



Willow Tree Waste Management Facility Aboriginal Due Diligence Assessment

FINAL REPORT

Prepared for GHD Pty Ltd

22 December 2022

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Biosis project no.: 36975

File name: 36975.Willow.Tree.WMF.ADDA.FIN01.20221222

Citation: Biosis (2022). Willow Tree Waste Management Facility Aboriginal Due Diligence Assessment. Report for GHD Pty Ltd. Garabedian, C., Crissell, M. and Bridge, A. Biosis Pty Ltd. Sydney, NSW. Project no: 36975.

Document control

| Version | Internal reviewer | Date issued |
|------------------|-------------------|-------------|
| Draft version 01 | Taryn Gooley | 31/05/2022 |
| Final version 01 | Maggie Butcher | 22/12/2022 |

Acknowledgements

Biosis gratefully acknowledges the contributions of the following people and organisations in preparing this report:

- Client: Shaun Lawer, GHD Pty Ltd.

Biosis staff involved in this project were:

- Astrid Mackegard and Jen Townsend (mapping).
- Mathew Smith (field investigation).

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Glossary

| | |
|----------------------------------|---|
| ACHA | Aboriginal Cultural Heritage Assessment |
| ADDA | Aboriginal Due Diligence Assessment |
| AHIMS | Aboriginal Heritage Information Management System |
| AACo | Australian Agricultural Company |
| Biosis | Biosis Pty Ltd |
| Consultation requirements | <i>Aboriginal Cultural Heritage Consultation Requirements for Proponents</i> |
| Council | |
| DCP | Development Control Plan |
| Due Diligence Code | <i>Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales</i> |
| EP&A Act | <i>Environmental Planning and Assessment Act 1979</i> |
| GHD | GHD Pty Ltd (client) |
| GSV | Ground Surface Visibility |
| Heritage NSW | Heritage NSW, Department of Planning and Environment (DPE) |
| ICOMOS | International Council on Monuments and Sites |
| LEP | Local Environment Plan |
| LGA | Local Government Area |
| NPW Act | <i>National Parks and Wildlife Act 1974</i> |
| NSW | New South Wales |
| PAD | Potential Archaeological Deposit |
| QBB | Queensland Brigalow Belt |
| Study area | 258 Merriwa Road (Lot 213 DP 1173230) Willow Tree, NSW |
| The Code | <i>The Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW</i> |
| WMF | Waste Management Facility |

Summary

Biosis Pty Ltd (Biosis) has been commissioned by GHD Pty Ltd (GHD) on behalf of the Liverpool Plains Shire Council Council) to undertake an Aboriginal Due Diligence Assessment (ADDA) for the proposed expansion of the existing Willow Tree Waste Management Facility (WMF) at 258 Merriwa Road (Lot 213 DP 1173230) Willow Tree, New South Wales (NSW). The project involves expansion of an existing landfill, including cell construction, to receive up to 9000 tonnes per year of domestic putrescible, organic and clean fill waste. This will involve the construction of a hazardous materials shed, green waste and metal drop off bays, a transfer station, dual weighbridge, car parking stockpiling and the creation of a bulky drop off area. The proposed development will be assessed against Part 4 of the *Environmental Planning and Assessment Act 1979* NSW (EP&A Act).

An assessment in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010b) (due diligence code) has been undertaken for the study area in order to inform Council of their responsibilities with regards to Aboriginal cultural heritage in the area. In addition to the basic tasks required for an ADDA, an extended background review, as well as an archaeological survey in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010c) (the Code) was conducted, in order adequately map areas of high, moderate and low archaeological potential.

The study area lies within the Brigalow Belt South Bioregion, which extends from central NSW to the mid-Queensland coast. The study area is located within three soil landscapes; the Glen Oak, Inverkip Road and Disturbed Terrain soil landscapes. The study area is located within a complex landmass, sloping south-west, away from a crest in the eastern portion and towards a drainage depression in the south-western portion. Historical aerial imagery shows extensive levels of previous disturbance throughout the study area as a result of vegetation clearance and the utilisation of the land as a rubbish tip from the mid-twentieth century.

Background research included a search of the Aboriginal Heritage Information Management System (AHIMS) database and a review of regional and local archaeological survey reports to assess the potential for Aboriginal heritage values or items to be present within the study area. The AHIMS search identified three Aboriginal archaeological sites within a 10 kilometre radius of the study area. None of these registered sites are located *within* or within 200 metres of the study area.

Previous archaeological surveys within the local and regional areas and their findings were also reviewed as part of this assessment. The results of the previous surveys along with a review of the geology, hydrology and soil landscape characteristics of the study area have been examined to provide a series of predictive statements of the study area's archaeological potential. The predictive statements indicated that there was low to moderate likelihood for surface artefacts and potential archaeological deposits (PAD) to be present within the study area.

A field investigation consisting of an archaeological survey of the study area was conducted by Biosis Archaeologists Mathew Smith and Molly Crissell on 18 May 2022. The overall effectiveness of the field investigation for examining the ground for Aboriginal sites was deemed low. This was attributed to extensive levels of disturbances throughout the northern portion of the study area due to the existing gravel quarry and extensive vegetation cover restricting ground surface visibility (GSV) throughout the remainder of the study area, which also provided a low amount of exposures.

No previously unrecorded Aboriginal cultural heritage sites were identified during the field investigation, with the study area being assessed as containing low archaeological potential. This was due to significant disturbances throughout the study area associated with the large gravel quarry within the northern portion of the site.

The following management recommendations have been developed relevant to the study area and influenced by:

- Predicted impacts to Aboriginal cultural heritage.
- The planning approvals framework.
- Current best conservation practise, widely considered to include:
 - Ethos of the Australia ICOMOS Burra Charter (2013).
 - The Code.

Prior to any impacts occurring within the study area, the following is recommended:

Recommendation 1: No further archaeological assessment is required in areas of low archaeological potential

This assessment has determined that the study area contains low archaeological potential for Aboriginal object to be present. No further archaeological work is required in the study area throughout the areas identified as containing low archaeological potential subject to recommendations 2 and 3 below.

Recommendation 2: Discovery of Unanticipated Aboriginal Objects

All Aboriginal Objects and Places are protected under the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence to disturb an Aboriginal site without a consent permit issued by the Heritage NSW, Department of Planning and Environment (Heritage NSW). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the Heritage NSW and Aboriginal stakeholders.

Recommendation 3: Discovery of Aboriginal Ancestral Remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. Immediately cease all work at that location and not further move or disturb the remains.
2. Notify the NSW Police and Heritage NSW's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location.
3. Not recommence work at that location unless authorised in writing by Heritage NSW.

1 Introduction

1.1 Project background

Biosis has been commissioned by GHD to undertake an ADDA for the proposed expansion of the existing Willow Tree WMF at 258 Merriwa Road (Lot 213 DP 1173230) Willow Tree, NSW (Figure 1 and Figure 2). The project involves expansion of an existing landfill, including cell construction, to receive up to 9000 tonnes per year of domestic putrescible, organic and clean fill waste (Figure 3). This will involve the construction of a hazardous materials shed, green waste and metal drop off bays, a transfer station, dual weighbridge, car parking stockpiling and the creation of a bulky drop off area.

An assessment in accordance with the Due Diligence Code has been undertaken for the study area in order to inform responsibilities with regards to Aboriginal cultural heritage in the area. In addition to the basic tasks required for a due diligence assessment, an extended background review, as well as an archaeological survey in accordance with the Code was conducted, in order adequately map areas of high, moderate and low archaeological potential.

1.2 Location of the study area

The study area is located within the Liverpool Plains Local Government Area (LGA), Parish of Parsons Hill, and County of Buckland (Figure 1). The study area incorporates Lot 213 DP1173230 and is bounded by Lot 12 DP857377 to the north, Lot A-F DP37874 and Merriwa Road to the south, Lot 214 DP1173230 to the east and Lot 1 DP502092 and Lot 11 DP905157 to the west (Figure 2).

