National significance as evidence of ground-breaking scientific discoveries, leading to revisions of our understanding of the origins of the universe, and as evidence of Australia's pre-eminence in the international development of radioastronomy. There is renewed interest in the history of radioastronomy due to Australia's key role in the Square Kilometre Array, to which the Fleurs antennas can be considered historical precursors. The elements are considered to have outstanding interpretive potential.

RECOMMENDATIONS

As part of the Western Sydney Infrastructure Plan, RMS is proposing to build the M12 Motorway to provide direct access to the planned western Sydney airport at Badgerys Creek and Sydney's motorway network. The proposed M12 Motorway would run east-west between the M7 Motorway, Cecil Hills and The Northern Road, Luddenham.

The preferred route corridor passes through the southern portion of a former CSIRO/University of Sydney research site. The Fleurs field site was the location of four innovative antennas that were an integral part of Australia's post-war leadership in the new field of radioastronomy. These were the Mills Cross, Chris Cross, Shain Cross and Fleurs Synthesis Telescope (FST). The site and its surviving fabric is of State heritage significance. Fleurs is listed in the Penrith LEP as a site of Local significance.

A survey of non-Aboriginal heritage, conducted as part of the route options study in 2016, identified the Fleurs site as potentially having significance at a State or National level and recommended further investigation. The current survey was undertaken to contribute to a Statement of Heritage Impact (SOHI), in support of an environmental impact statement (EIS) being prepared for the M12 Motorway by the Jacobs-Arcadis Joint Venture.

The survey found that one element of the Shain Cross may be impacted by the Motorway development. A set of installations, including an antenna, from the FST are also within the corridor. Other remaining antenna infrastructure is not directly impacted but requires further consideration, including a standing FST antenna in the north of the site and an intact portion of the Shain Cross. Both FST antennas are in situ but in poor condition.

It is recommended that:

- All extant elements of the radiotelescopes and associated infrastructure, including rubbish mounds, are to be left intact;
- SC01 should be left in situ and a buffer 50 m in diameter maintained around it. No vehicle entry or road construction activities should take place within this zone;
- At South Creek Antenna Complex 1 the signal box, trench, plinths and cables are not disturbed and left in situ. A 25 m buffer zone should be maintained around the site. No vehicle entry or road construction activities should take place within this zone;
- At South Creek Antenna Complex 2, the power structure, signal box and antenna are not disturbed and left intact. A 25 m buffer zone should be maintained around the site. No vehicle entry or road construction activities should take place within this zone;
- Ground penetrating radar, or other remote sensing survey techniques, should precede any ground disturbance;
- A heritage sub-plan should be prepared to describe how the heritage values of the site will be conserved and managed during the construction of the road;
- Contractors and subcontractors working in the area must be informed of the buffer zones, the elements and their significance, to prevent accidental damage or encroachment;
- A Conservation Management Plan should be made for the entirety of the Fleurs Field Site; and,
- The University of Sydney seek advice about the process of nominating the site to the State Heritage Register

Recommended whole-of-site heritage conservation and management issues:

- This technical heritage assessment is to be shared with other owners of the former Fleurs site;
- A Conservation Management Plan for the entire Fleurs site should be prepared;
- Urgent assessment of the structural condition of the North Antenna is required;
- The North Antenna and Shain Cross are preserved as a significant scientific cultural landscape;

- The rubbish mounds should NOT be cleaned up without an assessment and attempt to relate materials to the different antennas. The 'rubbish' is significant fabric, and could be used to reconstruct parts of the antennas for educational or interpretive purposes;
- The antenna fabric preserved in the rubbish mounds should be considered for re-use within new residential or business developments;
- Social significance to the local community and to the astronomical community should be further explored through an oral history program, for example, with scientists such as John Bunton who worked on the FST;
- Further work should be undertaken at the ATNF Historic Photograph Archives, which contains approximately 50,000 images from 1939 onwards (Orchiston 2001:12);
- Consultation should occur with the International Astronomical Union Working Group on Historic Radio Astronomy as a group which represents stakeholders with a close relationship to the Fleurs site; and,
- Assessment be undertaken to determine if Fleurs meets the criteria for National Heritage Listing.

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APPENDIX A

SURVEY OF RADIO ANTENNAS IN AUSTRALIA

Site	Operator	Description	Status	Date
Mawson Lakes	SpeedCast/Airbus	Skynet, UK Defence	Operational	2016
Darwin Weather Data Earth Station	BoM	Shoal Bay, NT. One or more satellite antennas that receive data either in L-band or X-band.	Operational	2015?
Mawson Lakes Earth Station	NewSat/SpeedCast?	12 antennas from 2.4 to 13 m in diameter, with C and Ku - band capabilities to 12 geosynchronous satellites	Unclear	2013?
Australian Square Kilometre Array Pathfinder (ASKAP)	CSIRO; ATNF	Murchison, WA. Murchison Radio-Astronomy Observatory (MRO) 700-1800 MHz. 36 x 12 m parabolic dishes.	Operational	2012
Yatharagga Satellite Station (West Australian Space Centre)	Swedish Space Corporation	Near Yarragadee, WA. Geodesy and satellite laser ranging. A US Navy telescope is located at the facility.	Operational	2012
AuScope Very Long Baseline Interferometer (VLBI) Array	Geosciences Australia, University of Tasmania	12 m VLBI dishes located at Katherine, (NT), Yaragadee (WA) and Mt Pleasant (Tas). Also 26 m Mt Pleasant used. Geodetic data.	Operational	2009
IMOS Townsville		QLD. At least one receiving antenna	Operational	2008
Australian Defence Satellite Communications Station	US/Australia	Kojarena, near Geraldton, WA. Signals intelligence facility with four satellite tracking dishes.	Operational	2007
Murchison Widefield Array (MWA)	Consortium	Murchison, WA, Murchison Radio-Astronomy Observatory (MRO). 80-300 MHz. Fixed 128 array of 16-element dual-polarisation antennas covering 80-300 MHz. SKA Pathfinder.	Operational	2007
Mopra Radio Telescope	CSIRO, ATNF	Near Coonabarabran, NSW. 0.3 – 100 GHz. 22 m dish	Operational	2006
New Norcia Deep Space Antenna 1	ESA/ESTRAK	New Norcia, WA. 35 m dish antenna, 4.5 m dish, various other facilities. Deep space missions and LEOPS. Gnangara functions moved here on closure	Operational	2000
BLUEsat UNSW/ACSER Groundstation	UNSW	Kensington, NSW. Microsatellite ground station using Yagi antennas	Operational	2000s
Shoal Bay Receiving Station	Australian Signals Directorate	Shoal Bay, NT. Signals intelligence. 17 dish antennas.	Operational	1999?
Uralla Lockheed Martin Earth Station	Lockheed Martin	Uralla, NSW. Telemetry, tracking and command services for a wide range of customers. 2 x 14.2 m parabolic dish antennas, 1 x 3.8 m antenna, 1 x 4.3, 1 x 2.4 m	Operational	1998
Crib Point Satellite Earth Station	BoM	HMAS Cerberus Naval Base, near Crib Point, Vic. Meteorological Satellite Earth Station for Japanese and Chinese weather satellites.	Operational	1991
Perth WASTAC Earth Station	BoM, Murdoch, Curtin, CSIRO, GA	Murdoch University, WA. An L and X-band receiver.	Operational	1989?

Site	Operator	Description	Status	Date
Australia Telescope Compact Array (ACTA)	CSIRO, ATNF	Narrabri, NSW. Paul Wild Observatory 0.3 – 110 GHz. 6 x 22 m dish synthesis array. Built on Culgoora site	Operational	1988
Davis Station	BoM, AAD	Antarctica.	Operational	1987
Perth Station	ESA/ESTRACK	Gnangara, WA 15 m-diameter full-motion S/X-band tracking antenna, relocated from Carnarvon together with infrastructure. Tracking ESA Earth observation, science and navigation missions	Decommissioned	1987
Belrose Optus Earth Station	Optus Singtel	Belrose NSW, Optus 44 antennae, 8 tracking and 36 fixed.	Operational	1985
Mount Pleasant Radio Observatory	University of Tasmania	Hobart, Tasmania. Three radio telescopes: the 1.2–23 GHz. 26 metre dish antenna, formerly located at Orroral Valley NASA Tracking Station ACT and still used for satellite tracking; the 14 metre Vela Antenna and 12-metre AuScope VLBI Antenna.	Operational	1985
Joint Defense Facility Pine Gap	USA, Aust Department of Defence	Near Alice Springs, NT. Took over Nurrungar functions after closure. Signals intelligence. 14 dish antennas with radomes.	Operational	1970
Joint Defense Facility Nurrungar	USAF, Aust Department of Defence	Woomera SA (near Island Lagoon). Dish antenna with radome. Cold War 'early warning' defence; space surveillance	Abandoned 1999	1969
OTC Earth Station Carnarvon	Australia/NASA/ESA	Carnarvon, WA. Heritage-listed 'Casshorn' horn antenna, 30 m parabolic dish. Satellite tracking, Apollo, telecommunications satellites. It has local, national and international cultural-heritage significance. The Carnarvon Space and Technology Museum opened in 2012.	Partially decommissioned, some elements operational	1969
Ceduna Radio Observatory	University of Tasmania	Ceduna, SA. Formerly Ceduna 1 Satellite Earth Station owned by Telstra (OTC); transferred to UTas in 1995. 1.2–23 GHz 30 m telescope	Operational	1969
Culgoora Radioheliograph	CSIRO	Near Narrabri, NSW. 96 x 13 m dish antennas. Replaced by ACTA. Four antennas have been removed to the Boonah Space Centre (amateur SETI research) and dismantled. One is part of a BoM/IPS facility	Mostly demolished	1967
Honeysuckle Creek Tracking Station	NASA	Near Canberra, ACT. Apollo 11, Skylab, Deep Space Network	Demolished	1967
Cooby Creek Tracking Station	NASA	Toowoomba, QLD; Applications Technology Satellite (ATS) programme. 12 m dish, GEO satellite tracking and Apollo testing. Steerable crossed Yagi antenna, smaller VHF antennas. Operations buildings were demountables.	Equipment removed 1970	1966
Orroral Valley Tracking Station	NASA	Near Canberra, ACT; STADAN Network. LEO satellites. 26 m antenna now at Mt Pleasant. Numerous Yagi and smaller dishes. 9 m is now at CDSCC. Island Lagoon Minitrack moved here.	Demolished	1965
Canberra Deep Space Communications Complex (CDSCC)	CSIRO, NASA JPL	Tidbinbilla, ACT. 1x70m dish, 2x34m dishes. Spacecraft tracking	Operational	1965

Site	Operator	Description	Status	Date
Casey Station	BoM, AAD	Antarctica. A dome-covered satellite communications antennae.	Operational	1964-1969?
Carnarvon Tracking Station	NASA	Carnarvon, WA. Satellite tracking; Gemini, Apollo, Skylab programmes. Replaced Muchea and some Muchea equipment was moved here. Includes an FPQ-6 precision tracking radar, a STADAN scientific satellite tracking facility, a Jupiter monitoring system, and a Solar Particle Alert Network (SPAN) facility. 26 m dish antenna	Demolished	1963
Bothwell	Grote Reber	'Dennistoun', near Hobart, Tas. Wire dipole array supported by 20 m wooden poles, 114 m long over 120 ha or one square kilometer, 0.5 to 2.1 MHz, built by Reber and G.R. Ellis. Reber's 'radioshack' is now part of the Grote Reber Museum.	Demolished	1962
Parkes Radio Telescope	CSIRO, ATNF	Parkes, NSW 64 m telescope (2nd largest movable dish in the Southern Hemisphere), US Network; Apollo 11 tracking. Still used for satellites. One Fleurs FST antenna.	Operational	1961
Mirikata	WRE	Woomera, SA, Rocket tracking and human spaceflight.	Abandoned/ looted	1960s
Melbourne University	Melbourne University	Parkville, Vic. Australis Oscar V amateur satellite tracking station	Unknown	1960s
Molonglo Observatory Synthesis Telescope (MOST)	University of Sydney	Molonglo, NSW. 600-1200 MHz. East-west arm of the former Molonglo Cross Telescope, approximately 1.6 km in length. Cylindrical paraboloid	Operational	1960
Lagoon Tracking Station	NASA, WRE	Woomera, SA. Station 9, Manned Space Flight Network; 85 m dish. Tracked Project Mercury. Also included a Minitrack interferometer, cross formation	Demolished	1960
Red Lake	WRE/NASA	Woomera, SA. FPS-16 radar antenna used to track rocket launches, NASA telemetry dish antennas for Projects Mercury and Gemini.	Unknown	1960
Muchea Tracking Station	NASA,WRE	Muchea, WA. Project Mercury. Station 8, Manned Space Flight Network. A small commemorative display on site	Demolished	1960
Murraybank	CSIRO	West Pennant Hills, NSW. 21 ft dish aerial based on Chris Cross design; receiver hut; small reference aerial transferred from Potts Hill.	Demolished	1954
Fleurs	CSIR/CSIRO/University of Sydney	NSW. Shain Cross, Mills Cross, Chris Cross, Fleurs Synthesis Telescope and a number of other antennas	Partially demolished	1953
Dapto	CSIRO/University of Wollongong	NSW. Radiospectrograph; three rhombic antenna interferometer	Demolished	1952
Kempton	Grote Reber	Tas. Wire dipole strung between two hills.	Some relics remain	1954
Llanherne Array	University of Tasmania	Near Hobart airport, Tas. Dipole arrayBuilt by G.R. Ellis. One shed remains.	Demolished	1950s
North Head	CSIR	NSW. Former radar station established 1940?	Original radar building survives	1950s?
Georges Heights (on Middle Head)	CSIR	NSW. Former radar station; antenna relocated to Potts Hill	Demolished	1950s?

Site	Operator	Description	Status	Date
Badgerys Creek	CSIR	NSW. A three-dish interferometer and broadside arrays.	Demolished	1949
Penrith	CSIR	NSW. Radiospectrograph – wire and wood manual aerial	Demolished	1949
Potts Hill	CSIRO	NSW. Swept-lobe interferometer; 36 ft 'transit' dish; 18 ft paraboloidal dish; prototype Mills Cross; solar grating interferometer	Receiver hut restored by Sydney Water in 2015	1948
Hornsby Valley	CSIR	NSW. Interferometer arrays – early Shain.	Demolished	1947
Collaroy	CSIR	NSW. Former radar station radar aerial adapted for radioastronomy. Radar station established 1942.	Demolished	1945
Dover Heights	CSIR	NSW. Former radar station; two-element Yagi; eight-element Yagi; 12-element Yagi; sunken in-ground dish known as 'hole in the ground'. Radar station established 1940	Demolished	1943-1947
Culgoora	BoM/IPS	NSW. Monitoring space weather. A 12 cm solar telescope, a 30 cm heliostat, a solar radiospectrograph which appears to be an original Culgoora antenna.	Operational	Unknown
Dongara Satellite Station	Swedish Space Corporation/US	Near Yarragadee, WA Polar and LEO satellite tracking. Three dish antennas and some minor antennas.	Operational	Unknown
Regency Park Optus Earth Station	Optus Singtel	Regency Park, SA. Intelsat Earth station with 1 tracking and 2 fixed antennae and serves as a Tracking, Telemetry & Control backup site	Operational	Unknown
Lockridge Optus Earth Station	Optus Singtel	Lockridge, WA. 12 tracking and 10 fixed antennae	Operational	Unknown
Oxford Falls Optus Earth Station	Optus Singtel, Intelsat	Oxford Falls, NSW. 8 antennas (4 tracking)	Operational	Unknown
Tasmanian Earth Resources Satellite Station (TERSS)	BoM/CSIRO/GA/UTas /IMOS	Hobart, Tas. X-band groundstation designed and built in Australia.	Decommissioned 2014	Unknown
Bassendean Earth Station	NewSat	Bassendean, WA. 11 antennas from 2.4 to 13 m in diameter, with C and Ku - band capabilities to 9 geosynchronous satellites	Unknown	Unknown
Sydney BoM Earth Station	BoM	Sydney, NSW. One or more satellite antennas that receive data either in L-band or X-band.	Operational	Unknown
Melbourne BoM Earth Station	BoM	Melbourne, Vic. One or more satellite antennas that receive data either in L-band or X-band.	Operational	Unknown
Mawson Station	BoM, AAD	Antarctica. Satellite communications antenna.	Operational	Unknown
Macquarie Island Station	AAD	Antarctica. Satellite communications antenna.	Operational	Unknown

Annexure B. Historical Archaeological Assessment, Research Design and Test Excavation Report: Former Cecil Park Historical Complex (Jacobs 2019)

Australian Government

BUILDING OUR FUTURE

NSW GOVERNMENT

Former Cecil Park Historical Complex

Historical Archaeological Assessment, Research Design and Test Excavation Report

Roads and Maritime Services | October 2019

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Glossary of terms and abbreviations

Term	Meaning
ACHAR	Aboriginal cultural heritage assessment report
ARD	Archaeological Research Design
CHL	Commonwealth Heritage List
Construction footprint	The construction footprint is the area required to build the project. This includes the area required for temporary work such as sedimentation basins, drainage lines, access roads, construction ancillary facilities.
CSSI	Critical state significant infrastructure
DP	Deposited plan
DPC	Department of Premier and Cabinet
DPIE	Department of Planning, Industry and Environment
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).
HAARD	Historical Archaeological Assessment and Archaeological Research Design
Heritage Act	*Heritage Act 1977* (NSW)
ICOMOS	International Council on Monuments and Sites
Jacobs	Jacobs Group (Australia) Pty Ltd
LGA	Local government area
M12 Motorway	The proposed M12 Motorway which is the subject of this document (also known as 'the project')
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales
OEH	Office of Environment and Heritage (Note: only refer to this agency where it is relevant as this agency is now DPC (Heritage) for non-Aboriginal heritage requirements)
Operational footprint	Generally includes the M12 Motorway and additional areas required for operation and maintenance of the project
PAD	Potential archaeological deposit
Roads and Maritime	Roads and Maritime Services
SEARs	Secretary's environmental assessment requirements
SEPP	State environmental planning policy
SHI	State Heritage Inventory
SHR	State Heritage Register
SoHI	Statement of heritage impact
SSI	State significant infrastructure
TfNSW	Transport for New South Wales

Executive summary

Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). The project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport.

Purpose and content of this report

This report includes a historical archaeological assessment, archaeological research design and presents the results of an historical archaeological test excavation of a former historical complex identified in Cecil Hills (previously known as Cecil Park), Western Sydney NSW (Lot 1 DP724970) (the subject site) – identified as Cecil Park School, Post Office and Church Site (Item 8) in the non-Aboriginal heritage assessment for the project. The complex consists of a former school, church and post office that occupied the site from 1895 to 1965 and which was identified as having potential for historical archaeological relics associated with that phase of occupation.

This report has been prepared to support the non-Aboriginal heritage assessment for the M12 Motorway project (the project), which will inform the Environmental Impact Statement (EIS). The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364) and to enable the Minister for Planning to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to impact on the former Cecil Park historical complex.

The report includes an archaeological assessment and research design for the Cecil Park historical complex, which was prepared in accordance with the *NSW Heritage Council's Archaeological Assessment Guidelines* (1996). It also provides a description of historical archaeological relics identified by archaeological test excavation and a response to research design questions posed to guide the investigation. The report is designed to be included as an appendix to the non-Aboriginal heritage assessment for the project.

Results

Historical research has confirmed that the subject site once housed a complex of former buildings associated with the village of Cecil Park, including the school and teacher's residence, the post office and the School Church of St Paul. The predominantly timber buildings were progressively added to the site from 1895 through to 1903 and became a social hub for the small rural location. The buildings were occupied until the 1950s prior to their demolition / removal.

Archaeological survey revealed that the site is relatively undisturbed and has a moderate potential for archaeological remains of the former Cecil Park historical complex. These remains were predicted to include structural remains (brick footings and post holes) and deeper subsurface features, such as wells, rubbish pits or cess-pits.

Archaeological test excavation has confirmed the predictions of the archaeological assessment, ie that the site is relatively undisturbed and that archaeological relics of the former Cecil Park historical complex have survived. These relics include intact brick footings of the former c1898 Cecil Park school, including a former

annex attached to the main school building, and a brick and mortar base, possibly for a stove. The footings were found below and in association with demolition fill containing occasional ceramic, glass and metal pieces, buttons, animal bone pieces with cut marks, and a marble. Given the integrity of the footings, it is likely that some *in situ* deposits associated with occupation of the school will survive within the broader building footprint. An artefact and charcoal rich deposit was also found in the footprint of the former c1906 St Paul's timber church. The deposit was found in association with broken bricks and may be the remains of a disturbed fireplace. Further investigation, including manual excavation of the deposit and surrounding rubbish piles, is needed to confirm this initial interpretation.

The subject site maintains its significance at a local level for its historical heritage value, research potential and for its potential social heritage values. Further archaeological salvage excavation and associated artefact analysis would provide insights into the changing layout of the building complex and the lives of the children, teachers and worshippers that lived at Cecil Park during the late 19th and early 20th centuries.

Conclusion

As the project is likely to impact archaeological evidence of the Cecil Park historical complex, further archaeological salvage excavation is recommended. This stage of excavation would ideally be carried out as part of the pre-construction phase of the project in accordance with the project approval.

1. Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). The project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport. The project would commence about 30 kilometres west of the Sydney central business district, at its connection with the M7 Motorway. The project traverses the local government areas of Fairfield, Liverpool and Penrith. The suburbs of Cecil Park and Cecil Hills are found to the east of the M12 Motorway, with Luddenham to the west.