1.3 Planning approvals

The proposed development will be assessed against Part 4 of the EP&A Act. Other relevant legislation and planning instruments that will inform the assessment include:

- NPW Act.
- *National Parks and Wildlife Amendment Act 2010*.
- *Liverpool Plains Local Environmental Plan 2011* (LEP).
- *Liverpool Plains Development Control Plan 2012* (DCP)

1.4 Scope of the assessment

The following is a summary of the major objectives of the assessment:

- Conduct background research in order to recognise any identifiable trends in site distribution and location, including a search of the AHIMS.
- Undertake archaeological survey as per requirement 5 of the Code, with particular focus on landforms with high potential for heritage places within the study area, as identified through background research.
- Record and assess sites identified during the survey in compliance with the guidelines endorsed by Heritage NSW.

-
- Determine levels of archaeological and cultural significance of the study area.
 - Make recommendations to mitigate and manage any cultural heritage values identified within the study area.

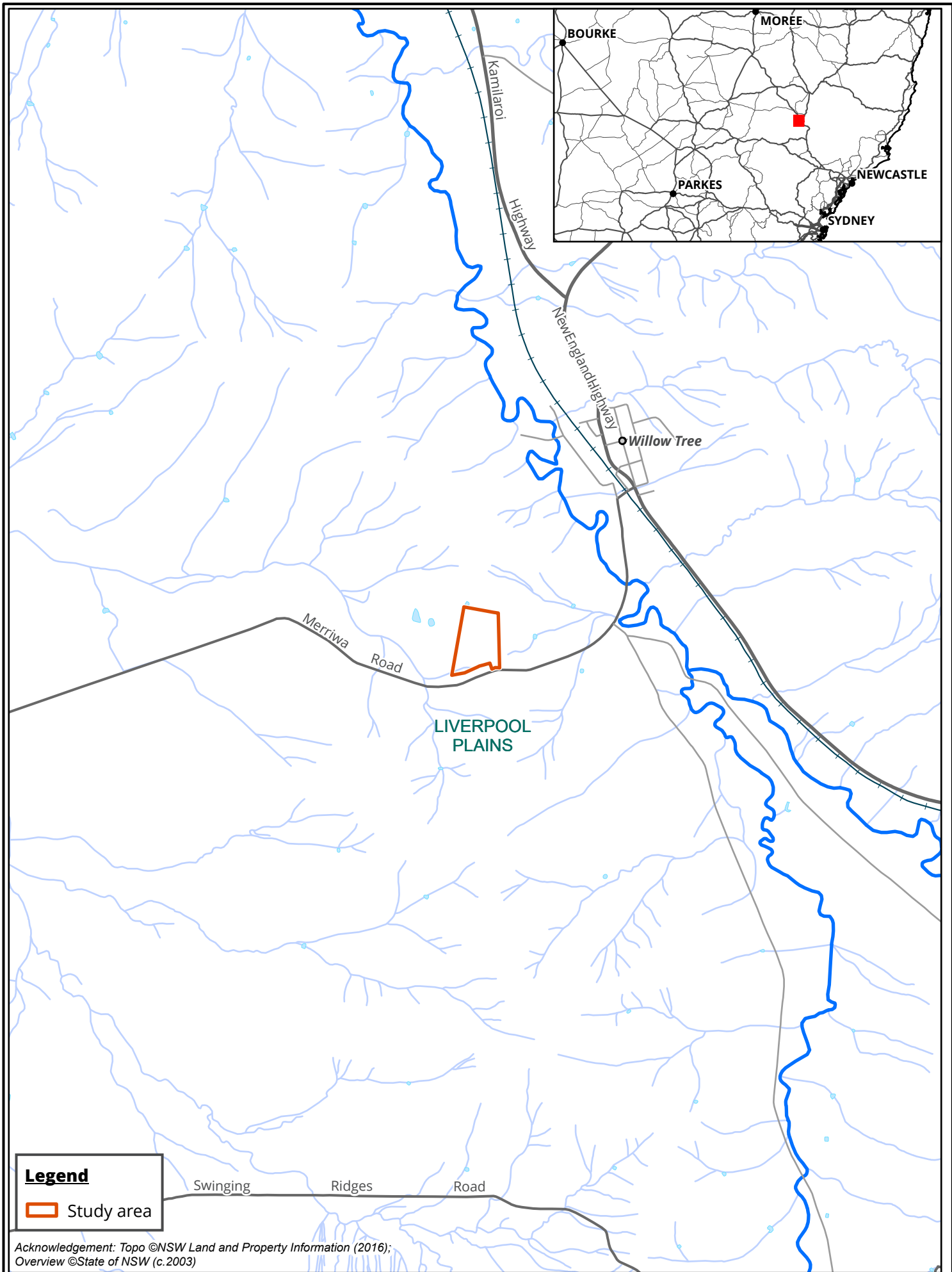
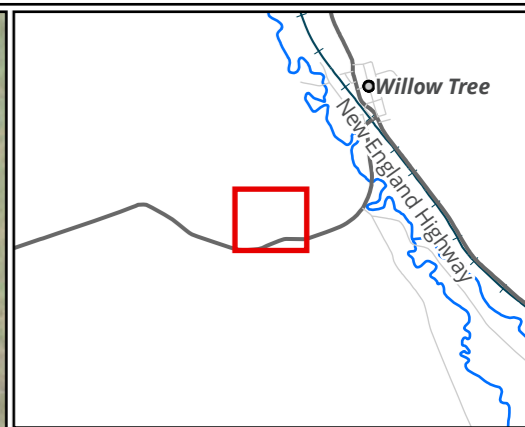


Figure 1 Location of the study area

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Checked by: ALB, Drawn by: AM, Last edited by: amackegard
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36975_WillowTreeWMF

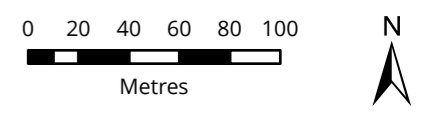
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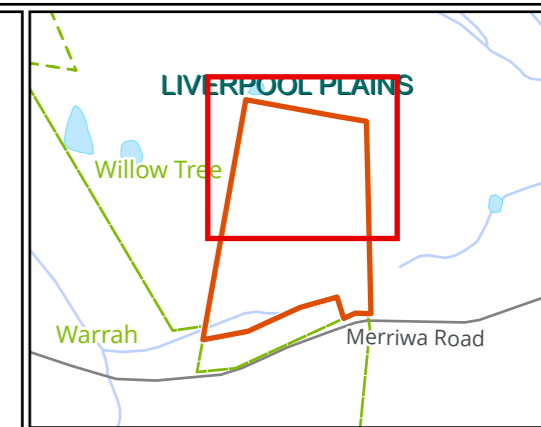
- Legend**
- Study area
 - Lot

Figure 2 Study area detail



Scale: 1:3,000@ A3
 Coordinate System: GDA 1994 MGA Zone 56

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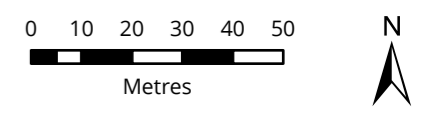
Legend

Study area

BYPASS ROUTE
TRUCKS
ROUTE
TRUCKS



Figure 3 Proposed development



Scale: 1:1,500@ A3
Coordinate System: GDA 1994 MGA Zone 56



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Drawn by: JET, Checked by: AB, Last edited by: jtowndend
Layout: 36975_F3_ProposedDevelopment
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2 Desktop assessment

A brief desktop assessment has been undertaken to review existing archaeological studies for the study area and surrounding region. This information has been synthesised to develop some Aboriginal site predictive statements for the study area and identify known Aboriginal sites and/or places recorded in the study area. This desktop assessment has been prepared in accordance with requirements 1 to 4 of the Code.

2.1 Landscape context

It is important to consider the local environment of the study area for any heritage assessment. The local environmental characteristics can influence human occupation and associated land use and consequently the distribution and character of cultural material. Environmental characteristics and geomorphological processes can affect the preservation of cultural heritage materials to varying degrees or even destroy them completely. Lastly landscape features can contribute to the cultural significance that places can have for people.

2.2 Geology, soils and landforms

The study area is located within the Brigalow Belt South Bioregion, in the southernmost component of the Queensland Brigalow Belt (QBB). It is situated within the south-eastern corner of the QBB, within the valleys and foot slopes of the Liverpool Ranges. The geological profile of the region consists of Early Triassic (251.90–247.2 million years ago) basalts and quartzose sandstones. The study area is underlain by the Banks Wall Sandstone geological unit, a member of the Grose Sandstone subgroup (Figure 4). Banks Wall Sandstones consist of finely laminated, medium to coarse grained sandstones, claystone and siltstone.

The topography within the region surrounding the study area is variable and consists of undulating, rolling and low hills, gently inclined hillslopes and small alluvial fans situated on the Tertiary basalt of the Liverpool Ranges, with a local relief of 0–40 metres (McInnes-Clarke 2002, pp. 116). Erosion is common in this landscape, and is expedited when surface vegetation is absent or removed. The study area slopes south-west, away from a crest in the eastern portion and towards a drainage depression in the south-western portion (Figure 5).

Stream order is recognised as a factor which assists the development of predictive modelling and has seen extensive use, most notably by Jo McDonald Cultural Heritage management (JMCHM) (JMCHM 2000, JMCHM 2005a, JMCHM 2005b, JMCHM 2008). Predictive models which have been developed for the region have a tendency to favour higher order streams as the locations of campsites as they would have been more likely to provide a stable source of water and by extension other resources which would have been used by Aboriginal groups.

The stream order system used for this assessment was originally developed by Strahler (1952). It functions by adding two streams of equal order at their confluence to form a higher order stream, as shown in Photo 1. As stream order increases, so does the likelihood that the stream would be a perennial source of water.

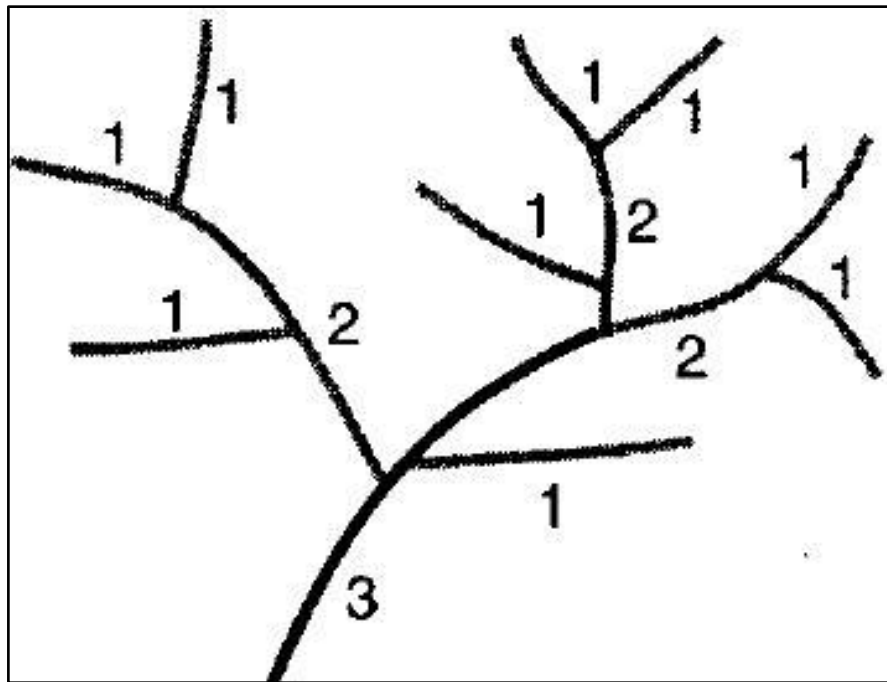


Photo 1 Diagram showing Strahler stream order (Ritter, Kochel, & Miller 1995, pp. 151)

There are several hydrological resources associated with the study area (Figure 5). Hydrology within the study area includes a first-order, non-perennial water course in the south-western portion, that enters through the western border and exits through the southern. Hydrology in the vicinity of the study area includes an array of first- and second-order creeklines, with the closest first-order creekline being located approximately 81 metres to the east, and the closest second-order creekline located approximately 373 metres to the north-east (Figure 5). The closest permanent water course is Borambil Creek, a fifth/sixth-order water course located approximately 1.12 kilometres east of the study area.

Soil landscapes have distinct morphological and topological characteristics that result in specific archaeological potential. They are defined by a combination of soils, topography, vegetation and weathering conditions. Soil landscapes are essentially terrain units that provide a useful way to summarise archaeological potential and exposure.

The study area is located within three soil landscapes; the Glen Oak, Inverkip Road and Disturbed Terrain soil landscapes (Figure 6). The Glen Oak soil landscape exists in the southernmost portion of the study area, along the southern border and is characterised as an erosional soil landscape comprising six soil profiles (Table 1). Topography generally consists of undulating low hills, gently inclined hillslopes with slopes that range 2–15% and a local relief between 10–40 metres. Soils are complex and vary from moderate to very deep (60–>200 centimetre) red dermosols, and moderately deep to deep (80–>120 centimetre) red and black vertosols. Very shallow (<20 centimetre) leptic tenosols are present on crests, benches and near rock outcrop. Moderately deep (>60 centimetre) black dermosols are present in drainage lines, with shallow (<20 centimetre) grey dermosols and deep (>100 centimetre) red kandosols on crests and upper slopes (McInnes-Clarke 2002, pp. 116). Descriptions of the soil types within the Glen Oak soil landscape are provided in Table 1 and Photo 2.

Table 1 Glen Oak soil landscape characteristics (McInnes-Clarke 2002, pp. 118–120)

| Soil material | Description |
|--|--|
| Glen Oak 1 (gk1)—reddish brown clay loams and clays (topsoil—A₁ horizon) | Clay/silty clay loam to light clay that is hard-setting with a dark reddish brown (5YR 3/2–5YR 3/3) to reddish brown (5YR 4/4) colour. This material occurs as topsoil (A horizon) and has a pH of 7.0. Soil has low permeability, high organic matter, and the structure ranges |