The project is predominately located in greenfield areas. The topography in and around the project comprises rolling hills and small valleys between generally north–south ridge lines. The existing land uses are semi-rural residential, recreational, agricultural, commercial and industrial. The main residential areas are Kemps Creek, Mount Vernon and Cecil Hills.

The project is required to support the opening of the Western Sydney Airport by connecting Sydney's motorway network to the airport. The project would also serve and facilitate the growth and development of Western Sydney which is expected to undergo significant development and land use change over the coming decades. The motorway would provide increased road capacity and reduce congestion and travel times in the future and would also improve the movement of freight in and through western Sydney.

The project location is shown in **Figure 1-1.**

1.2 Project overview

The project would include the following key features:

- A new dual-carriageway motorway between the M7 Motorway and The Northern Road with two lanes in each direction with a central median allowing future expansion to six lanes
- Motorway access via three interchanges/intersections:
  - A motorway-to-motorway interchange at the M7 Motorway and associated works (extending about four kilometres within the existing M7 Motorway corridor)
  - A grade-separated interchange referred to as the Western Sydney Airport interchange, including a dual-carriageway four-lane airport access road (two lanes in each direction for about 1.5 kilometres) connecting with the Western Sydney Airport Main Access Road
  - A signalised intersection at The Northern Road with provision for grade separation in the future
- Bridge structures across Ropes Creek, Kemps Creek, South Creek, Badgerys Creek and Cosgroves Creek
- A bridge structure across the M12 Motorway into Western Sydney Parklands to maintain access to the existing water tower and mobile telephone/other service towers on the ridgeline in the vicinity of Cecil Hills, to the west of the M7 Motorway

- Bridge structures at interchanges and at Clifton Avenue, Elizabeth Drive, Luddenham Road and other local roads to maintain local access and connectivity
- Inclusion of active transport (pedestrian and cyclist) facilities through provision of pedestrian bridges and an off-road shared user path including connections to existing and future shared user path networks
- Modifications to the local road network, as required, to facilitate connections across and around the M12 Motorway including:
  - Realignment of Elizabeth Drive at the Western Sydney Airport, with Elizabeth Drive bridging over the airport access road and future passenger rail line to the airport
  - Realignment of Clifton Avenue over the M12 Motorway, with associated adjustments to nearby property access
  - Relocation of Salisbury Avenue cul-de-sac, on the southern side of the M12 Motorway
  - Realignment of Wallgrove Road north of its intersection with Elizabeth Drive to accommodate the M7 Motorway northbound entry ramp
- Adjustment, protection or relocation of existing utilities
- Ancillary facilities to support motorway operations, smart motorways operation in the future and the existing M7 Motorway operation, including gantries, electronic signage and ramp metering
- Other roadside furniture including safety barriers, signage and street lighting
- Adjustments of waterways, where required, including Kemps Creek, South Creek and Badgerys Creek
- Permanent water quality management measures including swales and basins
- Establishment and use of temporary ancillary facilities, temporary construction sedimentation basins, access tracks and haul roads during construction
- Permanent and temporary property adjustments and property access refinements as required.

The project overview presented in this document represents the proposed concept design. If the project is approved, a further detailed design process would follow, which may include variations to the concept design. Flexibility has been provided in the concept design to allow for refinement of the project during detailed design, in response to any submissions received following the exhibition of the environmental impact statement (EIS), or if opportunities arise to further minimise potential environmental impacts.

The key features of the project are shown in **Figure 1-2**.

1.3 Purpose, scope and methodology of this report

This report combines the Historical Archaeological Assessment and Research Design (HAARD), which was initially prepared as a separate report, with the results of a subsequent archaeological test excavation of a former historical complex identified in Cecil Park, Western Sydney NSW (the subject site or site). The complex consists of a former school, church and post office that occupied the site from 1895 to 1965 and which was identified as having potential for historical archaeological relics associated with that phase of occupation.

The former historical complex (identified as Cecil Park School, Post Office and Church Site, Item 8) was initially identified by the JAJV during preparation the non-Aboriginal heritage assessment for the project. During previous assessment of the site, Aurecon (2016:110) found the site to be:

> "*historically significant for its association with education in western Sydney, and particularly the increasing settlement of areas beyond Liverpool in the late nineteenth century. The presence of the post office also indicates a historical significance with the similar establishment of postal and telecommunications within the area, consolidated in something of a social hub for the small rural location of Cecil Park."*

The aims of this report are to:

- Present the results of archaeological investigation of the former historical complex
- Provide guidance to Roads and Maritime on how to manage historical archaeological relics identified at the site
- Satisfy the requirements of the Secretary's Environmental Assessment Requirements (SEARs) issued for the project.

The HAARD included in this report was prepared in accordance with the NSW Heritage Council's *Archaeological Assessment Guidelines* (1996) with reference to the *Assessing Significance for Historical Archaeological Sites and 'Relics'* guideline (2009).

The scope of work included the following tasks:

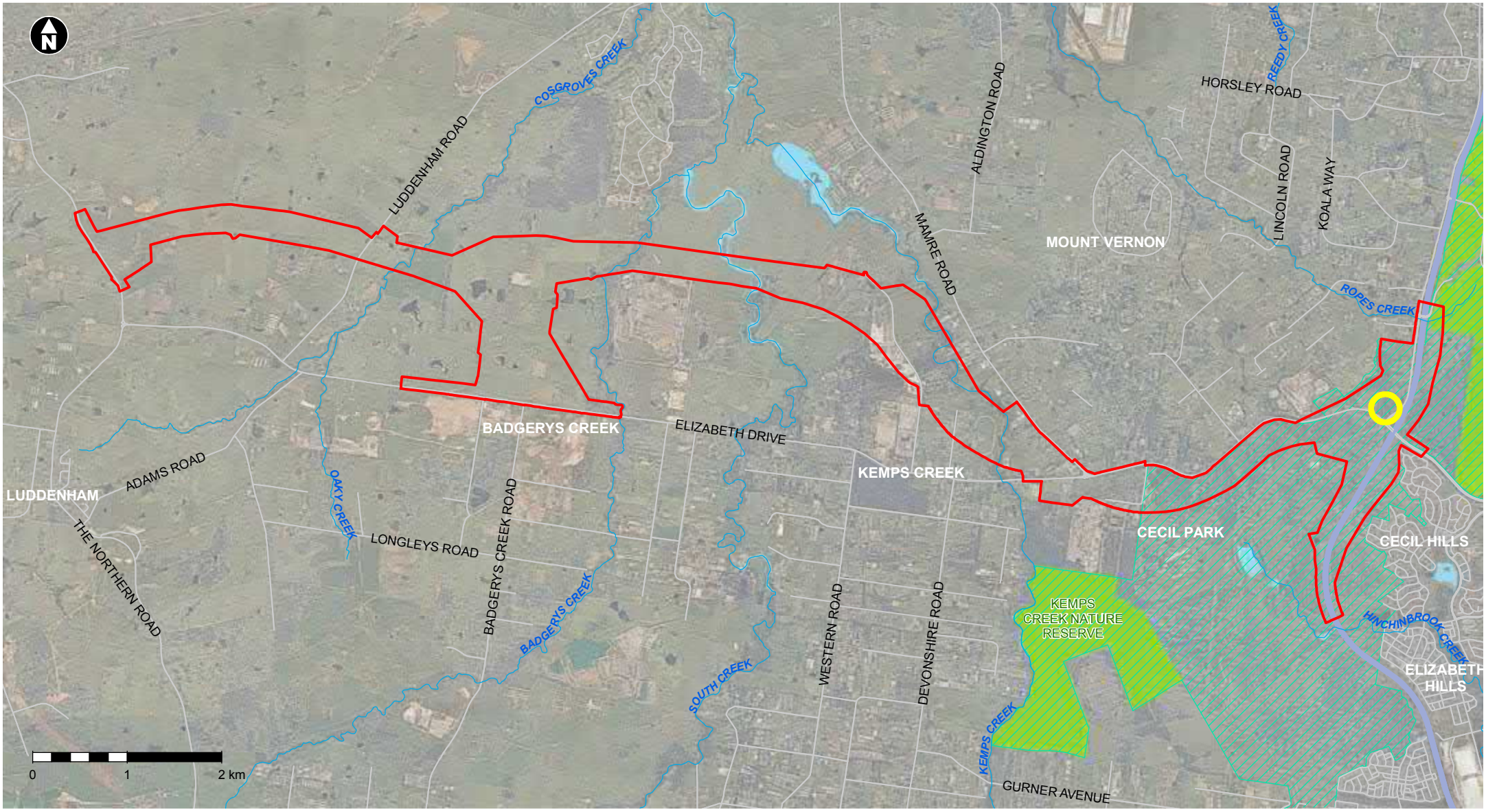
- Collation of existing information on the history of the subject site
- Inspection of the subject site to assess its potential for archaeological relics
- Formulation of an Archaeological Research Design (ARD) to guide archaeological investigation of the site
- Archaeological test excavation to determine the presence or absence of historical relics
- Determination of an appropriate mitigation strategy and approval process.

The following report includes a summary site history, an ARD which guided the method of the investigation, a description of the archaeological relics identified, a response to the research questions, a revised significance assessment and conclusions and recommendations. The report is designed to be included as an appendix to the project non-Aboriginal heritage assessment. Its recommendations have been incorporated into this broader study.

It should be noted that this assessment does not include the Former Cecil Park Public Hall (Item 13 in the non-Aboriginal heritage assessment) which was located near the former Cecil Park historical complex. Whilst the former hall helped to service the Cecil Park community it did not open until 1923 and has limited archaeological potential. As outlined in the broader non-Aboriginal heritage assessment, the item is unlikely to be significant at a local level for its research potential and, consequently, further archaeological investigation was not considered warranted.

1.4 Site location

The former Cecil Park historical complex is located on Lot 1 DP724970, Lot 28 DP654786 and Lot 2 DP922940 which is a vacant, heavily vegetated property located at 1097-1109 Elizabeth Drive and 33 Wallgrove Road, near the intersection of Elizabeth Drive and Wallgrove Road, Cecil Hills. As shown in **Figure 1-1** to **Figure 1-3** construction of interchanges and ramps for the project would impact the subject site.



M12 study area
Waterways
Motorway
Main roads
Western Sydney Parklands
NPWS Reserves

Figure 1-1 Location of the study area. The subject site is circled yellow.

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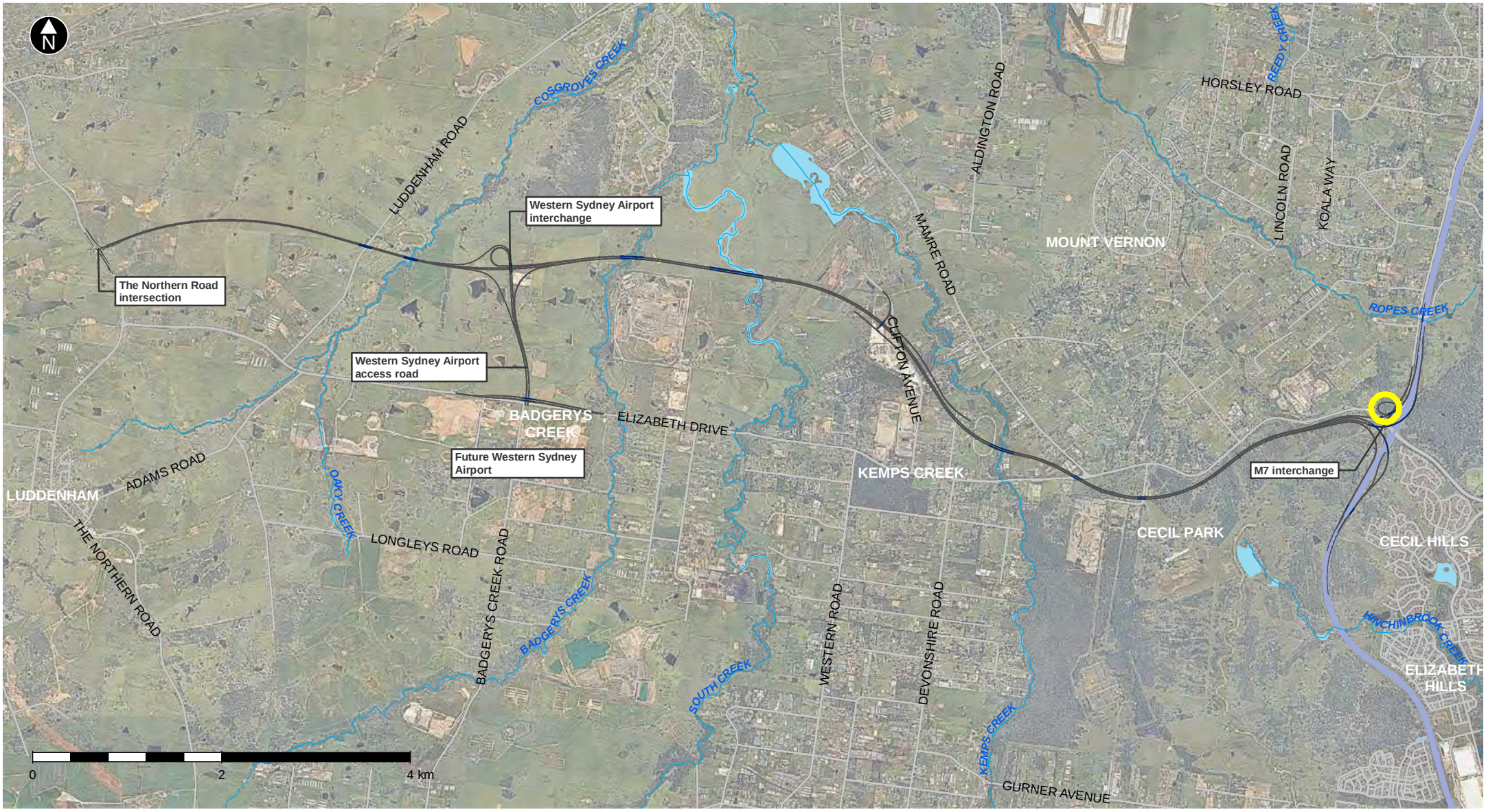

Figure 1-2 The proposed M12 Motorway. The subject site is circled yellow.

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The project
The project construction footprint
The project operational footprint
Motorway
Main roads

Archaeological potential
Subject site boundary

Heritage items

1. Cecil Park Public School
2. Cecil Park Public School (and post office)
D. School Church of St Paul

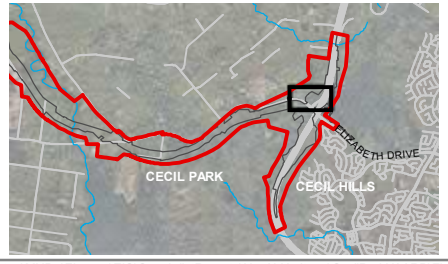

Figure 1-3 Cecil Park historical complex

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1.5 SEARs

On 30 October 2018, the Secretary of the NSW Department of Planning and Environment (DPE) issued SEARS to Roads and Maritime for the M12 Motorway EIS. The SEARs include the Commonwealth requirements under the *Environment Protection and Biodiversity Conservation Act* (Commonwealth) (EPBC Act). **Table 1-1** lists those requirements relating specifically to the assessment of the Project's potential impacts on the Cecil Park historical complex with a reference to the chapter or section of this report where each requirement is addressed.

Table 1-1 SEARs (heritage)

Secretary's requirement	Where addressed
5. Heritage	
2. Where impacts to State or locally significant heritage items are identified, the assessment must:	
a. include a statement of heritage impact for all heritage items including the Fleurs Radio Telescope Site and the McGarvie-Smith Farm Site (including significance assessment)	**Section 8**
b. consider impacts to the item of significance caused by, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, visual amenity, landscape and vistas, curtilage, subsidence and architectural noise treatment (as relevant)	**Section 8**
c. outline measures to avoid and minimise those impacts in accordance with the current guidelines; and	**Section 9**
d. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria).	**Annexure A**

In addition to the SEARs, a submission made to the DPE about the project by the NSW Heritage Council dated 8 June 2018 requested that:

> *In areas identified as having potential archaeological significance or 'relics', undertake a comprehensive archaeological assessment and management plan in line with Heritage Council guidelines which includes a methodology and research design to assess the impact of the works on the potential archaeological resource and to guide physical archaeological test excavations and include the results of these excavations.*
>
> *This is to be carried out by a suitably qualified archaeologist and is to discuss the likelihood of significant historical and Aboriginal archaeology on the site, how this may be impacted by the project, and include measures to mitigate impacts."*

1.6 Statutory context

In addition to satisfying the SEARs issued by DPE, the project is subject to certain provisions of the *Heritage Act 1977* (the Heritage Act). The Heritage Act provides several mechanisms by which items and places of heritage significance may be protected. The Act is designed to protect both listed heritage items, such as standing structures and potential archaeological remains or relics.

Approvals under Part 4 (or an excavation permit under s139) of the Heritage Act are not required for an approved project (or investigations required to meet the SEARs) under Division 5.2 of the EP&A Act, however, assessments such as this excavation report follows the intent of the Heritage Act.

Part 6 Division 9 of the Heritage Act protects archaeological 'relics' from being 'exposed, moved, damaged or destroyed' by the disturbance or excavation of land. This protection extends to the situation where a person has 'reasonable cause to suspect' that archaeological remains may be affected by the disturbance or excavation of the land. It applies to all land in NSW that is not included in the State Heritage Register (SHR). A 'relic' is defined by the Heritage Act as:

> *"Any deposit, artefact, object or material evidence that (a) relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and (b) is of State or local heritage significance."*

Section 139 of the Heritage Act requires any person who knows or has reasonable cause to suspect that their proposed works will expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to Section 140), unless there is an applicable exception (pursuant to Section 139(4)). In cases where a Section 139 permit is not required for projects assessed under Division 5.2 of the EP&A Act, works would need to be conducted in accordance with the intent of the Heritage Act.

Section 146 of the Heritage Act requires any person who is aware or believes that they have discovered or located a relic must notify the Heritage Council of NSW providing details of the location and other information required.

Following the discovery of archaeological relics during the test excavation, a Section 146 Notification was prepared by Jacobs and submitted to the NSW Heritage Division by Roads and Maritime. A copy of that Notification is included as **Annexure B**.

1.7 Exclusions

This assessment does not consider built heritage. It also does not include an assessment of Aboriginal cultural heritage values, which are documented in a separate Aboriginal Cultural Heritage Assessment Report (ACHAR) (Appendix I of EIS). No relevant geotechnical information was available for reference during preparation of this report.

1.8 Authorship

This assessment has been prepared by Fiona Leslie (Principal Archaeologist, JAJV), with research input from Deborah Farina (Senior Heritage Consultant, JAJV) and artefact catalogue and analysis prepared by Clare Leevers (Heritage Consultant, JAJV). Technical review of the deliverables was undertaken by Dr Karen Murphy (Technical Director (Heritage), JAJV).

2. Historical Summary

2.1 Preamble

This section of the report provides a summary of the history of the subject site, including a chronological timeline. This provides a context for the archaeological assessment, preparation of a research framework and the interpretation of archaeological relics identified at the subject site.

2.2 Historical background

Table 2-1 provides a brief timeline of events for the Cecil Park property.

Table 2-1 Brief timeline of events - Cecil Park property

Year	Event
1817-1886	Agricultural land associated with Macquarie Park (later Cecil Park)
1886	Subdivided lot sold to Thomas Hussey Kelly
1895	Subdivided Lot 1, Section 4, Deposited Plan 2954 sold to Queen Victoria (the Crown)
c.1895	Cecil Park Public School opened. Includes residence.
1896	Teacher's residence constructed of weatherboard
1897	Cecil Park post office opens
1898-1899	Brick school building constructed
1899	Full six acres of school block cleared and fenced
1903	School Church of St Paul opened adjacent to school by the Archbishop of Sydney
1905	Repairs made to school and teacher's residence
1940	School closed
1947	Residence of School removed from Cecil Park School to Tahmoor Public School
c.1950s	Closure of St Pauls Cecil Park
1963	Cecil Park post office closed
1964	Lease of site and buildings to Mr C A White
1965	School buildings demolished (approved 9 October 1964)

Cecil Park was part of a large land grant made to Thomas Wylde in 1817, then known as "Macquarie Park". His son, Sir John Wylde, inherited this land on his father's death in 1821 and the land was annexed to his own grant known as "Cecil Hills". The land stayed within the Wylde family until the late-19th century, when it was subdivided in 1886 into farmlets, then again in 1906 into smaller market garden lots (**Figure 2-1**). The lot comprising the school, post office and church was transferred to the Crown in 1895. The Certificate of Title, Volume 1156 Folio 195, specifically states that the transfer is "for the purposes of the *Public Instruction Act 1880*".