| Soil material | Description |
|---|--|
| | between weak to strong. Contains polyhedral peds (5–10 mm), 10–20% gravel (6–20 mm), rootlets (<1 mm) and roots (1–2 mm). Boundary can be abrupt or gradual, with depths ranging between 0–3 cm and 0–5 cm respectively. |
| Glen Oak 2 (gk2)—self-mulching clay loams and clays (topsoil—A₁ horizon) | Light to medium clay that is dark reddish brown (5YR 3/2–5YR 3/4) in colour. This material occurs as topsoil (A horizon) and has a pH that ranges between 6.0–6.5. Soil is moderately weak and crumbly, with slow to moderate permeability and has a self-mulching surface. It contains smooth-faced fabric with 2–10% gravel (6–20 mm), and 10–50 mm polyhedral peds. Boundary can be abrupt, with a depth of 0–4 cm or lead into bedrock, with a depth of 0–10 cm. |
| Glen Oak 3 (gk3)—stony reddish brown clay (subsoil—B₂ horizon) | Heavy clay that is hard-setting and moderately pedal, with 5–10 mm polyhedral peds. Colour is reddish brown (5YR 5/4) and the pH is 7.0. Soil material is weak pedal, plastic and slowly permeable. Soil layers occur to depths ranging between 3–>70 cm in the B ₂ horizon and typically contain 50–90% gravel (6–20 mm), rootlets (<1 mm) and roots (1–2 mm). The layer overlays Tertiary Basalt. |
| Glen Oak 4 (gk4)—reddish brown sandy light clay (subsoil—B₂ horizon) | Sandy clay that is hard-setting and yellowish red (5YR 4/6) in colour. It has a strong structure with a pH of 7.0, and contains prismatic peds 50–100 mm. |
| Glen Oak 5 (gk5)—dark brown clay (subsoils—B₂, B₂₁, B₂₂ horizons) | Heavy clay that is hard-setting, that is strongly pedal with a smooth-faced fabric. Colour ranges between very dark grey (5YR 3/1) and dark reddish grey (5YR 4/2). Material is plastic and slowly permeable, with a pH of 7.0; and contains 50–100 mm columnar peds and rootlets (<1 mm) and roots (1–2 mm) in the B ₂ horizon. In the B ₂₂ horizon, it is plastic and slowly permeable, with a pH of 8.5 and contains 20–50 mm columnar peds and roots (1–2 mm). Soil layer occurs to depths of 5–30 cm in the B ₂ horizon, and has a gradual boundary. Soils in the B ₂₂ horizon occur to depths between 30–>60 cm, with effervescence indicating the carbonate leaching depth, and overlays Tertiary Basalt. |
| Glen Oak 6 (gk6)—vertic red clay (subsoils—B₂₁, B₂₂ horizons) | Medium-heavy to heavy clay that has a self-mulching surface and is moderately to strongly pedal. Colour is reddish brown (5YR 4/4) to dark reddish grey (5YR 4/2), with grey mottle in the B ₂₂ horizon, and the pH ranges between 6.5–7.0. Material is a smooth-faced fabric, plastic with 20–50 mm sub-angular blocky peds. Soil layer occurs to depths of 4–60 cm in the B ₂ horizon, and has an abrupt boundary. Soils in the B ₂₂ horizon occur to depths between 60–80 cm and the layer overlies moderately weathered basalt. |

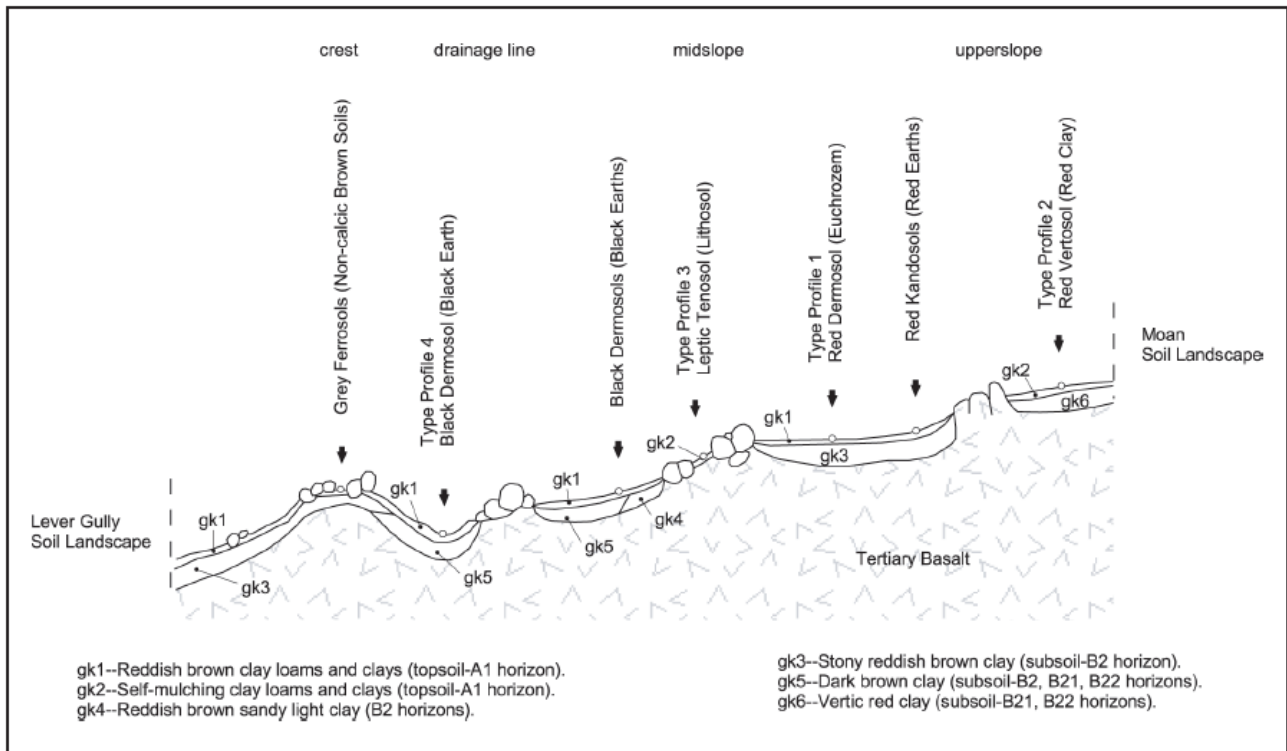


Photo 2 Distribution diagram of Glen Oak soil landscape (McInnes-Clarke 2002, pp. 120)

The Inverkip Road soil landscape exists throughout the majority of the study area and is characterised as an erosional soil landscape comprising five soil profiles (Table 2). Topography consists of undulating rises and rolling hills, with slopes ranging 2–8% on wide crests and lower slopes, however can occur as steeply as 15% on steeper sideslopes (McInnes-Clarke 2002, pp. 121). Soils are moderately deep to deep (50–>110 centimetre) red kandosols, chromosols and sodosols on crests and sideslopes; moderately deep (<100 centimetre) brown kandosols and brown sodosols on lower slopes; and moderately deep (>75 centimetre) black dermosols in drainage lines (McInnes-Clarke 2002, pp. 121). Descriptions of the soil types within the Inverkip Road soil landscape are provided in Table 2 and Photo 3.

Table 2 Inverkip Road soil landscape characteristics (McInnes-Clarke 2002, pp. 123–124)

| Soil material | Description |
|---|---|
| Inverkip Road 1 (ir1)—hard-setting dark brown fine sandy clay loam (topsoil—A₁ horizon) | Fine sandy clay to clay loam/fine sandy to clay loam/sandy clay loam/coarse sandy loam/clayey sand that is hard-setting. Colours range between dark brown (7.5YR 3/2–7.5YR 3/3) to reddish brown (2.5YR 4/3) to brown (7.5YR 4/4). Soil has a pH of 5.5–6.5, low fertility, high organic matter, localised stoniness, acidity and sodicity. Material is weak to moderately pedal, with 5–20 mm granular and 5–10 mm granular rough-faced peds. Contains coarse fragments (10–20%), fine to coarse gravels (2–60 mm) and roots (<1–2 mm). Boundary can be clear or abrupt, with average depth 0–8 cm and 0–10 cm respectively. |
| Inverkip Road 2 (ir2)—bleached fine sandy clay loam (topsoil—A₂ horizon) | Coarse sandy clay loam that is hard-setting and has weak pedality. Colour is brown (7.5YR 5/2) when wet to pinkish grey (7.5YR 7/2 when dry). Material is massive, with earthy fabric, low fertility and wet-bearing strength, and moderate permeability. Contains (20–50%) fine gravels to coarse gravels (2–60 mm), rootlets (<1 mm) and has a clear boundary with an average depth of 8–25 cm. |

| Soil material | Description |
|--|---|
| Inverkip Road 3 (<i>ir3</i>)— dark reddish brown sandy clay loams and clays (subsoils—B₂ horizons) | <p>Sandy clay loam that is hard-setting with moderate pedality. Colour is dark reddish brown (5YR 3/4) and the pH is 6.0. Material is moderately weak and crumbly, and has moderate permeability. Contains 20–50 mm smooth-faced peds, (2–10%) fine gravels (2–10 mm) and roots (<1 mm). Layer overlies moderately weathered quartz rich sandstone and has an average depth of 10–55 cm.</p> |
| Inverkip Road 4 (<i>ir4</i>)— mottled brown stony medium clay (subsoils— B₂, B₃ horizons) | <p>Light to medium clay that is hard-setting with moderate to strong pedality. Colour ranges from brown (7.5YR 5/3) to strong brown (7.5YR 5/8) to yellowish brown (10YR 5/4), commonly with prominent grey, brown or red mottles. Contains (10–50 mm) columnar or granular peds and has a pH of 5.5–8.5. Material has low permeability, low fertility, localised stoniness, high organic matter and sodicity. In the A-horizon, the layer has a clear boundary and average depth of 15–50 cm. In the B-horizon, the layer overlies moderately weathered conglomerate and has average depth of 5–>75 cm.</p> |
| Inverkip Road 5 (<i>ir5</i>)— dark grey sandy clay (topsoils, subsoil—A₁, A₂, B₂ horizons) | <p>Coarse sandy clay that is hard-setting with weak to moderate pedality. Colour ranges from very dark grey (10YR 3/1) to dark grey (10YR 4/1) to brown (7.5YR 4/2). Contains () granular and (5–50 mm) sub-angular blocky peds, fine gravels and gravels (2–20 mm) and rootlets (<1 mm). Material has low permeability, low fertility, localised stoniness, high organic matter and sodicity. In the A-horizon, the layer has a clear boundary and average depth of 0–50 cm. In the B-horizon, the layer has an average depth of 50–>75 cm.</p> |

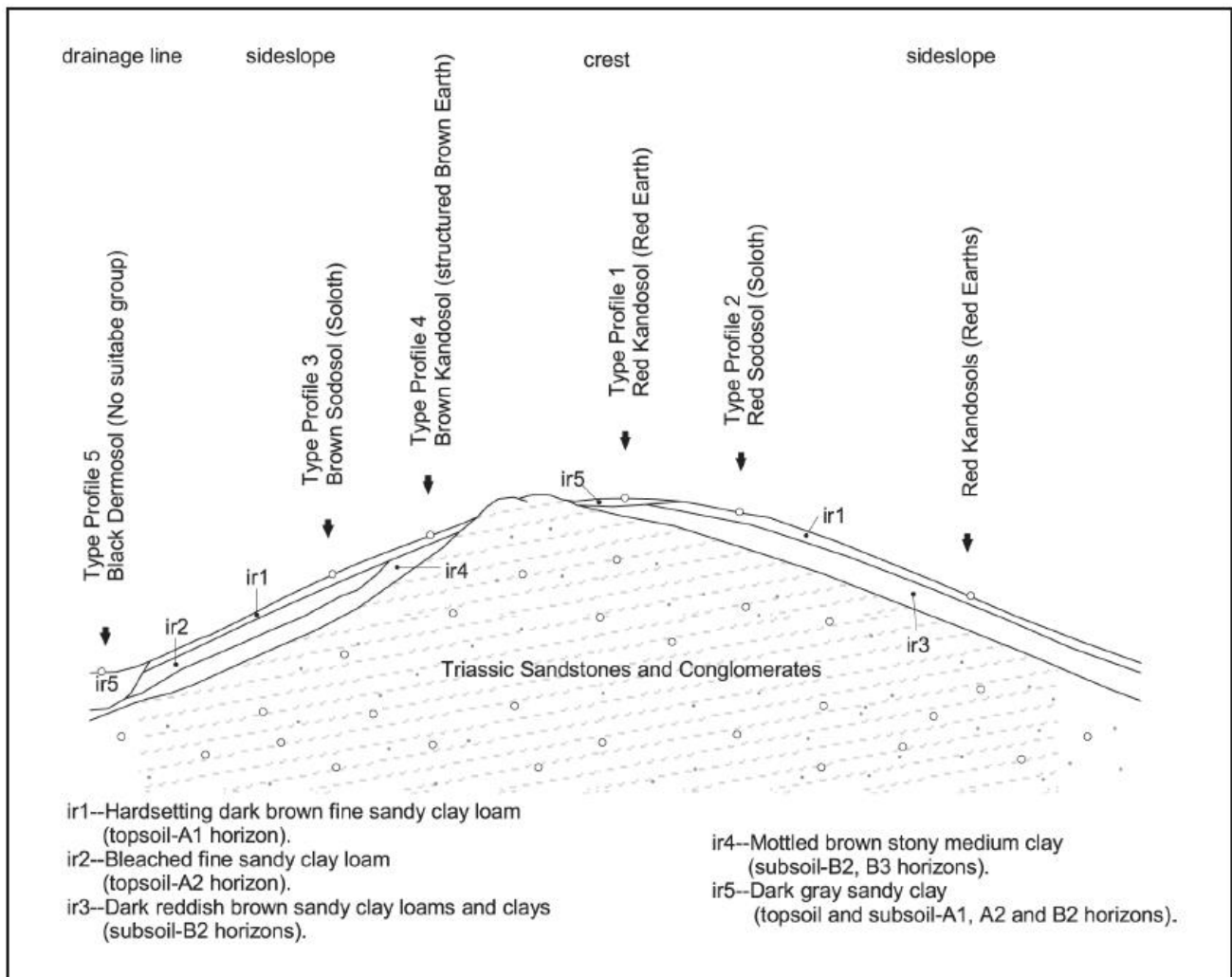
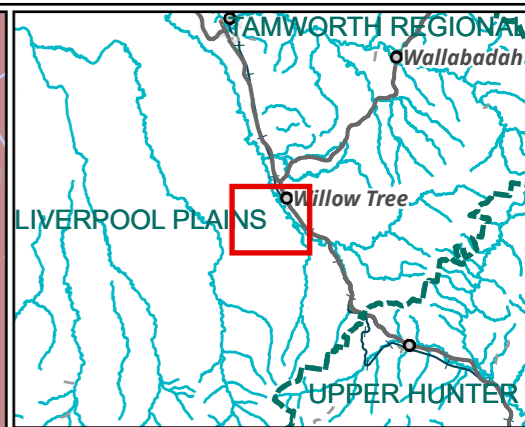
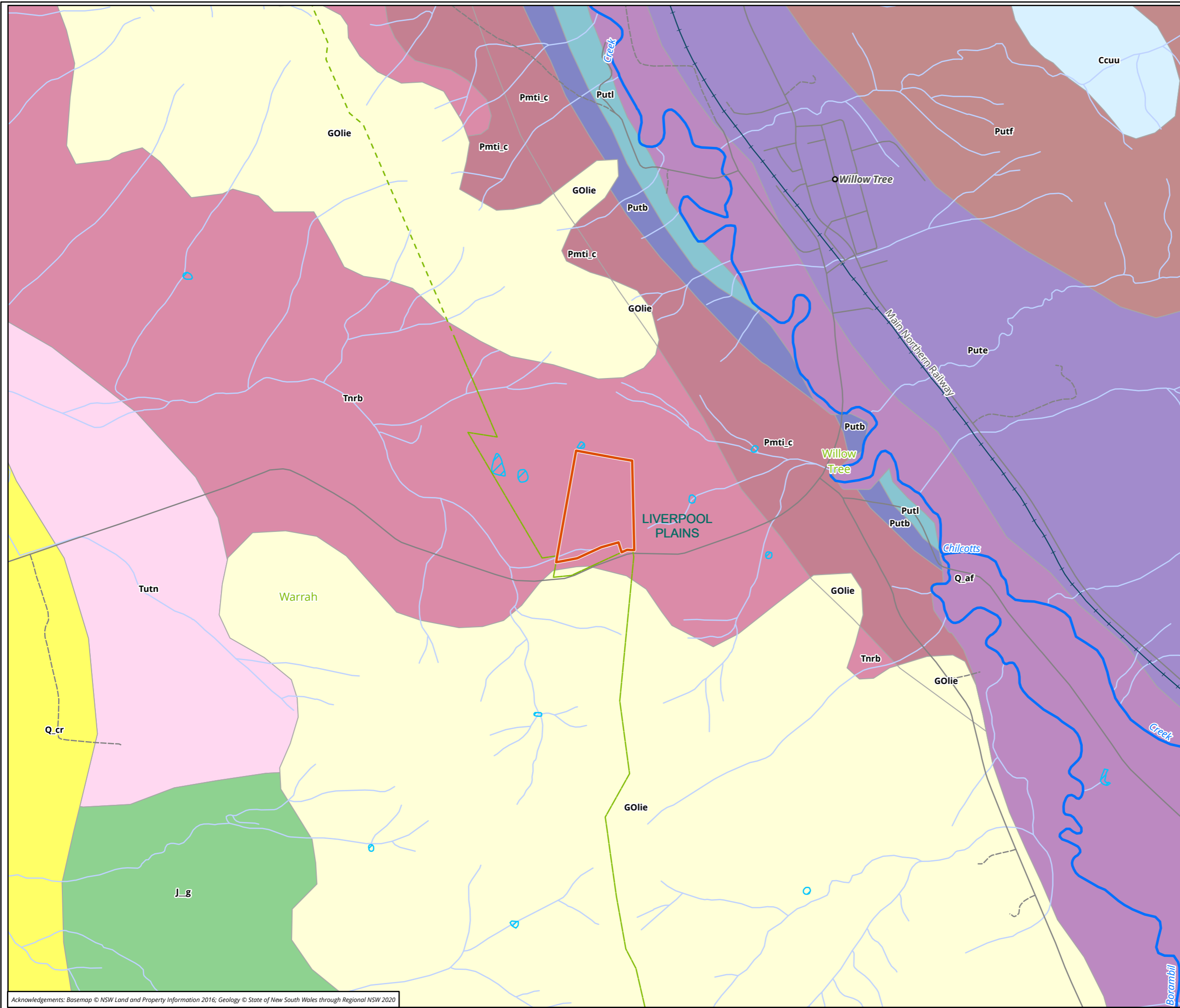