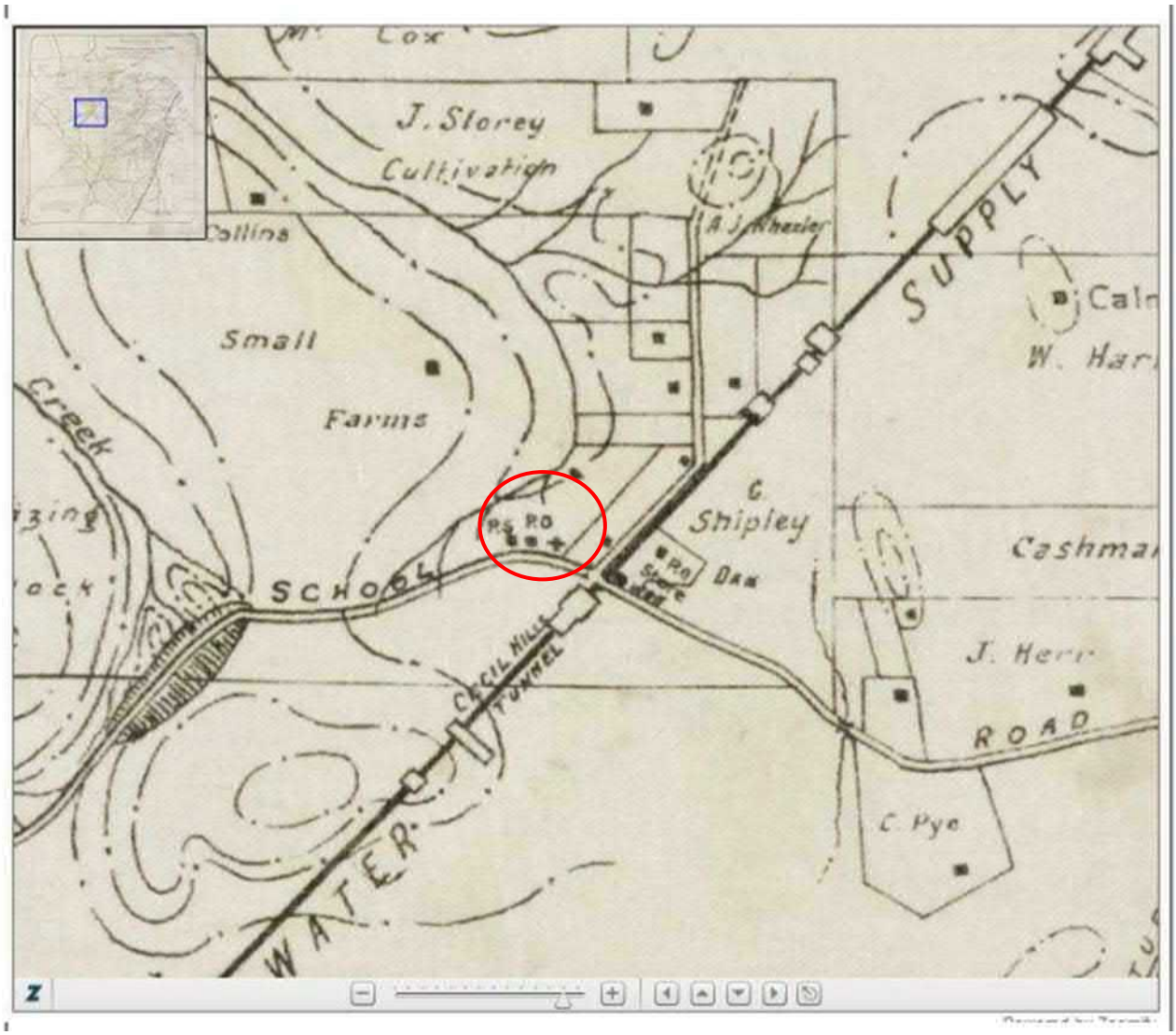


Figure 2-1 Extract from 1906 reconnaissance map for Liverpool Army Camp. The site of the Cecil Park School, Post Office and St Paul's Church is circled red. (Source: Aurecon (2016:116).

Figure 2-2 Further subdivision of Cecil Park, c.1906. The areas shaded dark grey represent sold lots. The approximate location of the school post office is circled in red (Courtesy: State Library of New South Wales).

Of interest, the 1906 Army reconnaissance map (**Figure 2-1**) shows a second post office on George Shipley's land on the other side of the Upper Canal, opposite the site. This appears to have been in error, as according to the existing archives of Cecil Park Post Office, held by the National Archives of Australia, Mr Flood was appointed teacher and postmaster at Cecil Park in 1897. He held this post until 1904, when Mrs Alice Jones took over both roles until 1909. The file states that the post office was to come to the school, '*being one block to the west of Shipley's store'* (Galbraith 1909).

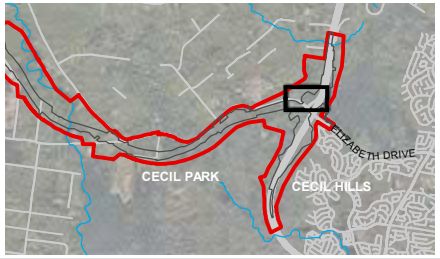
A newspaper article in 1938 describes the locality:

> *Cecil Park is situated nine miles out of Liverpool. It is a very small place, with a post-office and a public school. The public school holds about 25 pupils. The dance hall is almost next to the school, and dances are held here every Saturday night. The people of Cecil Park go in mostly for poultry farming, but some have orchards and cattle. There is a sheep station also. Altogether, Cecil Park is a very lovely place.* (The Sun, 1938:3)

The configuration of the former school, teacher's residence, post office and church is shown in the c1945 aerial photograph of the subject site (**Figure 2-3**).

The project
The project construction footprint
The project operational footprint
Motorway
Main roads

A = Cecil Park School
B = Teacher's Residence
C = Cecil Park Post Office
D = School Church of St Paul



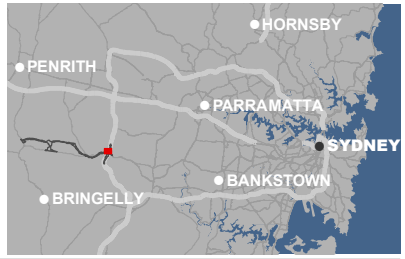


Figure 2-3 Undated aerial of site c.1945-1950.

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(Courtesy: NSW Department of Finance, Services and Innovation)

2.3 Former Cecil Park Historical Complex

2.3.1 Cecil Park Public School

The land was resumed for educational purposes in 1895 from T H Kelly to the Crown, with the school built the same year by McDermott and Murphy for the sum of £89 (Aurecon 2016:111). In October 1896 a tender was advertised by the Department of Public Instruction for the construction of a teacher's residence, to be made of wood, at the school premises.

A report in the *Nepean Times* set out complaints regarding the school building made by the local member, Mr T R Smith, to parliament in November 1897:

> *There was also a school at Cecil Park, which was only 20 feet by 14 feet. It had an iron roof and was a weatherboard building without any lining. In the winter time it was so cold that the children could not remain in the school, and in the summer time, with sixty-five children on the roll, hon. members could imagine what the condition of the atmosphere was like. As the population in that locality had increased very rapidly, before the next twelve months there would be 100 children attending the school. An application was made for an addition to the school and he thought the inspector recommended that 12 feet should be added to the building. But that would be of no use at all. It was necessary that 90 feet at least should be added* (Nepean Times 1897:8).

Correspondence from the Department of Public Instruction on 10 March 1898 indicated that rather than improve the existing school building, a new school building was proposed (Nepean Times 1898:7). Articles in the local newspapers throughout 1898 noted that the new building had not been constructed (The Cumberland Argus and Fruitgrowers Advocate 1898b). A tender was advertised in November 1898 calling for the "Erection of a School Building (Brick) (Hogue 1898:8630). The tender was later awarded to H A Baglee of Canley Vale for £330 (Department of Public Instruction 1898:9048).

A visit by the school board occurred on 2 December 1898, which found that the school was in a satisfactory condition under "…the energetic teacher's (Mr Flood's) charge". However, the student body was noted as slight, which was attributed to a measles outbreak (The Cumberland Argus and Fruitgrowers Advocate 1898a:3). In September 1899, it was reported that the entire land that had been resumed for the recreation of pupils of the school had been cleared and fenced with a "substantial two-rail fence" (The Cumberland Argus and Fruitgrowers Advocate 1899:3). In 1905, tenders were sought for the improvement to both the school and the teacher's residence and the project awarded to A E Gould of Parramatta in February 1906 (Department of Public Works 1906:800). In 1911, tenders were again sought for "renovations, painting, improvements, etc." for the school (Department of Public Works 1911:3750).

The first school master was Mr William Flood, who also served as postmaster, stayed at the school until 1904. Mr Joseph Kenniff was schoolmaster from 1904 until his retirement in 1921. The last school master was Alderman Wilf Davis, a member of the local council, who taught at the school for eleven years until its closure in 1940.

2.3.2 Cecil Park Post Office

Shortly after the opening of the school, the Cecil Park District & Progress Association began petitioning the Postmaster General to establish a post office in the vicinity of the school. Mr Bossley inspected the location in 1897 and reported that:

> *…there are about 18 households in the neighbourhood of the public school, all of whom live off the mail road and to them the establishment of an office would be a great convenience.*

Their correspondence - at present left at the school – is from 40 to 50 letters a week.
(Bossley 1897:61).

The post office was approved and the school master, Mr William Flood, was appointed as post master. This was done over the objections of Mr George A. Shipley, the proprietor of the nearby store.

Mr Flood held the position of post master until he was transferred to Minto public school in 1904, after which his successor, Mrs Alice Jones, took the position. In correspondence to the Deputy Postmaster General on 6 September 1909, it was noted that Mrs Jones had been removed to another school, and that details of the new teacher was needed to continue the post office duties, as the school was "where the post office is kept" (Galbraith 1909). The practice of the head teacher taking on the postmaster duties remained until the closure of the school in the 1940s. The post office continued to operate until 1963.

Figure 2-4 Cecil Hills Post Office, c. 1950 (Courtesy: National Archives of Australia of Australia).

2.3.3School Church of St Paul, Cecil Park

In 1903, a church was constructed to the east of the school and post office (see **Figure 2-3**). Anglican religious services had, until then, been held at the "creamery"; which at the time of the church's opening, was not in use (The Cumberland Argus and Fruitgrowers Advocate 1898b:3). The new church was opened by the Archbishop of Sydney, Dr William Saumarez Smith, on 17 October 1903 and dedicated to St Paul. The cost of construction was funded partially by the Church Society, but mostly by residents. According to newspaper reports of the time, the church was constructed of weatherboard with an iron roof, internally lined with timber. The capacity of the church was estimated to be for 100 people, and as with other nearby localities, such as the first Methodist Church at Badgerys Creek, doubled as a community hall (Liverpool Herald 1903:3) (RPS Manidis Roberts 2015:118). The church was formally named the "School Church of St Paul, Cecil Park" at the dedication ceremony, although later publications refer to the church as "St Paul's, Cecil Park".

No historical information was found regarding the exact dates of the closure of the church. The church celebrated its Golden Jubilee in 1953, however an absence of advertised sermon times at the church would suggest that it closed shortly thereafter.

3. Archaeological Potential and Comparative Analysis

The following subsections provide a description of potential archaeological features identified during an inspection of the subject site and an assessment of its archaeological potential. The site inspection was carried out on the 1 August 2018 by Fiona Leslie (Principal Archaeologist, JAJV), Deborah Farina (Senior Heritage Consultant, JAJV) and Chelsea Jones (Graduate Archaeologist, JAJV).

3.1 Site inspection

The site inspection confirmed thick vegetation and bushland is present across the property with very little of the ground surface visible. The property consists of generally flat to gently sloping land with a small drainage line present at the rear of the property running in an east – west direction. Apart from localised areas where the ground has been disturbed, the subject site appeared to be largely intact, with regrowth of vegetation occurring across the property.

A number of features were identified during the site inspection. These are described below, and their location shown in **Figure 3-4**:

- Exotic plantings near the gate on Elizabeth Drive (**Figure 3-1**). A disturbed area with brick pieces and rubble were noted near the plantings close to Elizabeth Drive and may be the remains of a former gate post.
- Two large exotic trees set back from the Elizabeth Drive frontage on the west side of the property with a large flat area directly in front and a circular depression at the rear. Several wine bottles were located under one of the trees (McWilliams Wines Pty Ltd). This area may indicate the location of the former school or possibly the teacher's residence.
- The remnants of a grassed vehicle track running north-east – south-west from Elizabeth Drive towards to the rear of the property.
- A large levelled area in the centre of the property at the Elizabeth Drive frontage. The levelled platform is cut into the natural slope and may represent a former building footprint.
- A section of *in situ* brick footing, possibly of a former cess-pit at the rear of the property (**Figure 3-1**). The footing was near the remnants of an open drain cut in to the natural ground.
- A large rubbish pile at the south-west end of the property. The rubbish pile measured roughly 10 metre x 2 metre x 1 metre and included bricks, bottle glass, metal pieces and ceramic fragments. This rubbish pile may represent demolition rubbish associated with the former Church of St Paul (**Figure 3-3**).

(a) (b)

Figure 3-1 Former Cecil Park School site: (a) *in situ* brick footing and rubbish at the rear of the property and (b) exotic plantings near Elizabeth Drive. Photo taken by Fiona Leslie on 1 August 2018.

Figure 3-2 Levelled area likely to be the site of the former Post Office, Cecil Hills, looking south toward Elizabeth Drive. Photo taken by Fiona Leslie on 1 August 2018.

Figure 3-3 Second levelled area likely to be the former site of St Pauls, Cecil Hills, looking south toward Elizabeth Drive. Photo taken by Deborah Farina on 1 August 2018.

Figure 3-4 Aerial photograph showing the approximate location of various features identified during the site inspection. This is based on a field sketch by Fiona Leslie on 1 August 2018

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3.2 Comparative Review

The following subsections describe a standing former school building at Agnes Banks and archaeological investigation of a school site at Googong, NSW, to assist with predictions on the range and type of archaeological material that may survive at the subject site.

3.2.1Former Agnes Banks Public School

The Former Agnes Banks Public School is a brick classroom block and teacher's residence now converted to private residences. The former school complex provided the focus for development at Agnes Banks, which is located 40 kilometres to the north of Cecil Hills, near Richmond NSW.

The former school is a brick building designed by George Allen Mansfield, an architect of the Council of Education. The building has a half-hipped roof over the former teacher's cottage and a gable over the former classroom. The building features two verandahs at the front of the building. The former teacher's house has a verandah running along the length of the cottage and a skillion roof. The timber framed multi-paned sash windows feature sandstone sills and the gable has a date stone. At the rear of the building a smaller building with gabled roof and external brick chimney flue is present. This is believed to be a later classroom addition. The external brick walls are painted, and the former school building is set within cleared grounds.

Of relevance to the subject site, the brick school building is constructed on brick strip and pier footings, with timber verandah posts. The teacher's residence is of a similar construction and features a brick chimney, sitting on a separate chimney brick footing.

The former school building and teacher's residence is one of three public schools erected on Castlereagh Road in 1879, demonstrates the provision of public education following the Public Schools Act of 1866 and is an excellent example of standard rural school building design of its time.

Figure 3-5 Street frontage of the former Agnes Banks Public School (Davies 2005).

Figure 3-6 Agnes Banks Public School - side elevation (Davies 2005).

Figure 3-7 Former teacher's residence and later school house at the rear of the former Agnes Banks Public School (Davies 2005).

3.2.2Archaeological Investigation of the Googong Public School

In February 2017 Navin Officer Heritage Consultants Pty Ltd undertook archaeological test excavation of the Googong Township, 4.5 kilometres south of Queanbeyan NSW. The investigation included a levelled area (GH5B) that may have housed the former Googong Public School (GH5B). The test excavation of GH5B revealed the following archaeological features:

- Remains of a small rubble fireplace with lime mortar coursing and an internal clay render
- Miscellaneous ceramic, glass and metal artefacts associated with the fireplace suggesting the building was of timber construction with glass windows probably built in the late 19th century with improvements into the early 20th century

- An absence of domestic artefacts associated with occupation and a high frequency of slate pencil fragments.

The presence of these features assisted interpretation of the site as the former late 19th and early 20th century school site and further archaeological investigation of the site was recommended.

3.3 Assessment of archaeological potential

The archaeological potential of the subject site was assessed to be moderate for the following reasons:

- The subject site appears to be largely intact with the ground surface relatively undisturbed, apart from localised areas of disturbance that relate to rubbish dumps or possible archaeological features. Vegetation regrowth was observed across the property
- The location of many of the features observed during the site inspection correlates with the location of the former buildings shown in the c1947 aerial photograph
- At least two large levelled areas are visible in the landscape and appear to indicate where former buildings once stood
- An intact section of brick footing was observed at the rear of the property and may be the remains of an outbuilding at the rear of the teacher's residence.

It should be noted that an active gas pipeline was identified running SE-NW across the subject site. However, disturbance associated with its installation is thought to be localised and likely to have impacted potential archaeological relics within the service corridor only.

According to available historical records, Cecil Park School was constructed c1895 and was open until 1940. The school building may have originally been timber, but by 1898 was replaced by a brick building with a timber teacher's residence constructed nearby. By 1906 the timber Post Office building and St Paul's Church had been added to the complex. The church was also a weatherboard building with iron roof, internally lined with timber. The church was open until the 1950s and the Post Office until the 1960s.

Based on this available information, it was predicted that archaeological relics would be limited to:

- Structural remains associated with the former buildings. These are likely to include brick strip and pier footings that supported the former school buildings and brick pad footings used to support the timber teacher's residence, post office buildings and church
- Very limited underfloor deposits associated with domestic occupation. Given the age of the buildings it is likely that the floors were constructed using tongue-and-groove floorboards. The likelihood that artefacts accumulated within the building footprints is therefore low
- Miscellaneous artefacts associated with use of the school buildings. These may include slate pencil fragments
- Deeper sub-surface features, including wells, rubbish pits and cess-pits at the rear of the property. Depending on when they were abandoned, these features may be filled with artefact-rich deposits. Analysis of artefacts recovered from these features may provide some insights into the former use of the former complex and more broad insights into the development of education, religious buildings and postal and telecommunication infrastructure during the late 19th and early 20th century.

It should be noted that there is no known cemetery attached to the former School Church of St Paul.

4. Research Design and Excavation Method

The following Archaeological Research Design (ARD) identified relevant historical themes to formulate appropriate research questions, which guided the strategy and archaeological methods employed during the investigation.

4.1 Historical themes

Table 4-1 below outlines historical themes, as identified by the NSW Heritage Council (2001), relevant to the subject site.

Table 4-1 Historical themes relevant to the subject site.

National Theme	NSW Theme	Local Theme	Examples
Developing local, regional and national economies	Communication	Activities relating to the creation and conveyance of information	Post Office, telephone exchange, printery, radio studio, newspaper office, telegraph equipment, network of telegraph poles, mail boat shipwreck, track, airstrip, lighthouse, stamp collection
Building settlements, towns and cities	Accommodation	Activities associated with the provision of accommodation, and particular types of accommodation – does not include architectural styles – use the theme of Creative Endeavour for such activities.	Terrace, apartment, semi-detached house, holiday house, hostel, bungalow, mansion, shack, house boat, caravan, cave, humpy, migrant hostel, homestead, cottage, house site (archaeological).
Educating	Education	Activities associated with teaching and learning by children and adults, formally and informally.	School, kindergarten, university campus, mechanics institute, playground, hall of residence, text book, teachers' college, sail training boat wreck, sportsfield, seminary, field studies centre, library, physical evidence of academic achievement (eg a medal or certificate).
Developing Australia's cultural life	Religion	Activities associated with particular systems of faith and worship	Church, monastery, convent, rectory, presbytery, manse, parsonage, hall, chapter house, graveyard, monument, church organ, synagogue, temple, mosque, madrasa, carved tree, burial ground
Building settlements, towns and cities	Towns, suburbs and villages	Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Town plan, streetscape, village reserve, concentrations of urban functions, civic centre, subdivision pattern, abandoned town site, urban square, fire hydrant, market place, abandoned wharf, relocated civic centre, boundary feature, municipal Coat of Arms

4.2 Research framework

The main aim of the archaeological investigation was to determine the nature and extent of archaeological relics within the subject site by undertaking archaeological test excavation. The following research questions were relevant to the proposed development area and guided the strategy and archaeological methods employed during the investigation:

- Is there any evidence of undocumented pre-1880s European and/or Aboriginal activity on the site?
- Have archaeological relics relating to the original school building constructed c1896 survived at the subject site? If so, what are their condition, nature, extent and significance? Does the evidence indicate the size of the original building and how does that compare to the later school shown in the 1940s aerial photograph? Does the evidence provide any information about former students and their use of the Cecil Park public school?
- Is there any archaeological evidence of the timber teacher's residence? If so, what is the condition, nature, extent and significance of the relics? Is there any evidence of a former cess-pit at the rear of the former house? Do the remains provide any insight into to the lives of former teachers who occupied the residence during the late 19th and early 20th centuries?
- Has any archaeological evidence of the former post office building survived? If so, what is the nature and extent of the relics?
- Is the rubbish pit identified at the eastern end of the subject site related to the former church? If so, what does the archaeological evidence tell us about the former church?

4.3 General strategy and approach

Given that features are clearly identifiable at the subject site and the features appear to correlate with the location of the former buildings shown on the 1940s aerial photograph, archaeological test excavation was the recommended strategy as the first stage of assessment.

Five strip trenches were placed in strategic locations across the subject site, as shown in **Figure 4-1**. A justification for the placement of each test trench and the aim of the testing is outlined in **Table 4-2** overleaf.

The archaeological test excavation was directed by Fiona Leslie, Jacobs Principal Archaeologist. Following the removal of grass and ground vegetation along the length of the test trench, the underlying ground surface was lightly scraped using a 6.5 tonne excavator to expose any archaeological features and/or deposits. No trees or larger vegetation were removed. Archaeological features identified during machine excavation were manually cleaned so that their full extent was exposed for recording.