Photo 3 Distribution diagram of Inverkip Road soil landscape (McInnes-Clarke 2002, pp. 125)

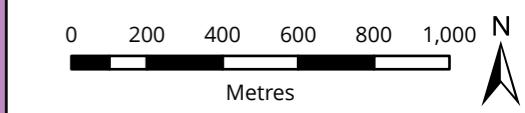
Both the Glen Oak and Inverkip soil landscapes are characterised as erosional landscapes. Landscapes of this nature comprise soils that are generally subject to movement of shallow soils, which can result in poor preservation of the archaeological record. Dispersed sandy soils of sandstone bedrock and loose quartz sandy loam, and earthy clayey sands, which occur in both soil landscapes, have a low erosion potential. However, when cleared of vegetation, the soils can be subject to high levels of erosion. As this soil landscape is characterised as highly erosional, the soils can be shallow, highly permeable, and have low levels of soil fertility. This would indicate that the presence of Aboriginal sites and objects may be unlikely where erosion has occurred (Chapman et al. 1989, pp. 64–67, McInnes 1997, p.45, cited by Umwelt (Australia) Pty Limited 2016, pp. 13).

The third soil landscape present within the study area is Disturbed Terrain. This soil landscape is located in the northern portion of the study area, in an area that has been completely disturbed by activities associated with removal and reburial of soils, and depositing of landfill. The landscape is characterised as a disturbed landscape that has been extensively altered by human activity and typically cleared of all vegetation, with a terrain that varies from level plains to rolling hills (McInnes-Clarke 2002, pp. 249). The soil types are highly variable and typical land usage includes gravel and clay quarries and rubbish tips (McInnes-Clarke 2002, pp. 249).



- Legend**
- Study area
 - Geological Units**
 - Ccuu, Currabubula Formation
 - G0lie, Liverpool East Basalt
 - J_g, Garrawilla Volcanics
 - Pmti_c, Bickham Formation - claystone
 - Putb, Borambil Creek Formation
 - Pute, Werrie Basalt
 - Putf, Temi Formation
 - Putl, Willow Tree Formation
 - Q_af, Alluvial floodplain deposits
 - Q_cr, Colluvial and residual deposits
 - Tnrb, Banks Wall Sandstone
 - Tutn, Napperby Formation

Figure 4 Geological units within the vicinity of the study area

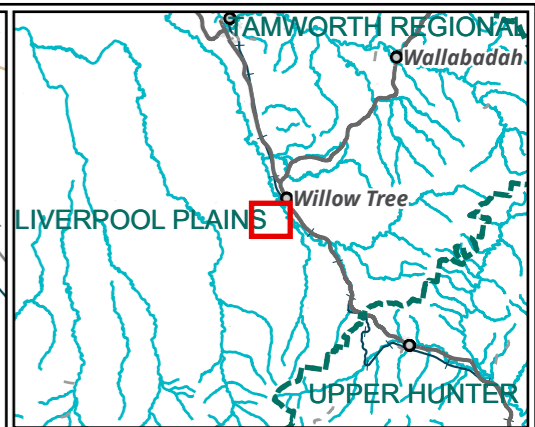
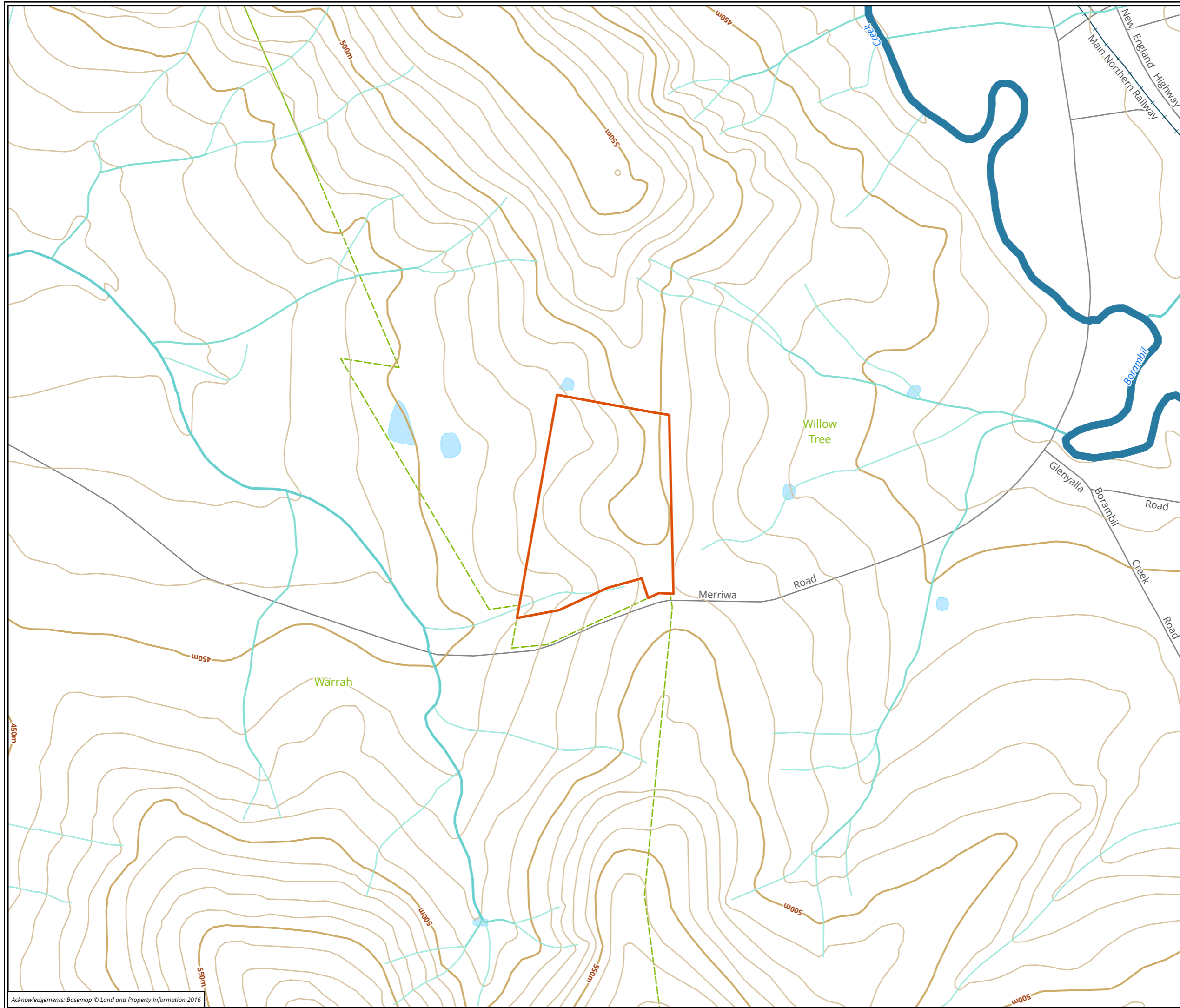


Scale: 1:20,000@ A3
 Coordinate System: GDA 1994 MGA Zone 56



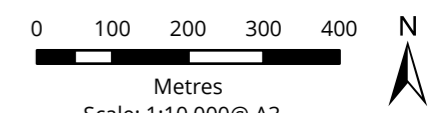
36975, Date: 10 May 2022,
 Drawn by: AM, Checked by: ALB, Last edited by: amackegard
 Layout: 36975_F4_Geology
 Project: P:\36900s\36975\Mapping\36975_WillowTreeWMF.aprx

Acknowledgements: Basemap © NSW Land and Property Information 2016; Geology © State of New South Wales through Regional NSW 2020



- Legend**
- Study area
 - Contour (10m)
- Strahler Order**
- 1
 - 2
 - 3
 - 6

Figure 5 Hydrology in the vicinity of the study area



Scale: 1:10,000@ A3
 Coordinate System:
 GDA 1994 MGA Zone 56

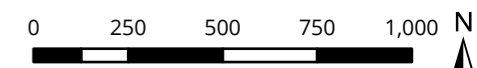


36975, Date: 10 May 2022,
 Drawn by: AM, Checked by: AV, Last edited by: amackegard
 Layout: 36975_F5_Hydrology
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 36975_WillowTreeWMF.aprx



- Legend**
- Study area
 - Soil Landscape units**
 - ba - BASIN GULLY
 - bc - BORAMBIL CREEK
 - do - DUNOVER
 - gk - GLEN OAK
 - ir - INVERKIP ROAD
 - lg - LEVER GULLY
 - ln - LANGS NECK
 - mn - MOAN
 - pc - PHILLIPS CREEK
 - qu - QUIPOLLY
 - qua - QUIPOLLY variant a
 - si - THE SIPHON
 - sr - SLIPPERY ROCK
 - th - THUNDERBOLTS MOUNTAIN
 - wc - WINDY CREEK
 - wh - WARRAH
 - wt - WILLOW TREE
 - xx - DISTURBED TERRAIN

Figure 6 Soil landscapes in the vicinity of the study area



Metres
 Scale: 1:20,000@ A3
 Coordinate System:
 GDA 1994 MGA Zone 56



36975, Date: 10 May 2022,
 Drawn by: AM, Checked by: AV, Last edited by: amackegard
 Layout: 36975_F6_Soils
 Project: P:\36900s\36975\Mapping\
 36975_WillowTreeWMF.aprx

2.3 Flora and fauna

The Brigalow Belt South Bioregion includes distinct ecological zones, including open forest and open woodland, with riparian vegetation extending along many of the watercourses. Each ecological zone hosts a different array of floral and faunal species, many of which would have been utilised according to seasonal availability. Aboriginal inhabitants of the region would have had access to a wide range of avian, terrestrial and aquatic fauna and repeated firing of the vegetation would have opened up the foliage allowing ease of access through and between different resource zones.

Plant fibres were twisted into string, which was used for many purposes, including the weaving of nets, baskets and fishing lines. String was also used for personal adornment. Bark was used in the provision of shelter; a large sheet of bark being propped against a stick to form a gunyah (Attenbrow 2002, pp. 113–114).

Within the Willow Tree region and surrounding landscapes there is a variety of floral species. The distribution of these plants is determined by soil combinations as well as the movement of seeds and plants between ecotones by Aboriginal people. In some areas of Australia, the repeated seasonal burning of vegetation allowed expedient plant growth.

The Glen Oak soil landscape typically dominated by White Box *Eucalyptus albans*, but also supports species that includes Rough-Barked Apple *Angophora floribunda*, Blakely's Red Gum *E. blakelyi*, Yellow Box *E. melliodora*, Kurrajong *Brachychiton populneus* and Native Olive *Notelaea microcarpa*. Low lying species commonly present throughout this soil landscape include Tree Violet *Hymenanthera dentata*, Cough Bush *Cassinia laevis*, Plains Grass *Stipa aristiglumis*, Slender Bamboo Grass *S. verticillata*, Three-Awn Spear Grass *Aristida ramosa* (McInnes-Clarke 2002, pp. 116-117).

The Inverkip Road soil landscape typically supports species that includes White Cypress Pine *Callitris glaucophylla*, Black Cypress Pine *C. endlicheri*, Narrow-Leaved Ironbark *E. crebra*, White Box, Blakely's Red Gum, Yellow Box, Bimble Box *E. populnea*, Kurrajong, Rough-Barked Apple and Native Olive. Low lying species commonly present throughout this soil landscape includes Three-Awn Spear Grass, Wiregrasses *A. spp.*, Spear Grasses *Stipa spp.*, Love Grasses *Eragrostis spp.*, Kangaroo Grass *Themeda australis*, Red Leg Grass *Bothriochloa macra*, Barbed Wiregrass *Cymbopogon refractus*, Tall Windmill Grass *Chloris ventricosa* and Bluebell *Wahlenbergia sp.* (McInnes-Clarke 2002, pp. 121-122).

As well as being important food sources, animal products were also used for tool making and fashioning a myriad of utilitarian and ceremonial items. For example, tail sinews are known to have been used to make fastening cord, while 'bone points', which would have functioned as awls or piercers, are sometimes part of the archaeological record. Animals such as Brush-tailed Possums were highly prized for their fur, with possum skin cloaks worn fastened over one shoulder and under the other. Kangaroo teeth were incorporated into decorative items, such as head bands (Attenbrow 2002, pp. 117).

Native fauna that may have inhabited the area or its surrounds include mammals such as Koala *Phascolarctos cinereus*, Sugar Glider *Petaurus breviceps*, Common Wombat *Vombatus ursinus* and Eastern Grey Kangaroo *Macropus giganteus*. Avian species may have included Noisy Miner *Manorina (Myzantha) melanocephala*, Crimson Rosella *Platycercus (Platycercus) elegans*, Australian Magpie *Gymnorhina tibicen* and White-throated Treecreeper *Cormobates leucophaea*. Three-toed Earless Skink *Hemiergis decresiensis*, Pale-flecked Garden Sunskink *Lampropholis guichenoti* and Lace Monitor *Varanus varius* are among the reptilian species that may have been present.