It should be noted that archaeological relics were not removed during the test excavation. In addition, if any State significant relics had been identified, Roads and Maritime and the Department of Premier and Cabinet (Heritage) (DPC (Heritage)) would have been notified immediately to discuss the proposed works and the requirements for further approval.

Table 4-2 Test trench locations and objectives.

Test Trench	Justification	Aim
Test Trench 1	Positioned to test the levelled area identified near the western boundary of the subject site. It is likely this area correlates with the former footprint of the school building.	To identify whether any remains of the original school building have survived and determine whether any underfloor deposits have survived.
Test Trench 2	Positioned where a small structure is shown in the c1945 aerial photograph. This building	To determine whether the structure is related to a deeper subsurface feature,

Test Trench	Justification	Aim
	is at the rear of the former school and teacher's residence and may be an outhouse.	such as a well or cess-pit.
Test Trench 3	Positioned to test the second levelled area identified in the central portion of the subject site. This area likely relates to the former teacher's residence.	To determine whether any archaeological remains of the former teacher's residence have survived.
Test Trench 4	Positioned to test the area where the *in situ* brick footing was located. The trench was located in the vicinity of the bricks.	To determine the extent, nature and condition of the bricks.
Test Trench 5	Positioned in the general location of the former church, where a large rubble pile was identified. The rubbish pile may relate to the demolition of the former church.	To determine if archaeological remains of the former church have survived. Is the rubbish pile related to its demolition?

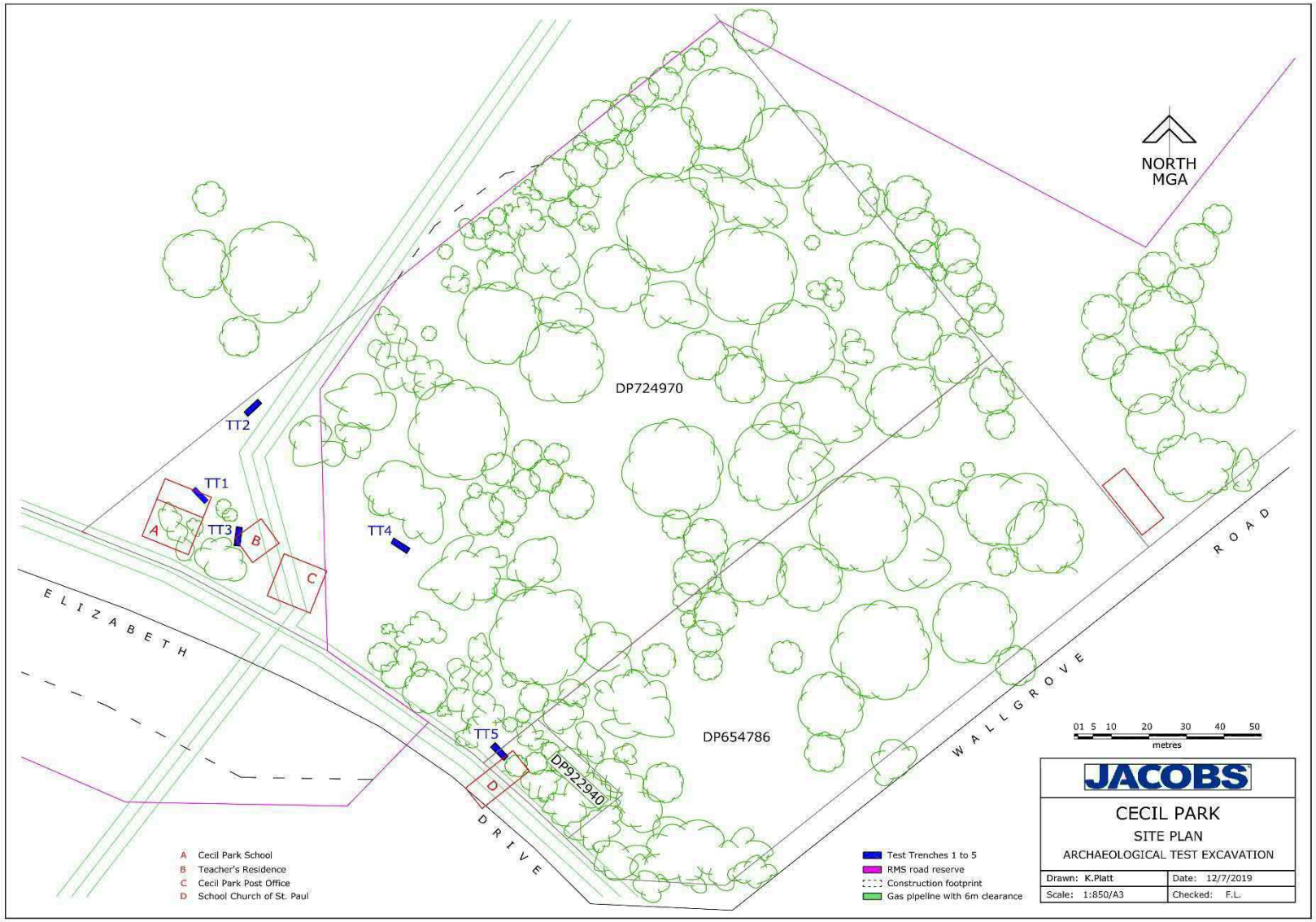

Figure 4-1 Plan showing the test trench locations across the subject site .

4.4 Management of potential Aboriginal objects

The Aboriginal cultural heritage values for the project have been addressed in a separate ACHAR (Appendix I of EIS). It was not the intention of the historical archaeological test excavation to disturb or harm Aboriginal objects. No Aboriginal objects were identified during the course of the investigation. However, if Aboriginal objects had been encountered, the historical excavation team would have stopped work and follow the Roads and Maritime's *Standard Management Procedure for Unexpected Heritage Items* (Roads and Maritime 2015).

4.5 Excavation methods

Standard archaeological excavation and recording methods were adopted during the investigation. These include undertaking the following tasks:

- A survey datum was established to record the levels of extant deposits and features
- Vegetation and grass were removed using a small (6.5 tonne) excavator fitted with a batter bucket. Spoil from excavation was placed adjacent to the trenches so that they could be backfilled and the site restored on completion of the excavation. The excavator used the existing unformed vehicle track where possible to avoid additional site disturbance
- After the removal of grass and topsoil manual excavation and recording of deposits was undertaken in reverse order of deposition to expose the surface of significant archaeological features or deposits or culturally sterile clay
- Scaled site plans and profile or cross-section drawings showing the location of all archaeological deposits and features revealed by excavation were prepared, as required. These were keyed to the site datum
- Photographic recording of all phases of the work on site was undertaken. This involved recording of archaeological features using an appropriate photographic scale
- A standard context recording system was employed, namely the location, dimensions and characteristics of all archaeological features and deposits were recorded on sequentially numbered proforma context recording sheets. This form of written documentation was supplemented by preparation of a Harris Matrix showing the stratigraphic relationships between features and deposits
- Historical artefacts retained for analysis were cleaned off site, sorted according to their fabric classes, bagged and boxed with reference to the context from which they were recovered
- Excavation was conducted until site clearance was achieved to the satisfaction of the Excavation Director.

4.6 Post excavation analysis

Historical artefacts recovered during test excavation were catalogued and analysed for presentation and inclusion in this report. Artefact processing was undertaken off site, as follows:

- Artefacts were cleaned and dried
- Items were then be divided into categories according to their type and fabric and in the case of glass and ceramics, by colour. These were further divided into those which are non-diagnostic and those which require closer consideration
- Items such as unmarked broken glass, shells, small wooden fragments, metal fragments etc. were weighed and recorded, then discarded

- Remaining items were retained for analysis and research.

Post-excavation analysis of materials recovered during excavation was undertaken in the North Sydney Jacobs storage area in Artarmon by Clare Leevers, Jacobs Archaeologist).

5. Excavation Results

5.1 Scope of works

The archaeological test excavation was conducted over a five day period from 1 to 5 July 2019 by a small team of archaeologists, including the Excavation Director (Fiona Leslie, Jacobs Principal Archaeologist) two assistant archaeologists (Deborah Farina, Jacobs Senior Archaeologist; Clare Leevers, Jacobs Archaeologist) and an experienced site planner (Kerry Platt, Jacobs). The nominated Excavation Director was a suitably qualified person who fulfils the requirements of the Heritage Council's Excavation Director Criteria to conduct test excavation of a locally significant archaeological site. Further information about the Excavation Director is included in Annexure A.

The investigation involved the excavation of five strip trenches, measuring 1.5 metres wide by 5 metres long, placed in strategic locations across the subject site (**Figure 4-1**). **Section 4.3** and **Section 4.5** provide further justification for the placement of each trench and a description of the excavation method. All trenches were backfilled on completion of the investigation.

The following sections outline the various phases of historical occupation and use that were identified on the commencement of the test excavation. A description of the stratigraphy observed within each trench and historical archaeological features and deposits identified during the test excavation is also presented. This is followed by a discussion and interpretation of the results and conclusions.

Plans of each test trench are included as **Annexure C**. Harris matrices and a context catalogue showing the stratigraphic relationships between contexts and deposits recorded in each test trench are provided in Annexure D and E. Contexts were numbered sequentially throughout the course of the investigation (ie C001, C002, C003 etc).

5.2 Phases of Occupation / Use

Table 5-1 lists the various phases of occupation / use identified at the subject site, as documented by the historical record. During the test excavation the stratigraphic relationship between archaeological contexts was recorded and each context attributed to a particular phase, where possible.

Table 5-1 Phases of occupation / use identified at the subject site.

Phase	Phase Description
A	Pre-European / natural topsoil and subsoil (pre 1895)
B	Construction of the first weatherboard school (c1895)
C	Occupation / use of the school (c1895 - 1898)
D	Demolition of the weatherboard school (c1898)
E	Construction of the brick school building, timber post office and St Pauls Church (c1898 – 1906).
F	Occupation / use of the brick school building, timber post office and church (c1898 – c1963)
G	Demolition of the school buildings (c1940 – 1963)
H	Subsequent levelling and use as vacant land (1963 onwards)

5.3 Stratigraphy and interpretation

5.3.1 Test Trench 1

Test Trench 1 was oriented in a northwest–southeast direction to cross the rear wall of the school building shown in the 1940s aerial photo of the subject site (**Figure 2-3**). Once the test trench was positioned and strung out a whipper snipper was used to trim long grass across the trench (**Figure 5-1**). The excavator was then used to gently remove the surface deposit, which consisted of grass and loose silty dark brown topsoil with very frequent grass roots [C001]. In the south-east corner of the trench numerous bricks and brick pieces were noted and left *in situ*, where possible.

Below the topsoil, a compact medium brown clay with very frequent brick and mortar pieces and occasional glass and metal fragments was found in the north-west corner of the trench [C009]. Given the amount of debris and building material found in this deposit, it was interpreted as demolition fill. Further careful machine excavation across the extent of the trench revealed a series of intact brick footings positioned quite close to the ground surface (**Figure 5-2**). The main external brick footings were orientated in a roughly east–west direction [C010, C016], with other footings (presumably internal walls) orientation north–south [C017, C023]. At this point, machine excavation was restricted to the north-west corner, to assist the removal of the demolition fill [C009].

Manual excavation techniques were then used to reveal the full extent of the brick footings and determine the absence or presence of any *in situ* archaeological deposits or features (**Figure 5-3**). Towards the south-east end of the trench, a concentration of *in situ* bricks was found. Further hand excavation revealed that the bricks were bonded to form a cement mortar pad, with a blue-grey stone positioned at its centre [C022] (**Figure 5-4** and **Figure 5-5**). It is possible that this brick and concrete pad was the foundation of a stove. The pad had been excavated directly into a very compact reddish-brown clay, with occasional charcoal, brick and mortar fragments and tree roots, which was interpreted as a disturbed natural B horizon clay [C018]. The brick and concrete pad appears to have been integrated with the external brick footing [C016], although further investigation of the brickwork directly outside the boundaries of the trench is needed to confirm this association.

At the southern end of the pad, a separate brick footing was observed [C023]. The footing is a single course of machine-made clay bricks laid in stretcher formation. The individual bricks measured 22 centimetres long by 11 centimetres wide and are bonded with a cement mortar. This footing appears to have formed an internal wall of the former building. Manual excavation of the deposits at the southern end of the trench revealed further miscellaneous bricks bonded in places with cement mortar, presumably the remnants of a formal brick wall of the building that had collapsed. Pieces of asbestos were noted in the fill in this area and manual excavation of the deposit ceased as a result. Manual excavation around the brick and cement pad, within the internal space of the former building, revealed no *in situ* deposits or features. The topsoil appears to have accumulated directly above the remnant footings, which were cut into the disturbed sterile B horizon soil [C018].

In the centre of the trench, to the west of the brick and concrete pad, a linear brick footing continued in a roughly east–west direction. This section of footing is comprised of machine-made clay bricks laid in header formation [C016]. The footing ended in a small brick pad, that presumably formed part of a brick pier. To the north of this, two smaller footings laid in stretcher formation were found, both of a similar construction of machine-made clay bricks bonded with cement mortar [C010, C017] (**Figure 5-6**). Given the formation and configuration of these footings, it is possible that they supported a lighter weight structure, such as a timber annex. In the north-west corner of the trench, a distinct cut for the footings was noted [C011] with the voids filled with demolition fill [C009]. Of interest, the demolition fill was restricted to the space between these footings, suggesting that the annex may have been demolished as a separate event. Below this fill was compact medium reddish brown sterile natural clay [C012].

Figure 5-1 Test Trench 1, pre-excavation, facing south-east.

Figure 5-2 Test Trench 1, mid-excavation, facing south-east.

Figure 5-3 Test Trench 1, end of excavation, facing north-west.

Figure 5-4 Test Trench 1, south-east corner showing the brick and concrete pad [C022] and associated footings [C016, C023].

Figure 5-5 Test Trench 1, south-east corner showing the brick and concrete pad [C022] and associated footings [C016, C023].

Figure 5-6 Test Trench 1, north-west corner showing the smaller footings and associated cut [C010, C017, C011].

Figure 5-7 Test Trench 1, north-east corner showing the service trench [and possible yard surface [C015].

The only other features noted in Test Trench 1 were found along its northern edge. A very distinctive service cut filled with angular gravel was observed running parallel to the linear external brick footings [C010, C016] (**Figure 5-7**). This supports the interpretation that these footings supported an external wall and annex of the former building. The service trench cut a distinctive dark brown silty clay loam with occasional artefacts, roots and very small mortar fragments [C015]. It is possible that this is a former yard surface relating to occupation of the school site. The service trench appears to lead to a circular ceramic drain inlet [C019] which contained a dark brown silty drain fill with occasional artefacts [C020]. The drain

was presumably cut [C021] into the former yard surface [C015], although further investigation is needed, given its location on the edge of the trench. The yard surface and drain fill would be considered intact relics and, as a result, were left *in situ*.

5.3.2Test Trench 2

Test Trench 2 was positioned along the western boundary of the subject site to investigate a small building shown in the c1940s aerial photo (**Figure 2-3**). The test trench was strung out and long grass removed using a whipper snipper (**Figure 5-8**). The excavator was then used to gently remove the surface deposit, which consisted of grass and loose to compact silty dark brown clay loam topsoil with very frequent grass roots and occasional pieces of rubble [C002].

Machine excavation at the north end of the trench revealed C002 sat directly above sterile red white mottled natural clay with occasional shale [C003]. In the central portion of the trench a concentration of mixed rubble, including concrete edge pieces, a piece of metal bed post, plastic and glass fragments were found within C002. The mixed rubble, however, was not contained within a cut and appeared to be miscellaneous demolition from the surrounding area and/or possibly from the former small building. Excavation continued to the B horizon clay (**Figure 5-9**).

No archaeological deposits or features were identified within Test Trench 2. A sample of artefacts from C002, however, was collected.

Figure 5-8 Test Trench 2, pre-excavation, facing south-west.

Figure 5-9 Test Trench 1, end of excavation, facing north-east.

5.3.3Test Trench 3

Test Trench 3 was oriented roughly north–south and positioned to cross the rear corner of the former teacher's residence shown in the c1945 aerial photo of the subject site (**Figure 2-3**). The test trench was strung out and long grass removed using a whipper snipper (**Figure 5-10**). The excavator was then used to gently remove the surface deposit, which consisted of grass and a fine grained medium brown silty clay loam with frequent grass roots [C004] (**Figure 5-11**).

Further mechanical excavation revealed a distinctive cut [C006] below C004 running north-south through the long axis of the trench (**Figure 5-12**). Along the western side of the trench the red white mottled B horizon clay was observed [C003]. This deposit appeared to have been cut and the eastern half of the trench filled with a compact mottled grey brown clay fill [C005]. A brick dump was also present at the southern end of the trench. Further manual excavation confirmed that the bricks were not *in situ*. Their presence, however, supports the evidence from the aerial photo of a building in the immediate area.

Machine excavation of C004 continued to determine the presence or absence of any *in situ* structural remains. No *in situ* structural remains were found in association with C004 and excavation revealed its depth was less than 100 millimetres. The deposit sat above sterile B horizon clay. A concrete pad and compact gravel fill was identified in the south-east corner of the trench adjacent to the brick dump [C007, C008]. These appear to be associated with a service trench that extends beyond the boundaries of the trench.

Whilst the association of the cut is unclear, it is possible that it represents a shallow footing trench and building platform associated with the former teacher's residence shown in the undated aerial photo of the subject site. The orientation of the cut appears to be in a similar alignment to the footprint of the former building, and the presence of artefacts within C004 supports domestic origins. Further careful archaeological investigation of the surrounding area is needed to expose the full extent and nature of the feature and confirm its origins and significance.

Figure 5-10 Test Trench 3, pre-excavation, facing south.

Figure 5-11 Test Trench 3, mid-excavation, base of topsoil [C004], facing south.

Figure 5-12 Test Trench 3, mid-excavation, showing a cut into sterile B horizon clay, facing west.

Figure 5-13 Test Trench 3, mid-excavation, brick dump in south-east corner, facing north.

Figure 5-14 Test Trench 3, mid-excavation, facing south.

Figure 5-15 Test Trench 3, end of excavation, facing north.

5.3.4Test Trench 4

Test Trench 4 was oriented north-west to south-east and positioned where brick rubble and whole bricks had been observed at the rear of the former building complex. The test trench was strung out and long grass removed using a whipper snipper (**Figure 5-16**). The excavator was then used to gently remove the surface deposit, which consisted of grass and loose to firm medium brown silty clay loam with frequent grass roots [C024].

Machine excavation continued, with miscellaneous bricks identified within C026. During excavation, one large blue stone was identified in the south-east corner of the trench [C025]. Weather conditions, at this point, deteriorated with heavy rain making visibility difficult. The stone was photographed, planned and left *in situ*. As the rain eased, machine excavation in the north-west portion of the trench continued until sterile red white mottled B horizon clay was reached. Given the absence of a clear cut and associated fill with the embedded stone, it was not defined as an archaeological relic. No other archaeological features or deposits were noted during excavation.

Figure 5-16 Test Trench 4, pre-excavation, facing north-west.

Figure 5-17 Test Trench 4, mid-excavation, stone left *in situ,* facing south west [C025].

Figure 5-18 Test Trench 4, end-of-excavation, facing south-east.

5.3.5Test Trench 5

Test Trench 5 was positioned in the location of the former School Church of St Paul, which was constructed c1906 and closed in the 1950s. The trench was oriented north-west to south-east and positioned where the former building is shown in the c1945 aerial photo (**Figure 2-3**). Given its proximity to the active high pressure gas main, a 6-metre buffer was required and the trench offset accordingly.

Once the test trench was strung out, long grass was removed using a whipper snipper. The excavator was then used to gently remove the surface deposit, which consisted of grass and loose to firm medium brown silty clay loam with frequent grass roots [C026] (**Figure 5-19**). Machine excavation at the south-east end of the trench quickly revealed the presence of a dark grey black silty clay loam with very frequent glass and charcoal fragments [C027]. Two metal door hinges and red clay brick fragments were noted near the surface of the deposit (**Figure 5-20**).

Given the presence and frequency of artefacts, the surface of the archaeological deposit was cleaned by trowel, with the aim of exposing its extent and finding an associated cut. Occasional artefacts were disturbed and collected during this process. Manual excavation revealed that the deposit was restricted to the south-east end of the trench and was cut into an underlying A2 horizon pale grey brown silty clay that contained occasional glass fragments [C029] (**Figure 5-22**). Given the frequency of charcoal, the presence of brick pieces and a clear cut into underlying soils, the deposit may be associated with a former fireplace. Further archaeological excavation to expose its full extent, however, would be necessary to understand its associations and significance.

Machine excavation from the edge of the archaeological feature across the remaining portions of the trench revealed modified topsoil lay about the sterile red white mottled B horizon clay. No further archaeological features or deposits were identified (**Figure 5-21**).

Figure 5-19 Test Trench 5, start of excavation, facing north.

Figure 5-20 Test Trench 5, mid-excavation, possible underfloor / fireplace deposit [C027], facing north-west.

Figure 5-21 Test Trench 5, end-of-excavation, facing south-east.

Figure 5-22 Test Trench 5, end-of-excavation showing extent of C027, facing south-west.

5.4 Summary of artefactual material

A total of 246 individually recorded artefact fragments were recovered from the test excavation (**Table 5-2**). Glass fragments formed the majority of the assemblage (94 pieces), followed by metal (75 pieces), brick and mortar (25 pieces) and ceramic (23 pieces).

The majority of the artefacts were recovered from the demolition fill [C001] excavated in Test Trench 1. As expected, the fill contained predominantly building materials (nails, brick pieces, window glass) with occasional food and beverage pieces (cut bone fragments, tableware, bottle glass) (**Figure 5-23** and **Figure 5-24**). Three small buttons, including one made of shell (**Figure 5-25**), and a marble were found within C001 (**Figure 5-26**). Occasional special finds like these are not surprising in the context of a small school and associated residence.

Artefacts recovered from the topsoil within Test Trench 2 included plastic and glass pieces, a glass marble and a glass inkwell bottle. No artefacts were identified in Test Trench 3. A glass inkwell bottle piece was also recovered from the topsoil in Test Trench 4.

The small number of artefacts recovered from Test Trench 5 during the cleaning of C027 were predominantly glass pieces, including four fragments of discoloured glass with manganese inclusions manufactured from c1890 to 1916 (**Figure 5-27**). Two intact metal door hinges were also recovered (leaf and barrel and leaf and pin) (**Figure 5-28**). It is likely that the remaining *in situ* deposit will contain a much greater range of domestic artefacts relating to occupation and use of the former church.

It is understood that Roads and Maritime will provide secure short-term storage of the recovered assemblage and will organise a long term repository with a local museum or historical society.

Table 5-2 Number of artefact fragments by fabric type and context.

Test Trench No.	Context No.	Glass	Ceramic	Metal	Bone	Brick/Mortar	Plastic	Other	Total
T1	C001	51	17	69	14	23	2	10	186
T2	C002	12	6	1			2	1	22
T4	C024	1							1
T5	C027	30		5		2			37
Total		94	23	75	14	25	4	11	246

Figure 5-23 Nails found in C001, Test Trench 1.

Figure 5-24 Pieces of bone found in C001, Test Trench 1.

Figure 5-25 Buttons found in C001, Test Trench 1.

Figure 5-26 Marble found in C001, Test Trench 1.

Figure 5-27 Discoloured glass found in C027, Test Trench 5.

Figure 5-28 One of two door hinges found in C027, Test Trench 5.

5.5 Synthesis and discussion

In summary, the following archaeological relics were identified during the test excavation:

- Intact brick footings of the former c1898 Cecil Park school in Test Trench 1. The footings appear to be associated with an annex attached to the main school building and include a former brick and mortar base, possibly for a stove. The footings were found below and in association with demolition fill and a number of artefacts, including ceramic, glass and metal pieces, were collected as part of the process of exposing the *in situ* structural remains. Of particular note, was the presence of buttons, animal bone pieces with cut marks and a marble. Given the integrity of the footings, it is likely that some *in situ* deposits associated with occupation of the school will survive within the broader building footprint.
- An artefact and charcoal rich deposit in Test Trench 5, which was exposed and left *in situ*. The deposit was found in association with bricks and may be the remains of a disturbed fireplace of the former c1906 St Paul's timber church. Further investigation, including manual excavation of the deposit, is needed to confirm this initial interpretation. Other brick piles were noted in the immediate vicinity and are also likely related to the former church and its outbuildings.

In Test Trench 3 a demolition fill and associated cut into the natural ground was identified and is likely to be associated with the former Teacher's Residence shown in the undated (c1945) aerial photo of the subject site (**Figure 2-3**). No *in situ* archaeological deposits or structural remains, however, were identified. Similarly, in Test Trenches 2 and 4 demolition fill and an embedded stone was identified but no *in situ* archaeological relics were found.

The archaeological test excavation has confirmed the presence of archaeological relics within the subject site, not surprisingly in the location of the former school and church as shown in the undated (c1945) aerial photograph. Given that the project would impact on the subject site, further archaeological salvage excavation is now required to further investigate relics prior to project works commencing. Given the condition of the footings of the former brick school and annex and the presence of an *in situ* artefact-rich

deposit associated with the former church, the relics clearly have integrity and research potential. Further analysis of both the school and church site may provide some insight into former occupation and use of the complex by local residents, teachers and students.

Given the presence of the active gas main, which traverses the subject site (see **Figure 4-1** and **Annexure C**), it is likely that some portions of the complex have been significantly disturbed. However, as demonstrated by the results of this test excavation, this area of disturbance is likely to be restricted to the gas main corridor only, with intact relics present in surrounding deposits.

6. Response to Research Design

6.1 Response to research questions

The main aim of the archaeological investigation was to determine the nature and extent of archaeological relics within the subject site by undertaking archaeological test excavation. A number of research questions were formulated to guide the strategy and archaeological methods employed during the investigation and are answered below.

Is there any evidence of undocumented pre-1880s European and/or Aboriginal activity on the site?

No. No evidence of any undocumented pre-1880s European or Aboriginal activity was observed during the archaeological test excavation.

Have archaeological relics relating to the original school building constructed c1896 survived at the subject site? If so, what are their condition, nature, extent and significance? Does the evidence indicate the size of the original building and how does that compare to the later school shown in the 1940s aerial photograph? Does the evidence provide any information about former students and their use of the Cecil Park public school?

No. No evidence of the original timber school building constructed in c1896 has been found at the subject site. Based on the results from Test Trench 1, it is likely that remains of the original timber building would be situated closer to Elizabeth Drive, if they have survived.

Despite the absence of evidence of the original school building, substantially intact brick footings of the later brick school building constructed c1898 were found within Test Trench 1. The remains include intact brick footings of an annex attached to the main school building and include a former brick and mortar base, possibly for a stove. The footings were found below, and in association with, demolition fill that contained occasional ceramic, glass and metal pieces. Of particular note, was the presence of buttons, animal bone pieces with cut marks, and a marble. These artefacts suggest that domestic activities, including cooking and eating, were being conducted at the school site. The structural remains were found in good condition and extend beyond the boundaries of the trench towards Elizabeth Drive.

Overlays of the location of Test Trench 1 and the former locations of the buildings, as shown in the c1945 aerial photo, (**Figure 4-1**) suggest that the brick footings align with the rear wall of the former brick school building and appear to have supported part of an annex. Given the integrity of the footings, more substantial brick footings of the main school building are likely to be present towards Elizabeth Drive and may be found in association with *in situ* occupation and yard deposits. If artefact-rich deposits are present in this location, their excavation and analysis would likely provide further insights into the lives of the former teachers and children that attended Cecil Park school during the late 19th and early 20th century. Such remains are considered to be locally significant for their historical heritage value and research potential.

Is there any archaeological evidence of the timber teacher's residence? If so, what is the condition, nature, extent and significance of the relics? Is there any evidence of a former cess-pit at the rear of the former house? Do the remains provide any insight into to the lives of former teachers who occupied the residence during the late 19th and early 20th centuries?

Some limited evidence of the timber teacher's residence was found in Test Trench 3, where demolition fill within a long linear cut into the natural ground was observed. The cut seems to follow the same orientation as the former building shown in the c1945 aerial photo (**Figure 4-1**). No *in situ* archaeological deposits or structural remains, however, were identified within Trench 3 and it is likely that construction of the active gas main may have significantly disturbed the location where the timber building once stood. Further archaeological investigation of the surrounding area, particular towards Elizabeth Drive and the active gas main, would be required to confirm this observation.

If *in situ* archaeological remains are present in the surrounding areas, they may provide some limited insight into the lives of former teachers that occupied the residence during the late 19th and early 20th centuries.

Has any archaeological evidence of the former post office building survived? If so, what is the nature and extent of the relics?

Given the location of the former post office in relation to the active gas main that traverses the subject site, it is unlikely that substantially intact archaeological remains of that former building have survived. Disturbed brick was observed within the gas main corridor in the rough location of the former post office and it is likely that installation of the service has significantly disturbed the former building and associated archaeological relics.

Is the rubbish pit identified at the eastern end of the subject site related to the former church? If so, what does the archaeological evidence tell us about the former church?

Excavation of Test Trench 5 revealed the presence of an artefact- and charcoal-rich deposit in close proximity to the rubbish pit identified near the former c1906 St Paul's timber church. The deposit may be the remains of a disturbed fireplace and has considerable research potential. Further archaeological excavation of the deposit and the associated rubbish pits is required to recover further information about occupation of the church. Based on the evidence recovered from Test Trench 5, it is highly likely that the rubbish pit relates to former demolition of the church and artefact-rich deposits may be present in the surrounding area.

7. Revised Significance Assessment

7.1 NSW heritage criteria for assessing significance

The concept of cultural heritage significance helps to estimate the value of heritage items. Items which are likely to be significant are those which '*help an understanding of the past or enrich the present, and which will be of value to future generations'* (Australia ICOMOS 2013). In Australia, the significance of a heritage item or place is generally assessed according to the following values:

- Aesthetic value
- Historic value
- Scientific value
- Social value.

The NSW Heritage Council has adopted specific criteria for heritage assessment, which have been gazetted pursuant to the *Heritage Act 1977*. The seven criteria upon which the following assessment of significance is based are outlined below:

- Criterion (a) an item is important in the course, or pattern, of NSW cultural or natural history
- Criterion (b) an item has strong or special association with the life or works of a person, or group or persons, of importance in NSW cultural or natural history
- Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW
- Criterion (d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons
- Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW cultural or natural history
- Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW cultural or natural history
- Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW cultural or natural places or cultural or natural environments.

Components of the *NSW Heritage Manual*, published by the NSW Heritage Office and Department of Urban Affairs and Planning (NSW Heritage Office 2001) (now DPC (Heritage), sets out a detailed process for conducting assessments of heritage significance. In 2009, DPC (Heritage) issued a new set of guidelines for assessing the significance of historical archaeological sites and relics. This calls for a broader consideration of multiple values of archaeological sites beyond their research potential. The following assessment of archaeological significance for the subject site follows this DPC (Heritage) guideline and is augmented with answers to the questions posed by Bickford and Sullivan below.

7.2 Bickford and Sullivan's Questions

The assessment of significance of historical archaeological sites requires a specialised framework for consideration. The most widely used framework is that developed by Bickford and Sullivan in 1984 and comprises three questions which can be used as a guide for assessing the significance of an archaeological site:

- Can the site contribute knowledge that no other site can?
- Can the site contribute knowledge that no other resource can?
- Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

7.3 Re-assessment of heritage significance

The following sections provide a revised significance assessment for the former Cecil Park historical complex. It incorporates the results of the archaeological test excavation, where relevant. Updated text from the original significance assessment presented in the HAARD is *italicised* to highlight the changes made.

Criterion (a) an item is important in the course, or pattern, of NSW cultural or natural history

The subject site is associated with two phases of historical development: agricultural land that formed part of the large estate known as 'Macquarie Park' granted to Thomas Wylde (1817 – 1886) and its subsequent subdivision and development for the Cecil Park Public School, post office and School Church of St Paul (1895 – 1965). Following the demolition of the school buildings in 1965 the land has remained vacant and undeveloped. As it housed the school, post office and church, the subject site was a central locality within the small community of Cecil Park. As such, it is historically significant to the local area for its association with education, religious worship and postal and telecommunications infrastructure in the settlement of Cecil Park and the broader development of western Sydney. *Archaeological test excavation has confirmed the presence of substantially intact archaeological relics of the former brick school building and the timber church. Further archaeological excavation and analysis of these deposits is likely to provide further insight into the lives of Cecil Park children, teachers and worshippers during the late 19th and early 20th centuries.*

Criterion (b) an item has strong or special association with the life or works of a person, or group or persons, of importance in NSW cultural or natural history

The school, church and post office site have no known significant historical associations to a person or groups of people of importance in NSW or the Cecil Park area. It is likely that the School Church of St Paul, Cecil Park would have been significant to the Anglican Church and local Anglican worshippers when it was still standing.

Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW

Despite the integrity of brick footings identified at the former Cecil Park school site, archaeological relics at the subject site are unlikely to have aesthetic significance.

Criterion (d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons

Although there is no known current social significance attached to the site, the school, church and post office buildings would have represented the heart of the early Cecil Park community. *Archaeological relics of the Cecil Park school and church site may be significant to the present Cecil Hills community, however, further community consultation would be required to understand the strength of this association.*

Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW cultural or natural history

Archaeological test excavation has revealed the presence of substantially intact brick footings of the former Cecil Park school building and in situ archaeological deposits associated with the former St Paul's church. Some disturbed remains of the former teacher's residence may also be present outside of the active gas main corridor. Archaeological evidence of the former post office, however, is unlikely to have survived the installation of this service.

The condition and integrity of the archaeological relics exposed to-date suggest that areas surrounding the former school and church sites have considerable archaeological potential for further archaeological relics, including brick footings and artefact-rich underfloor and yard deposits. Further salvage excavation and analysis would provide further insights into the changing layout of the buildings and their use over time. The

recovery and analysis of artefacts from these contexts may also provide some significant insight into the lives of the former teachers, worshippers and local children. Information about wealth, diet and lifestyle could be gained from such analyses. This kind of information is not readily available in the historical record and could contribute to broader questions about the development of education and religious buildings in Western Sydney during the late 19th and early 20th century. As a result of investigations to-date, the subject site is significant at a local level for its research potential.

Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW cultural or natural history.

The subject site is unlikely to be rare, as there are many examples of late 19th and early 20th century schools, post offices and churches still standing in NSW.

Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW cultural or natural places or cultural or natural environments

The subject site is unlikely to be significant in terms of this criterion.

7.3.1Revised statement of significance

The following Statement of Heritage Significance included in the HAARD is revised as follows:

The former Cecil Park historical complex located on Lot 1 DP724970 is significant at a local level for its historical heritage value, research potential and for its potential social heritage values. The subject site housed the public school, post office and the School Church of St Paul from 1895 to the 1950s and likely became a social hub for the small rural location of Cecil Park. Since the demolition of the school buildings in 1965, the site has remained vacant and undeveloped. Although there is no known current social significance attached to the site, the school, church and post office buildings most likely would have represented the heart of the early Cecil Park community. *Archaeological test excavation has confirmed the presence of structural remains and in situ archaeological deposits of the former brick public school and the timber Church of St Paul at the subject site. However, at this stage, no deeper sub-surface features have been identified (ie wells, cess pits). Given the condition and integrity of the remains, it is considered likely that further substantially intact archaeological relics of the former complex will survive in the surrounding areas. Further salvage excavation and analysis would provide further insights into the changing layout of the buildings and their use over time. In particular, the analysis of artefacts recovered from in situ deposits would provide information on the lives of children, teachers and worshippers who lived at Cecil Park. Very little information is currently available on the history of the former historical complex and, as such, these relics would be of local heritage significance.*

8. Impact assessment

8.1 Impact on identified relics

Construction of the interchange and ramp at the junction of the M7 Motorway and Elizabeth Drive would result in a direct impact on archaeological relics identified at the Cecil Park historical complex. As shown in **Figure 1-3**, part of the historical complex is located within the construction and operational footprints. This includes the former Cecil Park Post Office and the former School Church of St Paul. Excavation within this area during construction of the interchange and ramp would disturb and/or remove subsurface remains. Whilst the former Cecil Park school site is situated outside the construction footprint, the disturbance of adjacent structures would result in an impact to the entire complex.

The following aspects of the project respect or enhance the heritage significance of the item for the following reasons:

While the project will have a direct impact on archaeological deposits of the Cecil Park Post Office and the former School Church of St Paul, a detailed archaeological investigation of the entire complex prior to its disturbance may enhance its significance through the realisation of its research potential. Undertaking further archaeological investigation of the complex under a well-structured research design by an appropriately qualified historical archaeologist would reveal further information and the development of education and postal and telecommunications in western Sydney from the late 19th century and into the 20th century. As with the test excavation, it is recommended that any further salvage excavation be undertaken by an archaeologist who fulfils DPC (Heritage)'s Excavation Director criteria.

The following aspects of the project could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:

The project would have a direct impact on archaeological relics of the former Cecil Park Post Office and the former School Church of St Paul. To minimise impacts to the site and maximise the opportunity for realising its research potential archaeological salvage excavation of impact areas should be undertaken in accordance with an archaeological research design and methodology.

The following impacts of the project have been assessed:

- Vibration – this item would not be impacted by vibration as the archaeological deposits would be salvaged prior to construction commencing
- Demolition – relics associated with the former Cecil Park Post Office and the former School Church of St Paul would be disturbed or removed, whereas relics of the Cecil Park school site would not be impacted
- Archaeological disturbance – potential relics of the former Cecil Park Post Office and the former School Church of St Paul would be subject to disturbance as they are located within the construction footprint and would likely be removed or disturbed during excavation. Archaeological relics of the Cecil Park school site, however, would not be impacted
- Altered historical arrangements and access – given the archaeological nature of the subject site the potential impacts would be limited to relics. The site is not currently accessed via formal roads so access to the site would not be affected
- Visual amenity – as the heritage significance of this heritage item is related to subsurface archaeological remains, and the site does not have aesthetic significance, assessment of visual impacts is not relevant to this item
- Landscape and vistas – as the heritage significance of this heritage item is related to subsurface archaeological remains, and the site does not have aesthetic significance, assessment of visual impacts is not relevant to this item

- Curtilages – not relevant to this heritage item, as much of the area of archaeological potential would be removed and no longer exist following archaeological investigation and project construction, and the site would no longer be of significance
- Subsidence – not applicable to this project
- Architectural noise treatment – not relevant to this heritage item.

9. Conclusions and recommendations

9.1 Conclusions

The subject site housed a complex of former buildings associated with the village of Cecil Park including the school and teacher's residence, the post office and the School Church of St Paul. The predominantly timber buildings were progressively added to the site from 1895 through to 1903 and occupied until the 1950s prior to their demolition.

Archaeological test excavation of the subject site has confirmed the presence of intact historical archaeological relics of the former Cecil Park historical complex. Relics include:

- Intact brick footings of the former c1898 Cecil Park school including a former annex attached to the main school building and a brick and mortar base, possibly for a stove. The footings were found below and in association with demolition fill containing occasional ceramic, glass and metal pieces, buttons, animal bone pieces with cut marks and a marble. Given the integrity of the footings, it is likely that some *in situ* deposits associated with occupation of the school will survive within the broader building footprint
- An artefact and charcoal rich deposit in the footprint of the former c1906 St Paul's timber church. The deposit was found in association with bricks and may be the remains of a disturbed fireplace. Further investigation, including manual excavation of the deposit and surrounding rubbish piles, is needed to confirm this initial interpretation.

The subject site maintains its significant at a local level for its historical heritage value, research potential and for its potential social heritage values. Further archaeological salvage excavation and associated artefact analysis would provide some insights into the changing layout of the building complex and the lives of the children, teachers and worshippers that lived at Cecil Park during the late 19th and early 20th centuries.

The proposed construction of an interchange and ramp at the junction of the M7 Motorway and Elizabeth Drive for the project would disturb or destroy archaeological relics associated with the former historical complex.

9.2 Recommendations

Based on the results of historical research, archaeological assessment and test excavation it is recommended that:

- A copy of this report is included in the non-Aboriginal heritage assessment prepared in support of the EIS for the M12 Motorway Project for consideration by the Department of Planning, Industry and the Environment (DPIE) and DPC (Heritage). The EIS is to include a revised significance and impact assessment for the former and Cecil Park historical complex and recommendations for further archaeological salvage of the complex.
- Roads and Maritime must liaise with local museums and/or historical societies to arrange a long term secure artefact repository for the artefact assemblage. Once that arrangement has been made, DPC (Heritage) must be notified for their records. In the short term, Roads and Maritime must provide secure short term secure storage for the assemblage.
- An Archaeological Research Design (ARD) for archaeological salvage of the former historical complex must be prepared and implemented prior to construction commencing by a suitably qualified historical archaeologist who fulfils the Heritage Council's *Excavation Director Criteria* to conduct open area excavation of a locally significant archaeological site. The ARD is to include a revised impact assessment, revised research questions and a methodology to ensure archaeological relics within the project construction footprint are adequately investigated in accordance with standard NSW archaeological practice.

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The Cumberland Argus and Fruitgrowers Advocate 1899 Cecil Park. The Cumberland Argus and Fruitgrowers Advocate. Saturday 9 September 1899.

Annexure A – Nominated Excavation Director

Roads and Maritime chose to nominate Fiona Leslie (Principal Archaeologist, Jacobs) as the Excavation Director for the archaeological test excavation of the former Cecil Park Historical Complex. Fiona has directed numerous excavations under both s.140 and s.60 permits issued under the Heritage Act. These include:

- Parramatta Linen Service, O'Connell Street, Parramatta (s.140 permit)
- Bathurst Base Hospital – Historical and Aboriginal test excavation (s.60 permit)
- Liverpool Hospital – Historical archaeological test excavation (s.140 permit)
- Hadley Park Residence, Castlereagh – Historical archaeological
- Emanuel School, Randwick – Historical archaeological monitoring (s.60 permit)
- Eskbank House, Lithgow – Historical archaeological monitoring (s.140 permit)
- John Kay Grave Site, Terrigal – Historical archaeological test excavation (s.140 permit)
- Federation Forest Reserve, Blacktown – Historical archaeological test excavation (s.140 permit)
- Undercliff, Manly – Historical archaeological test and salvage excavation (s. 140 permit)
- 5 Parramatta Square – Aboriginal and historical test excavation (s.140 permit)

The following test and salvage excavations have also been directed by Fiona Leslie under Major Project Approvals issued by the DPE:

- K2K Project, 6 Ravenswood Road, Kundabung – Historical archaeological test and salvage excavation
- Former Carlton United Brewery Site, Chippendale – Historical archaeological test and salvage excavation

A copy of Fiona's CV can be provided, on request, if further information on her skills and experience is required.

Annexure B – s146 Notification

Memorandum

Subject	**Cecil Park: Notification of the discovery of archaeological relics**	**Project Name**	M12 Motorway EIS
Attention	Suzette Graham, Roads and Maritime Services		
From	Fiona Leslie, JAJV		
Date	11 July 2019, revised 30 July 2019 and 21 August 2019		
Copies to	Tim Colman, JAJV		

The following memorandum provides information to the NSW Roads and Maritime Services (Roads and Maritime) regarding the discovery of historical archaeological relics during archaeological test excavation at Cecil Park, NSW as part of the M12 Motorway project (the project).

The memorandum includes:

- an introduction, including background information about the project
- site location information
- description of the relics identified
- likely significance of the identified relics
- proposed management strategy.

This memorandum has been prepared to accompany a notification to the Heritage Division, Department of Premier and Cabinet (DPC) in accordance with Section 146 of the *Heritage Act, 1977*.

Introduction

Roads and Maritime is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Protection and Biodiversity Act 1999* (Commonwealth; EPBC Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network. The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport.

During preparation of an Environment Impact Statement (EIS) for the project, the Jacobs-Arcadis Joint Venture (JAJV) was engaged by Roads and Maritime to conduct archaeological test excavation of a former historical complex identified in Cecil Park, western Sydney. The former historical complex (hereafter referred to as the subject site or site) consists of a former school, church and post office that occupied the site from 1895 to 1965 (see Figure 1) and which was identified as having potential for locally significant historical archaeological relics.

The test excavation was carried out in accordance with Section 5.2.3 of the EP&A Act, whereby an Excavation Permit for testing prior to approval of a State Significant Infrastructure (SSI) Project is not required. The archaeological test excavation was conducted over a 5-day period from 1 – 5 July 2019, was guided by an Historical Archaeological Assessment and Research Design (HAARD) prepared by JAJV, and was directed by Jacobs Principal Archaeologist, Fiona Leslie.

It should be noted that, in accordance with the provisions of the *Heritage Act 1977*, no in-situ archaeological relics were removed during the investigation. In-situ structural remains and archaeological deposits were simply exposed to record and understand their likely extent, research potential and significance.

Site location

The former Cecil Park historical complex is located on Lot 1 DP724970, Lot 28 DP654786 and Lot 2 DP922940 which is a vacant, heavily vegetated property located at 1097-1109 Elizabeth Drive and 33 Wallgrove Road, near the intersection of Elizabeth Drive and Wallgrove Road, Cecil Hills. As shown in Figure 2, construction of interchanges and ramps for the M12 Motorway has the potential to impact on the subject site.

In accordance with the HAARD five (5) strip trenches were placed in strategic locations across the subject site (see Figure 3). The justification for the placement of each test trench and the aim of the testing is presented in Table 1 below.

Table 1: Test trench locations and objectives

Test Trench	Justification	Aim
Test Trench 1	Positioned to test the levelled area identified near the western boundary of the subject site. It is likely this area correlates with the former footprint of the school building.	To identify whether any remains of the original school building have survived and determine whether any underfloor deposits have survived.
Test Trench 2	Positioned where a small structure is shown in the c1945 aerial photograph. This building is at the rear of the former school and teacher's residence and may be an outhouse.	To determine whether the structure is related to a deeper subsurface feature, such as a well or cess-pit.
Test Trench 3	Positioned to test the second levelled area identified in the central portion of the subject site. This area likely relates to the former post office buildings	To determine whether any archaeological remains of the former post office have survived.
Test Trench 4	Positioned to test the area where a concentration of brick was identified. The trench was placed directly above the bricks.	To determine the extent, nature and condition of the bricks and determine whether they relate to a former outbuilding.
Test Trench 5	Positioned where a large rubble pile was identified. The rubbish pile may relate to the demolition of the former church.	To determine if archaeological remains of the former church have survived. Is the rubbish pile related to its demolition?

Description of Relics

The following relics were identified during the test excavation:

- Intact brick footings of the former c1898 Cecil Park school in Test Trench 1 (see Figures 4 and 5). The footings appear to be associated with an annex attached to the main school building and include a former brick and mortar base, possibly for a stove. The footings were found below and in association with demolition fill and a number of artefacts, including ceramic, glass and metal objects, were collected as part of the process of exposing the in-situ structural remains. Given the integrity of the footings, it is likely that some in-situ deposits associated with occupation of the school will survive within the broader building footprint.
- An artefact-rich deposit in Test Trench 5, which was exposed and left in-situ. The deposit was found in association with bricks and may be the remains of a disturbed fireplace of the former

c1906 St Paul's timber church. Further investigation, including manual excavation of the deposit, is needed to confirm this initial interpretation (See Figures 6 and 7). Other brick piles were noted in the immediate vicinity and are also likely related to the former church and its outbuildings.

- Demolition fill and an associated cut into the natural ground was identified in Test Trench 3 and are likely associated with the former Teacher's Residence shown in the c1946 aerial photo. No in-situ archaeological deposits or structural remains were identified.
- Similarly, demolition fill was identified in Test Trenches 2 and 4, but no in-situ archaeological relics were found.

Artefacts collected during the archaeological test excavation will be cleaned and catalogued by the JAJV archaeology team, the results incorporated into an Excavation Report and the assemblage boxed and transferred to Roads and Maritime for secure short-term storage. RMS will commence discussions with a local museum to organise a long-term secure storage solution for the assemblage and this information will be included in the Excavation Report.

Potential Significance

The following Statement of Heritage Significance was included in the HAARD:

The former Cecil Park historical complex located on Lot 1 DP724970 is significant at a local level for its historical heritage value, research potential and for its potential social heritage values. The subject site housed the public school, post office and the School Church of St Paul from 1895 to the 1950s and likely became a social hub for the small rural location of Cecil Park. Since the demolition of the school buildings in 1965, the site has remained vacant and undeveloped. Although there is no known current social significance attached to the site, the school, church and post office buildings most likely would have represented the heart of the early Cecil Park community. Potential archaeological relics may include structural remains (brick strip footings, brick pads and post holes) and deeper sub-surface features, such as wells, cess-pits and rubbish pits. If substantially intact archaeological relics associated with the former historical complex have survived, their analysis may provide some insights into the changing layout of the building complex and the lives of the children, teachers and worshippers that lived at Cecil Park during the late nineteenth and early twentieth centuries. This kind of information could contribute to broader questions about the development of education, religious buildings and postal and telecommunications infrastructure in Western Sydney during the late 19th and early 20th century.

Archaeological test excavation has confirmed the presence of structural remains and in-situ archaeological deposits of the former brick public school and the timber Church of St Paul at the subject site. However, at this stage, no deeper sub-surface features have been identified (ie wells, cess pits). Given the condition and integrity of the remains, it is considered likely that further substantially intact archaeological relics of the former complex will survive in the surrounding areas. Further salvage excavation and analysis would provide further insights into the changing layout of the buildings and their use over time. In particular, the analysis of artefacts recovered from in-situ deposits would provide information on the lives of children, teachers and worshippers who lived at Cecil Park. Very little information is currently available on the history of the former historical complex and, as such, these relics would be of local heritage significance.

Management Strategy

The following strategy to document and manage archaeological relics at the subject site is recommended to Roads and Maritime:

- The results of the archaeological test excavation be presented in a stand-alone Excavation Report and a summary be incorporated into the non-Aboriginal heritage assessment prepared in support of the EIS or Submissions preferred infrastructure report for the M12 Motorway project. The Excavation Report, non-Aboriginal heritage assessment and EIS should include a revised significance and impact assessment for the former and Cecil Park Historical Complex and recommendations for further archaeological investigation of the complex.
- A copy of the Excavation Report and HAARD for the Cecil Park Historical Complex be included in the EIS for the M12 Motorway project for consideration by the Department of Planning, Industry and the Environment (DPIE) and DPC (Heritage).
- If the project is approved by the DPIE, a subsequent Archaeological Research Design (ARD) for archaeological salvage of the former historical complex should be prepared prior to construction by a suitably qualified historical archaeologist who fulfils the Heritage Council's *Excavation Director Criteria* to conduct open area excavation of a locally significant archaeological site. The ARD should include revised research questions and a methodology to ensure any archaeological relics within the project construction footprint are adequately investigated in accordance with standard NSW archaeological practice. The archaeological salvage should ideally take place as part of the early works component of the construction program and Roads and Maritime would need to ensure that sufficient time and resources was made available to the Construction Contractor and Project Archaeologist to carry out the investigation.

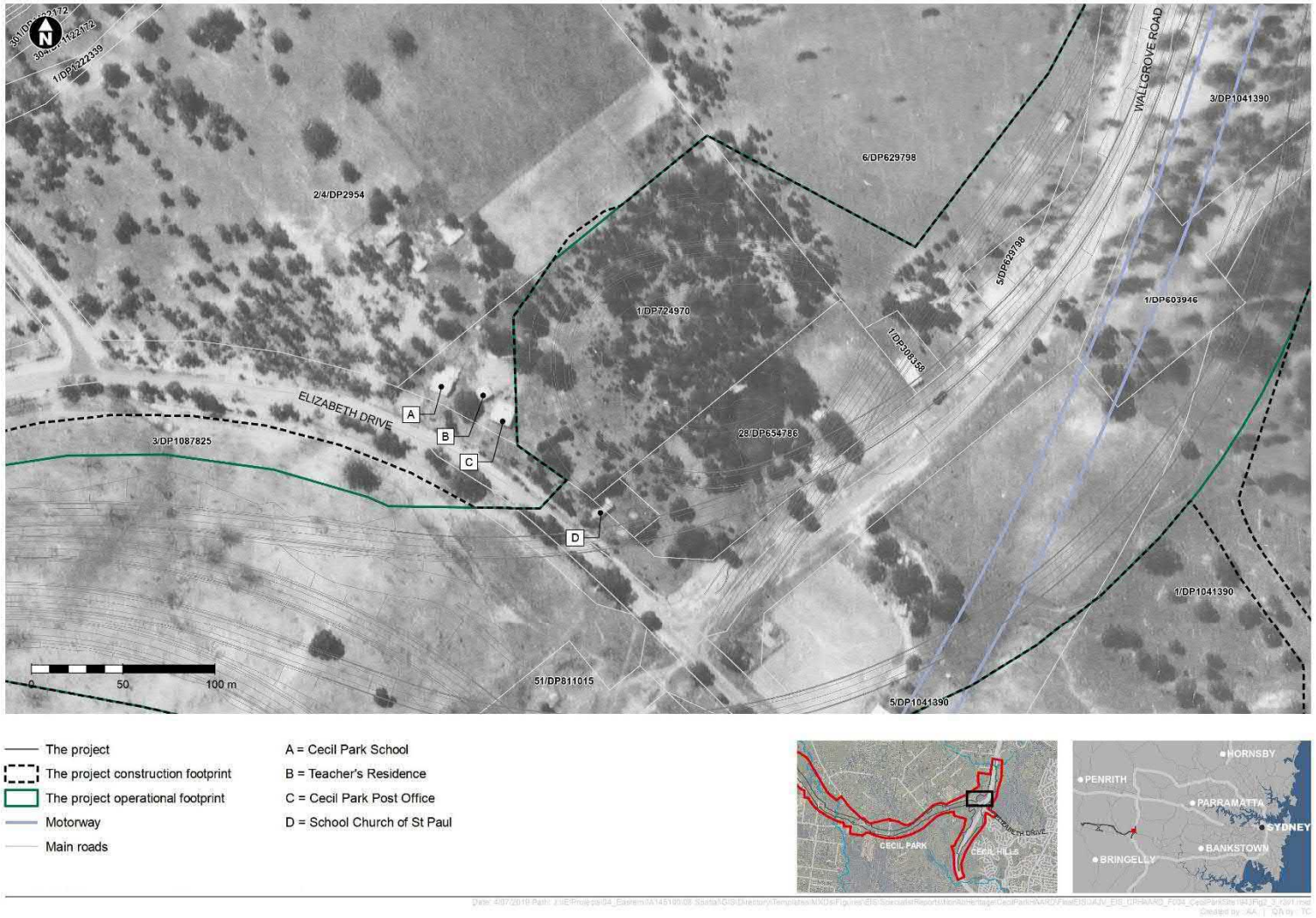


Figure 1: Undated aerial of the subject site, c.1945-1950 showing the layout of the historical complex. (Courtesy: NSW Department of Finance, Services and Innovation)

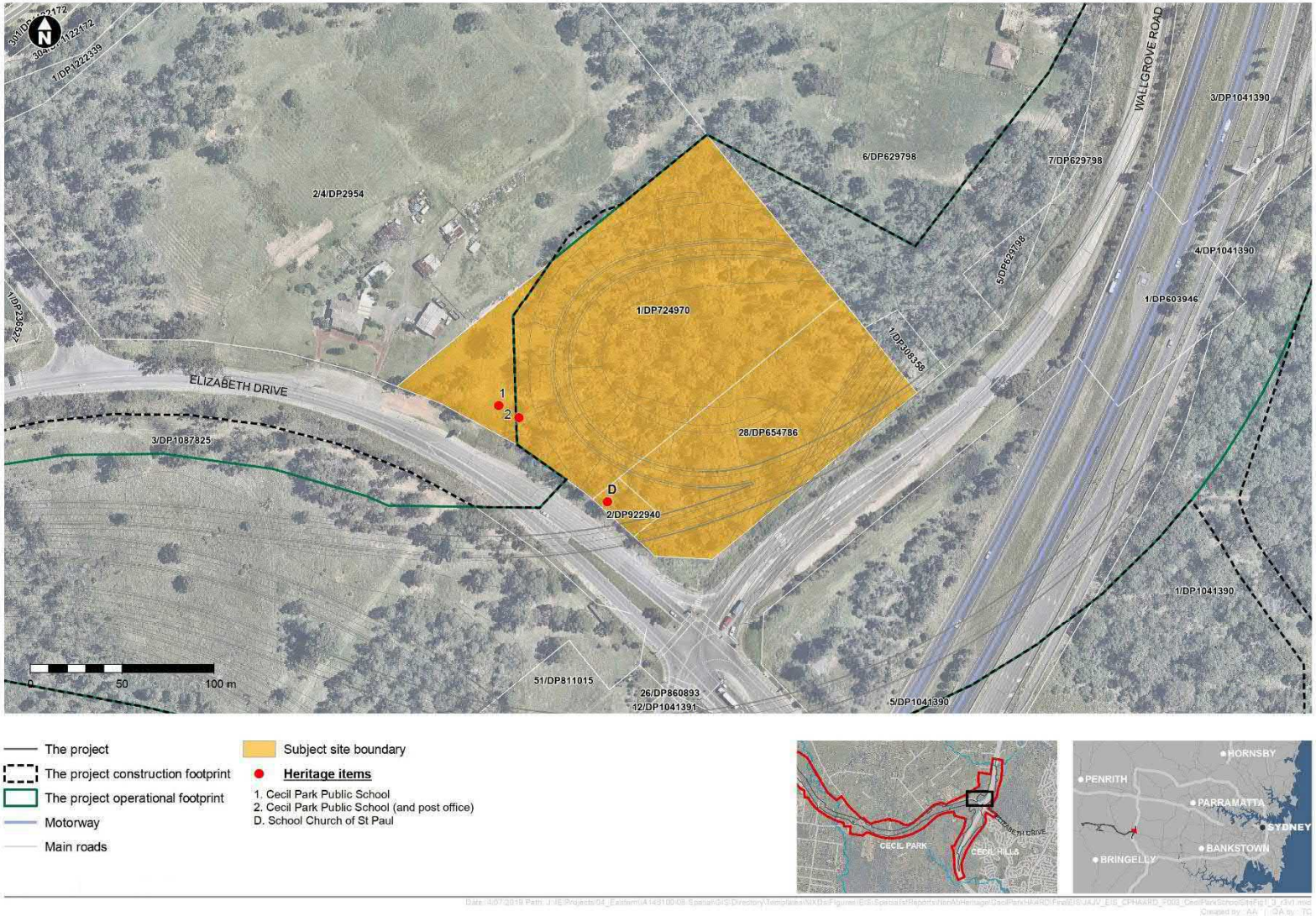


Figure 2: Site location

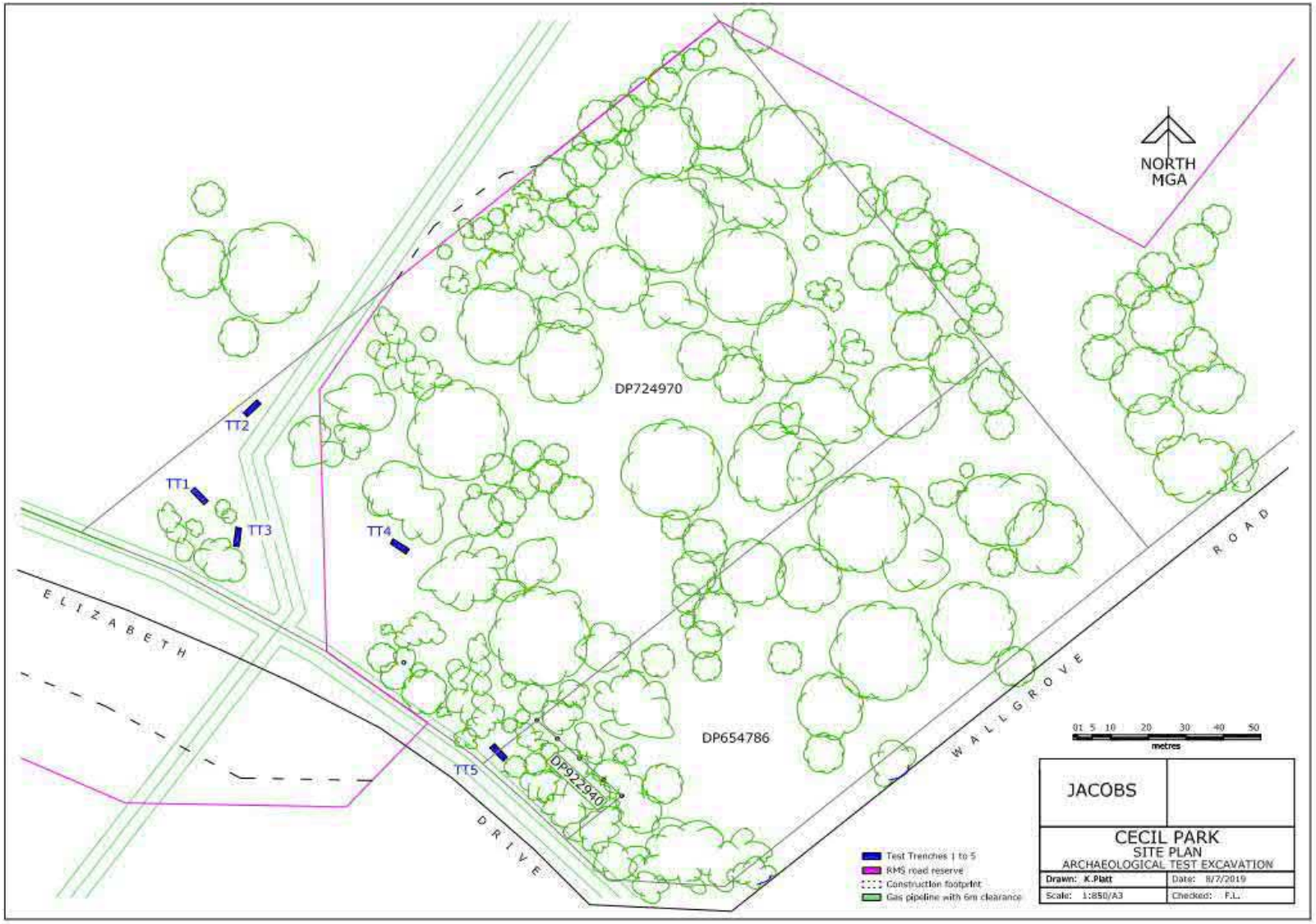


Figure 3: Test trench locations

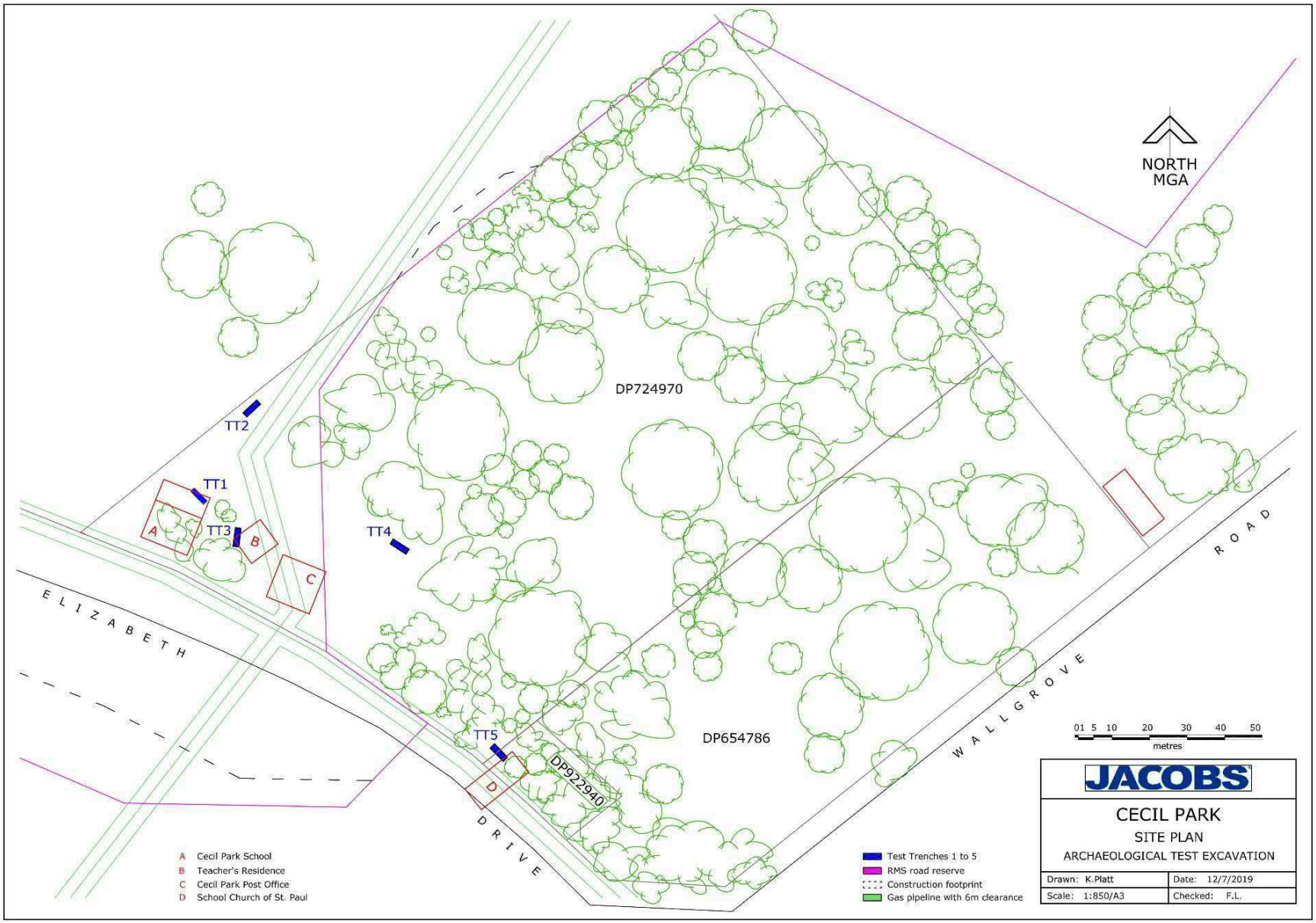
Figure 4: Test Trench 1 – in-situ structural remains of the former Cecil Park school

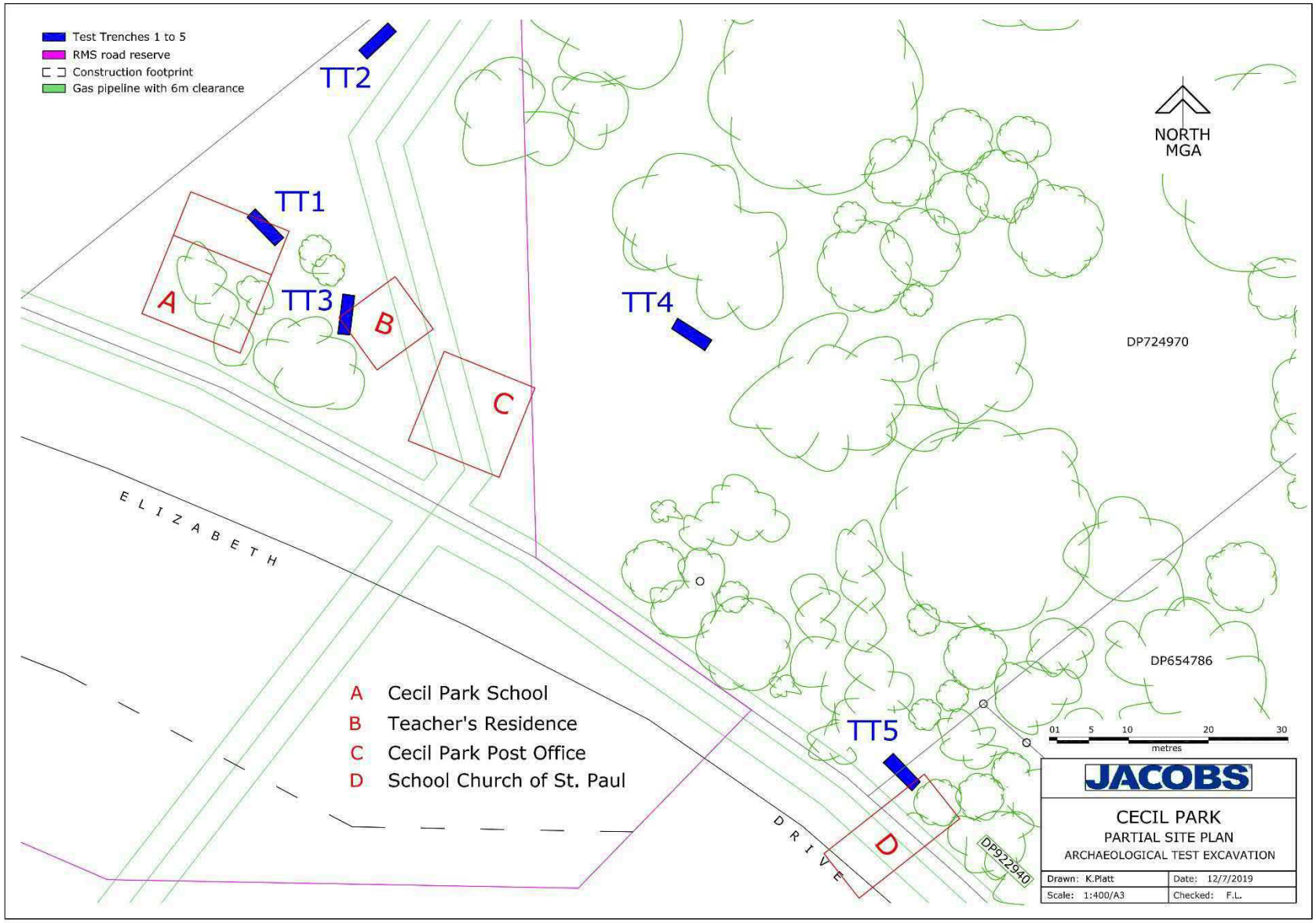
Figure 5: Test Trench 1 – brick and mortar pad

Figure 6: Test Trench 5 – start of excavation

Figure 7: Test Trench 5 – in-situ artefact rich deposit with bricks identified within a distinctive cut

Annexure C – Excavation Plans


NORTH
MGA
DP724970
DP654786
DP922940
TT1
TT2
TT3
TT4
TT5
A
B
C
D
E L I Z A B E T H
D R I V E
W A L L G R O V E
R O A D
A Cecil Park School
B Teacher's Residence
C Cecil Park Post Office
D School Church of St. Paul
Test Trenches 1 to 5
RMS road reserve
Construction footprint
Gas pipeline with 6m clearance
0 1 5 10 20 30 40 50
metres
JACOBS
CECIL PARK
SITE PLAN
ARCHAEOLOGICAL TEST EXCAVATION
Drawn: K.Platt
Date: 12/7/2019
Scale: 1:850/A3
Checked: F.L.


Test Trenches 1 to 5
RMS road reserve
Construction footprint
Gas pipeline with 6m clearance
TT1
TT2
TT3
TT4
TT5
A
B
C
D
NORTH
MGA
DP724970
DP654786
DP922940
ELIZABETH
DRIVE
A Cecil Park School
B Teacher's Residence
C Cecil Park Post Office
D School Church of St. Paul
01 5 10 20 30
metres
JACOBS
CECIL PARK
PARTIAL SITE PLAN
ARCHAEOLOGICAL TEST EXCAVATION
Drawn: K.Platt
Date: 12/7/2019
Scale: 1:400/A3
Checked: F.L.


NORTH
MGA
REDUCED LEVELS AHD
1 115.38
2 115.24
3 115.19
4 115.28
5 115.12
6 115.16
7 115.15
8 115.11
9 115.04
10 115.11
11 115.15
12 115.18
0 0.25 0.50 1
metres
JACOBS
CECIL PARK
ARCHAEOLOGICAL TEST EXCAVATION
TEST TRENCH 1
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Date: 12/7/2019
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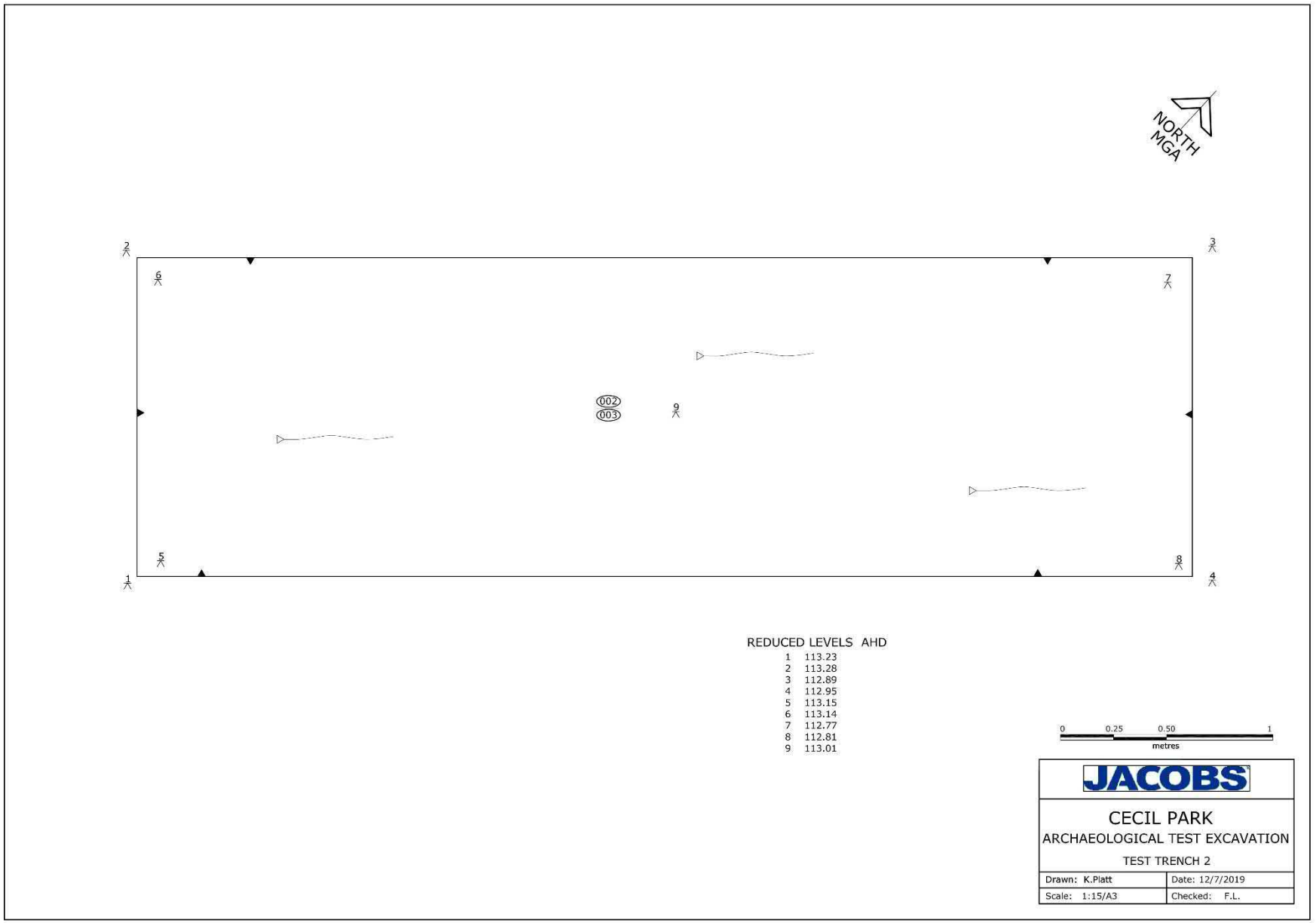
Checked: F.L.



REDUCED LEVELS AHD

1	113.23
2	113.28
3	112.89
4	112.95
5	113.15
6	113.14
7	112.77
8	112.81
9	113.01

0 0.25 0.50 1
metres

JACOBS

CECIL PARK
ARCHAEOLOGICAL TEST EXCAVATION
TEST TRENCH 2

Drawn: K.Platt	Date: 12/7/2019
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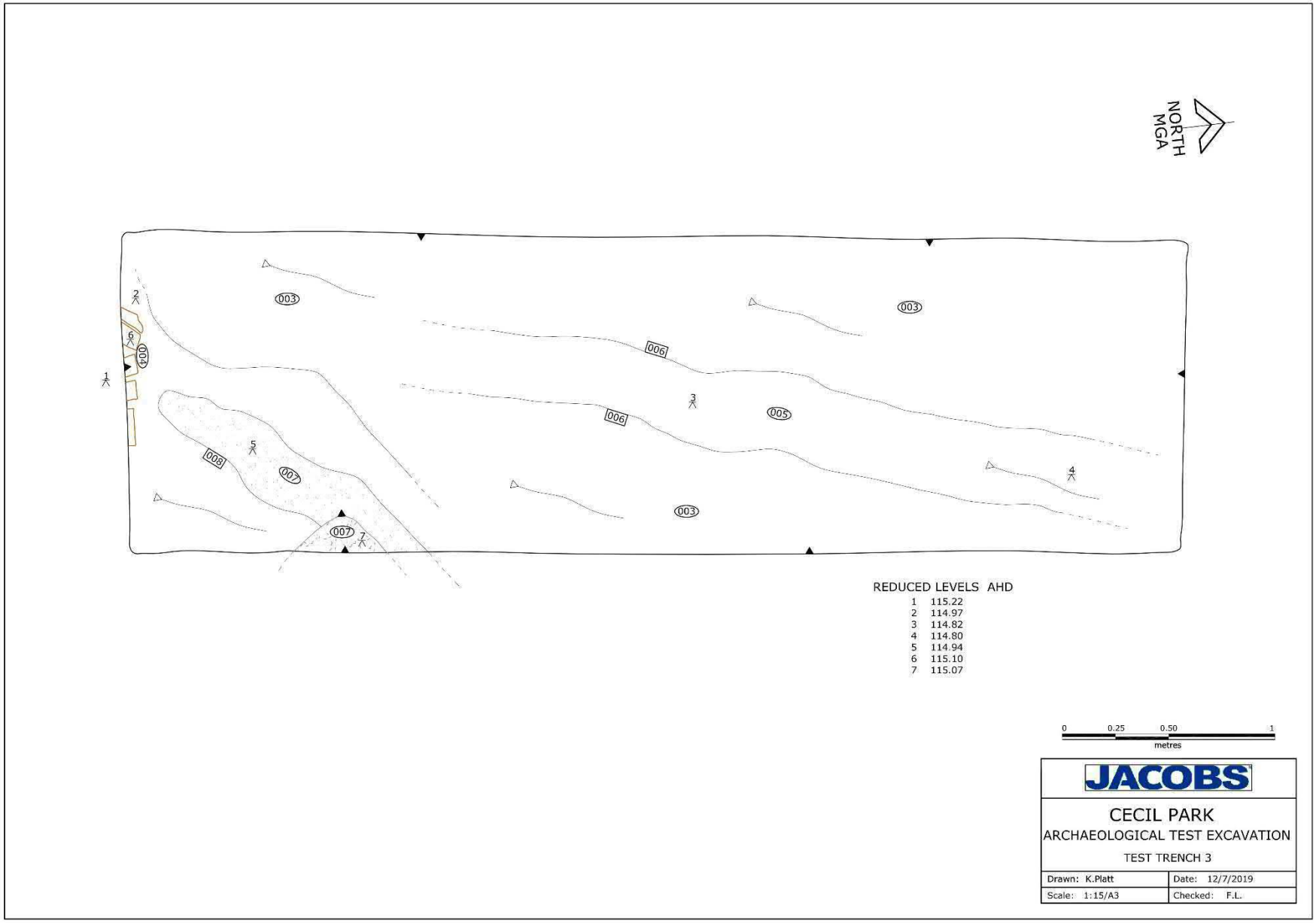
NORTH
MGA
001
002
003
004
005
006
007
008
1
2
3
4
5
6
7
REDUCED LEVELS AHD
1 115.22
2 114.97
3 114.82
4 114.80
5 114.94
6 115.10
7 115.07
0 0.25 0.50 1
metres
JACOBS
CECIL PARK
ARCHAEOLOGICAL TEST EXCAVATION
TEST TRENCH 3
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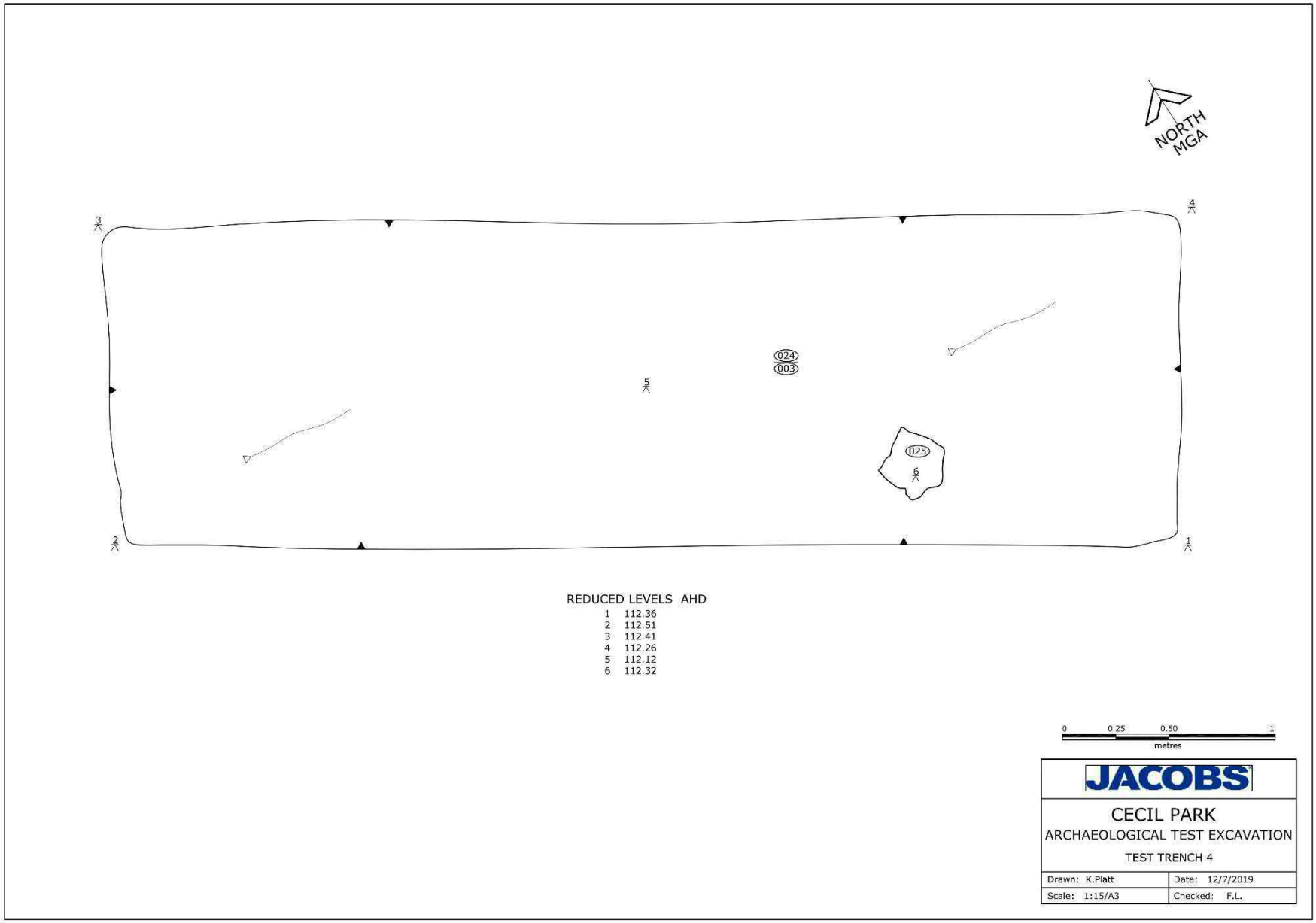

REDUCED LEVELS AHD

1	112.36
2	112.51
3	112.41
4	112.26
5	112.12
6	112.32

0 0.25 0.50 1
metres

JACOBS

CECIL PARK
ARCHAEOLOGICAL TEST EXCAVATION
TEST TRENCH 4

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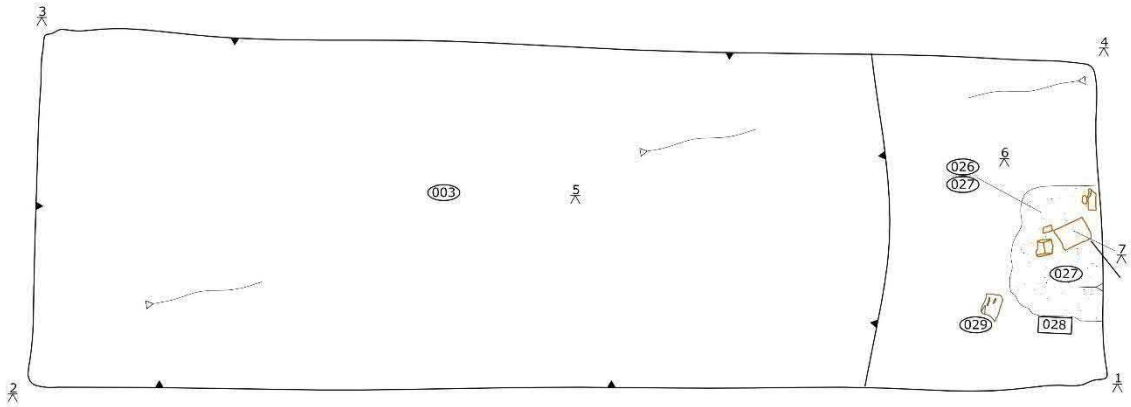
Scale: 1:15/A3	Checked: F.L.



REDUCED LEVELS AHD

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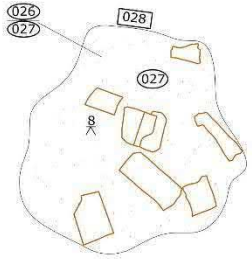
4	111.80
5	111.70
6	111.79
7	111.85
8	112.16



0 0.25 0.50 1 1.5
metres

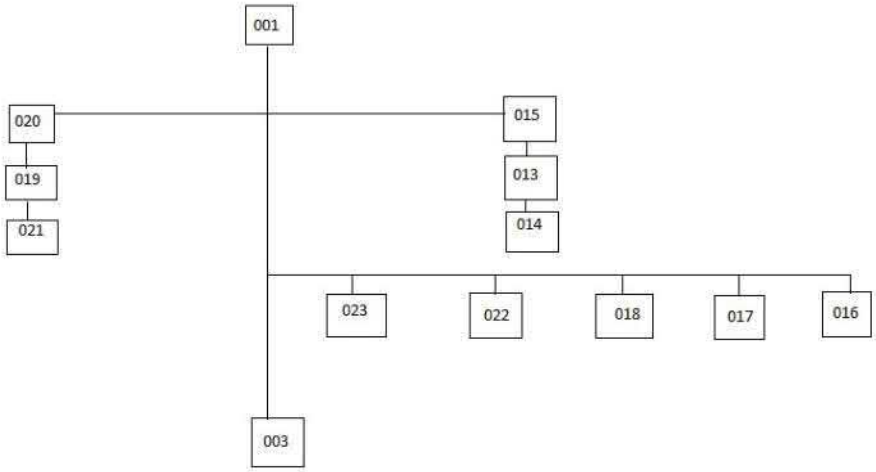
JACOBS

CECIL PARK
ARCHAEOLOGICAL TEST EXCAVATION
TEST TRENCH 5

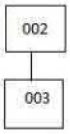
Drawn: K.Platt	Date: 12/7/2019
Scale: 1:20/A3	Checked: F.L.

Annexure D – Harris Matrices

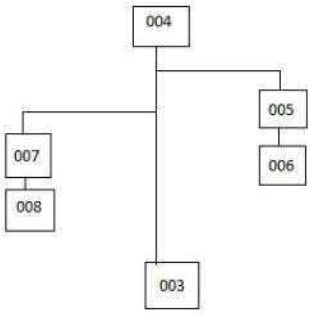
Test Trench 1



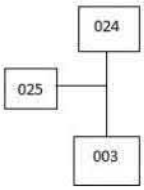
Test Trench 2



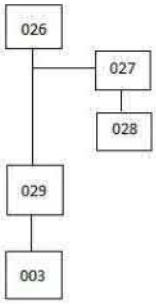
Test Trench 3



Test Trench 4



Test Trench 5



Annexure E – Context Register

Date	Trench / Area No.	Context No.	Description	Average thickness (mm)	Phase	Above	Below	Cuts	Cut by	Contains
1-7-19	1	C001	Loose topsoil and mixed fill with organic matter/ grass	70- 200	E	009				
2-7-19	2	C002	Loose to compact dark. Grey brown silty clay with very. frequent grass roots and occasional rubble	150-170	H	003	N/A	-	-	-
	2	C003	Red white mottled clay. B-Horizon with occasional charcoal flecks. Base of trench Shale- Sterile	N/A	A	N/A	002	-	-	-
3-7-19	3	C004	Fine grained medium brown- silty clay- uniform- very frequent grass roots- 10 yr 3/2. – Modified topsoil	150m	H	005+003	N/A	-	006	-
		C005	Compact mottled grey brown, clay with frequent metal nails, glass, ceramic + marble + brick dump at south end of Trench - Demolition fill?	>100m		006	004	-	-	-
		C006	Cut for 005- Runs. N-S, through trench- possible rubbish pit/Demolition	N/A		-	005	003		005
		C007	Concrete pad in east section with compact gravel part of 005? Or separate service	N/A		-	005?	-		-
		C008	Cut for 007			-	003		007	-
5-7-01	1	C009	Compact med brown Clay with very frequent brick + mortar pieces, occasional glass, metal fragments- Demolition fill Restricted to south west corner	Max 110	G.	012	001	-	-	-
	1	C010	Brick footing- Rear wall. Single courses of machine-made clay brick bonded with cement mortar- L. shaped	?	E	010	001	-	-	-
	1	C011	Cut for Brick footing- only evident in internal space of building (South). Demo pressed in to fill.	N/A	E	?	009	012	-	009
	1	C012	Compact five grained reddish-brown clay. Sterile, likely B-Horizon, internal SW Room	Unknown	E	?	009	-	011	-
	1	C013	Dark brown silty way with very frequent angular gravel. Service fill?	Unknown	F	?	001	015	-	-

Date	Trench / Area No.	Context No.	Description	Average thickness (mm)	Phase	Above	Below	Cuts	Cut by	Contains
	1	C014	Cut for service. Linear, only south cut side of exposed	-	F	-	-	015	-	013
5-7-19	1	C015	Dark brown silty clay loan with occasional artefacts and roots and mortar frags. Possible yard surface at rear of building.	Unknown	F	?	001	-	014	-
	1	C016	Brick footing at rear of building. Single and double course. Heade. One brick with shallow rectangular frog. Machine-made bricks	N/A	E	-	001	015 + 018	-	-
	1	C017	Internal wall. Brick footing. Likely constructed at same as C016. Oriented N-S	N/A	E	-	001	018	-	-
	1	C019	Ceramic drain inlet	-	F	020	001	-	-	-
	1	C020	Dark Brown silty drain fill with occasional artefacts.			021	019	-	-	-
	1	C021	Cut for service drain							019 + 020
5-7-19	1	C022	Brick + Mortar pad in rear room. Blue/grey stone laid in centre of feature. Likely base for pot belly or similar. Brickwork cracked in places. Cement mortar	Unknown depth	E	?	001	018	-	-
	1	C023	Brick footing orientation-s. Internal wall. Single course of machine-made clay bricks laid stretcher. Bricks measure 22 x 11 cm. Standard size. Bonded with cement mortar	Unknown	E	-	001	018	-	-
	4	C024	Moderately compact med brown silty clay loam with frequent grass roots, occasional brick fragments.	100- 120		025 +003	-	-	-	-
	4	C025	Stone piece embedded in 003. Unsure of association. No obvious cut. Left- in- situ	N/A		-	024	003	-	-
	5	C026	Loose to firm medium brown silty loam- Topsoil modified. - Very freq. grass roots	90mm-100m		027	-	-	-	-
	5	C027	Dark grey black silty clay with frequent glass fragments, two door hinges, charcoal and 2 clay bricks. Possible underfloor deposit associated with a former fireplace footing	Unknown		028	026	-	-	-
5-7-19	5	C028	Cut for 027- Possibly for fireplace footing or similar. Rectangular at west end- continues into east section	N/A				029	-	027
5-7-19	5	C029	Modified A2 Horizon with occasional glass fragments associated with 027	50- 80		003	026	-	028	-

Annexure F – Artefact Catalogue

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
1	01	C001	Inorganic/non-metal	Glass	Indeterminate	Plate glass shards	n/a	Clear/colourless	12	n/a	
2	01	C001	Inorganic/non-metal	Glass	Food/beverage	Vessel	Base fragments, Embossed text	Clear/colourless	3	1	Embossed lettering = 1821-1920s
3	01	C001	Inorganic/non-metal	Glass	Indeterminate	Vessel	Base and side fragments Possible chamfered corners	Clear/colourless	5	1	
4	01	C027	Inorganic/non-metal	Glass	Recreation	Marble	n/a	Turquoise	1	1	Potentially a corkscrew marble, pitting and signs of use.
5	01	C001	Inorganic/non-metal	Glass	Indeterminate	Potentially bottle glass	n/a	Brown	7	n/a	
6	01	C001	Inorganic/non-metal	Glass	Indeterminate	Potentially bottle glass	n/a	Olive	1	n/a	
7	01	C001		Mother of Pearl Shell	Clothing	Button(s)	n/a	White	1	1	
8	01	C001 NE corner		Celluloid	Clothing	Button (s)	n/a	Cream	1	1	
9	01	C001	Inorganic/non-metal	Ceramic	Tableware	Saucer or small plate	Well/lip junction	White glaze	2	1	Earthenware
10	01	C001	Inorganic/non-metal	Ceramic	Food/beverage	Jar or other container	Rim fragment	White glaze	1	1	Earthenware
11	01	C001	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	n/a	White glaze	1	n/a	Porcelain
12	01	C001	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	Rim fragments	Green glaze	2	1	Redware? Fragments conjoin

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
13	01	C001	Inorganic/non-metal	Ceramic	Indeterminate	Base fragment	n/a	Red-brown (unglazed)	1	1	
14	01	C001	Organic/animal	Bone	Food/beverage	Rib fragment	n/a	Brown	2	n/a	Potential cut marks
15	01	C001	Organic/animal	Bone	Food/beverage	Knuckle	Cut/sawn in half	Brown	1	1	
16	01	C001	Organic/animal	Bone	n/a	Indeterminate	n/a	Brown	1	n/a	Potential humerus (non-human)
17	01	C001	Organic/animal	Bone	n/a	Indeterminate	n/a	Brown	7	n/a	Small non-diagnostic fragments
18	01	C001	Inorganic/non-metal	Ceramic	Building material	Brick	Accreted sandy, cement mortar attached	Red	2	n/a	
19	01	C001	Inorganic/non-metal	Ceramic	Building material	Brick	n/s	red	6	n/a	
20	01	C001	Inorganic/non-metal	Ceramic	Building material	Cement	n/a	Grey	3	n/a	
21	01	C001	Inorganic/metal	Metal - ferrous	Indeterminate	Metal strip	n/a	Rust	1	n/a	
22	01	C001	Inorganic/metal	Metal	Indeterminate	Sheet metal	n/a	Grey	1	n/a	Bent into corner profile, not rusty
23	01	C001	Organic/plant	Wood	Indeterminate	Indeterminate	n/a	Brown	2	n/a	Potentially old fence timbers
24	01	C001	Inorganic/non-metal	Coal?	Heating	Fragment	n/a	Black	1	n/a	
25	01	C001	Inorganic/non-metal	Mortar	Building material	Sandy mortar	n/a	beige	8	n/a	Small degrading fragments
26	01	C001	Organic/synthetic	Thermoplastic	Irrigation	Sprinkler head	n/a	Red-brown	1	n/a	
27	01	C001	Organic/plant	Wood	Indeterminate	Indeterminate	n/a	brown	1	n/a	Seems modern

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
28	01	C001	Inorganic/metal	Metal - ferrous	Building material	Nails	Square head	Rust	16	13	
29	01	C001	Inorganic/metal	Metal - ferrous	Building material	Screw	With non-ferrous washer	Rust	1	1	
30	01	C001	Inorganic/metal	Metal - ferrous	Building material	Bolt	n/a	Rust	1	1	
31	01	C001	Inorganic/metal	Metal - ferrous	Indeterminate	Indeterminate	n/a	Rust	1	n/a	
32	01	C001	Inorganic/metal	Metal - ferrous	Indeterminate	Sheet metal	n/a	Rust	3	n/a	
33	04	C024	Inorganic/non-metal	Glass	Writing	Inkwell	Threaded rim, makers mark	Brown	1	1	Australian Glass Manufacturers 1.S.151 c1934-1948
34	01	C001	Inorganic/metal	Copper alloy?	Indeterminate	Frame?	Riveted corners	Grey-green	1	1	
35	01	C001 NE corner	Inorganic/non-metal	Glass	Food/beverage	Vessel	Base fragment, embossed text	Brown	1	1	Australian Glass Manufacturers 1.S.343
36	01	C001 NE corner	Organic/animal	Bone	n/a	Indeterminate	n/a	Brown	1	n/a	
37	01	C001 NE corner	Organic/animal	Bone	n/a	Rib fragment	n/a	Brown	1	n/a	Potential cut marks
38	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Building material	Nails	Square head	Rust	8	8	
39	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Building material	Tack or spike	Round head	Rust	2	1	
40	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Building material	Sheet metal	n/a	Rust	6	N/a	
41	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Building material	Container/pot	n/a	Rust	1	1	No lid, sanitary can seal. In US, post-1904, in UK post-

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
											1930
42	01	C001 NE corner	Inorganic/non-metal	Mortar	Building material	Sandy mortar	n/a	Beige	1	n/a	Small degrading fragment
43	01	C001 NE corner	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	Decorative Handle fragments	White glaze	3	n/a	Very white paste but not porcelain
44	01	C001 NE corner	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	Hand painted line work decoration in dark brown/black	White glaze	1	n/a	Earthenware
45	01	C001 NE corner	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	n/a	White glaze	5	N/a	Earthenware
46	01	C001 NE corner	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	n/a	Unglazed, beige paste	1	n/a	Dark coating inside curve, potentially organics
47	01	C001 NE corner	Inorganic/metal	Metal – non-ferrous	Pharmaceuticals	Tube	Partial labelling still legible	White, red and rust	1	1	Likely an early, metal container for 'Veganin' tablets, a strong analgesic used to ease the pain of migraines, dysmenorrhoea and other strong muscular pain. Made by William R Warner & Co. Pty Ltd Sydney. Tubes were generally plastic post 1950s/1960s
48	01	C001 NE corner	Organic/synthetic	Thermoset?	Hygiene	Toothbrush head	n/a	Grey (discoloured)	1	1	No bristles remaining, has been malformed through degradation, heat and/or pressure.
49	01	C001 NE corner	Inorganic/non-	Glass	Indeterminate	Vessel	Body	Clear/colourless	8	n/a	Embossed lettering = 1821-

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
			metal				fragments, embossed lettering				1920s
50	01	C001 NE corner	Inorganic/non-metal	Glass	Indeterminate	Indeterminate	Clear and white glass together	Colourless and white	1	n/a	
51	01	C001 NE corner	Inorganic/non-metal	Glass	Food/beverage	Bottle	Neck, rim, shoulder, body and base fragments. Embossed lettering.	Clear/colourless	14	1	
52	01	C001 NE corner	Organic/animal	Bone	Food/beverage	Long bone fragment	n/a	Brown	1	n/a	
53	01	C001 NE corner	Inorganic/non-metal	Plastic	Indeterminate	Screw-thread cap	Vertical ribbing on outer edge of cap, presumably for grip	Black	1	n/a	
54	01	C001 NE corner	Organic/synthetic	Rubber	Indeterminate	Indeterminate	n/a	Black	1	n/a	Wear and cracking, likely from weathering
55	01	C001 NE corner	Inorganic/non-metal	Slag? Asphalt?	Indeterminate	Indeterminate	n/a	Grey	1	n/a	
56	01	C001 NE corner	Inorganic/non-metal	Ceramic	Building material	Brick	Chamfered stamp/frog with embossed lettering and makers mark, small portion of	Red	1	n/a	Letters 'LIV' on fragment, potentially for 'LIVERPOOL'. Mark is a raised circle with a line through it, likely part of the frog stamp/mould.

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
							sandy mortar adhered in one corner				
57	01	C001 NE corner	Inorganic/non-metal	Ceramic	Building material	Brick	Mould marks	Red	1	n/a	T-shape in profile, potentially roof capping?
58	01	C001 NE corner	Inorganic/non-metal	Natural	N/A	Rock	n/a	Brown	2	n/a	
59	01	C001 NE corner	Inorganic/non-metal	Ceramic	Building material	Brick	n/a	Beige	1	n/a	Gravel inclusions visible on broken face, other faces weathered
60	01	C001 NE corner	Inorganic/metal	Lead	Indeterminate	Thin strip	n/a	Grey	1	n/a	
61	01	C001 NE corner	Inorganic/metal	Aluminium	Indeterminate	Indeterminate	Horizontal ribbing	Grey	1	n/a	
62	01	C001 NE corner	Inorganic/metal	Metal – nonferrous	Indeterminate	Indeterminate		Grey	1	n/a	
63	01	C001 NE corner	Inorganic/metal	Metal	Indeterminate	Eyelet	Fibre still present	Rust	1	n/a	
64	01	C001 NE corner	Inorganic/metal	Metal – nonferrous	Indeterminate	Eyelet or washer		Grey	1	n/a	Uneven disc with hole drilled through
65	01	C001 NE corner	Inorganic/metal	Metal	Indeterminate	Label disc	Raised lettering around outer border	Rust	1	n/a	
66	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Indeterminate	n/a	Rust	1	n/a	Fuse box cover?
67	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Sheet metal	n/a	Rust	3	n/a	
68	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Wire	n/a	Rust	3	n/a	

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
69	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Screw	Threaded	Rust	3	n/a	
70	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Indeterminate	n/a	Rust	4	n/a	Small tacks?
71	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Nail	Round head	Rust	2	n/a	Hatched top
72	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Bolt/fixture	n/a	Rust	2	n/a	
73	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Ring	n/a	Rust	1	n/a	~8 cm diameter
74	01	C001 NE corner	Inorganic/metal	Metal - ferrous	Indeterminate	Indeterminate	Wire fragment through disc	Rust	2	n/a	
75	01	C001 NE corner	Inorganic/metal	Metal	Indeterminate	Indeterminate	Diagonal hatching on outer edge	Brown	1	n/a	Valve cap?
76	05	C027	Inorganic/non-metal	Glass	Indeterminate	Plate glass shards	n/a	Clear/colourless	17	n/a	
77	05	C027	Inorganic/non-metal	Glass	Indeterminate	Blob glass	n/a	Clear/colourless	3	n/a	
78	05	C027	Inorganic/non-metal	Glass	Indeterminate	Indeterminate	n/a	Purple	4	n/a	Likely ‘clear’ glass discoloured – manganese inclusion. c1890-1916
79	05	C027	Inorganic/non-metal	Glass	Indeterminate	Indeterminate	n/a	Aqua	3	n/a	
80	05	C027	Inorganic/non-metal	Glass	Indeterminate	Indeterminate	n/a	Brown	1	n/a	
81	05	C027	Inorganic/non-metal	Glass	Indeterminate	Indeterminate	Clear and white glass	Colourless and white	1	n/a	

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
							together				
82	05	C027	Inorganic/non-metal	Ceramic	Building material	Brick	n/a	red	2	n/a	
83	05	C027	Inorganic/metal	Metal - ferrous	Indeterminate	Sheet metal	n/a	Rust	3	n/a	
84	05	C027	Inorganic/metal	Metal - ferrous	Building Material	Door hinge	Leaf and barrel	Rust	1	n/a	Leaf end broken off
85	05	C027	Inorganic/metal	Metal - ferrous	Building Material	Door hinge	Leaf and pin	Rust	1	n/a	~30 cm in length
86	02	C002	Inorganic/non-metal	Ceramic	Water management	Pipe fragments	Portion of bell end	Brown glazed terracotta	3	n/a	
87	02	C002	Inorganic/non-metal	Plastic	Indeterminate	Indeterminate	n/a	Mottled	1	n/a	Appears to have been melted, mix of dull colours
88	02	C002	Inorganic/non-metal	Plastic	Indeterminate	Indeterminate	n/a	Black	1	n/a	
89	02	C002	Inorganic/non-metal	Glass	Food/beverage	Bottle	Numbers on bottle base ‘10’	Brown	7	n/a	Likely fragments of a small beer bottle
90	02	C002	Inorganic/non-metal	Glass	Indeterminate	Vessel	n/a	Clear/colourless	3	1	
91	02	C002	Inorganic/non-metal	Glass	Writing	Inkwell	Roll top	Clear/colourless	1	1	Likely had a cork stopper. Continuous 2-piece mould c.1903 and later
92	02	C002	Inorganic/non-metal	Ceramic	Indeterminate	Indeterminate	n/a	White glaze	1	n/a	Earthenware
93	02	C002	Inorganic/non-metal	Ceramic	Food/beverage	Teacup handle	Floral pattern on outer edge of handle/ear. Small	White glaze with blue transfer decoration	1	1	Earthenware

Catalogue No.	Test Trench	Context	Class	Material	Function	Form	Features	Colour / Pattern	# of fragments	Minimum Number of Individuals (MNI)	Notes
							portion of inner bowl intact, appears to be willow pattern border.				
94	02	C002	Organic/synthetic	Elastomer	Indeterminate	Rubber Tubing	Vertical ribbing on exterior	Brown	2	n/a	Hosing related to gas regulator?
95	02	C002	Inorganic/metal	Metal	Heating	Gas regulator	Made in Japan sticker on underside	Grey-brown and rust	1	n/a	Made in Japan
96	02	C002	Inorganic/non-metal	Glass	Recreation	Marble	n/a	Brown/grey/blue swirl	1	1	

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October 2019
RMS 19.1374
ISBN: 978-1-925891-89-8