2.4 Land use history

The rich coal deposits of the Hunter River were first discovered by European settlers in 1797, and a settlement was established at the start of the Hunter River in 1801 (Davies 1991, pp. 16). The Liverpool Plains region was

first explored in 1817 and 1818 by Surveyor General, John Oxley and reported the rich pastures back to England, although this area was hard to venture into because of the barrier of the Liverpool Ranges (Goonoo Goonoo Station n.d.). The area was not occupied until 1824 when Henry Danger successfully discovered a way to navigate through the Liverpool Ranges through the Hunter Valley (Davies 1991, pp. 16). In April of 1824, the Australian Agricultural Company (AACo) was formed in order to raise and farm sheep for merino wool to sell in London, and in 1828, they acquired one million acres (404,685 hectares) in the Port Stephens area (Australian National University, Archives 2012). In 1832 the pastoral pursuit was expanded, and the AACO acquired an additional 250,000 acres (101171.4 hectares) of land in Warrah, now known as Willow Tree, and surrounding regions (Photo 4).

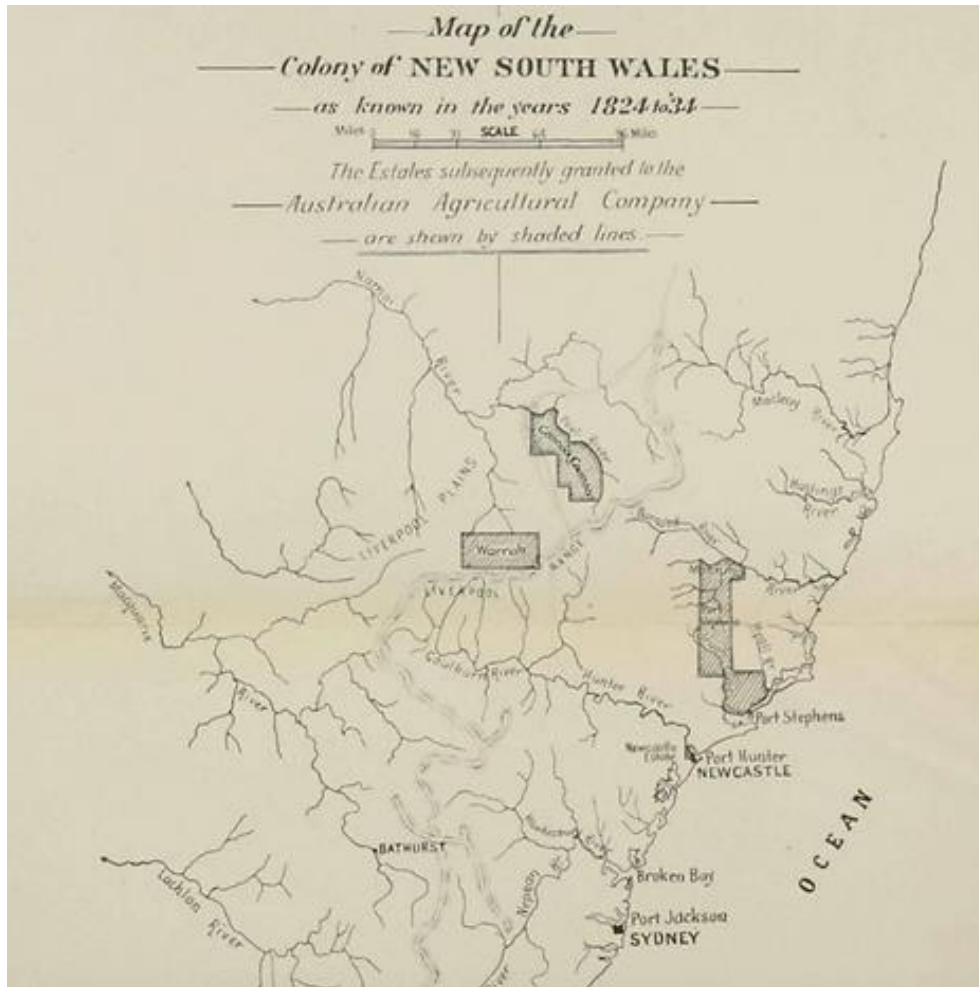


Photo 4 Map showing grants awarded to Australian Agricultural Company, shown in shaded areas (Source: Goonoo Goonoo Station n.d.)

The study area can be seen in a charting map that dates post-1828. The region has been subdivided into several lots and continued to be used for agricultural purposes during this time. In 1833, the AACO began moving sheep into this region from Port Stephens, and the landscape was exploited well into the 20th century (Goonoo Goonoo Station n.d.).

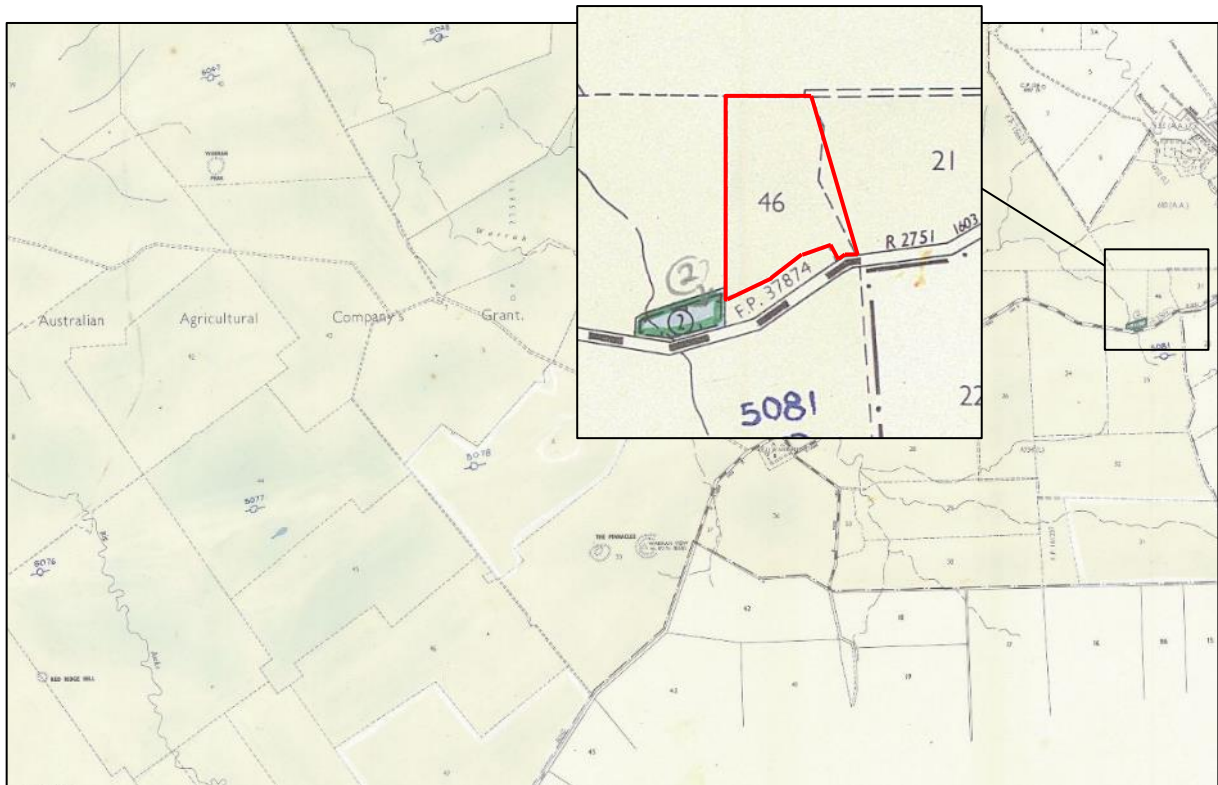


Photo 5 Charting Map of Parish of Parsons Hill, with the study area outlined in red (Source: NSW Land Registry Services)

Historical aerial photographs assist in identifying modern developments that occurred within the study area. An aerial photograph dated to 1953 shows that the land within the study area has been subjected to extensive vegetation clearance with some large vegetation remaining throughout, mostly in the northern portion of the study area (Photo 6). The faint beginnings of dirt tracks can be seen through the centre of the study area.

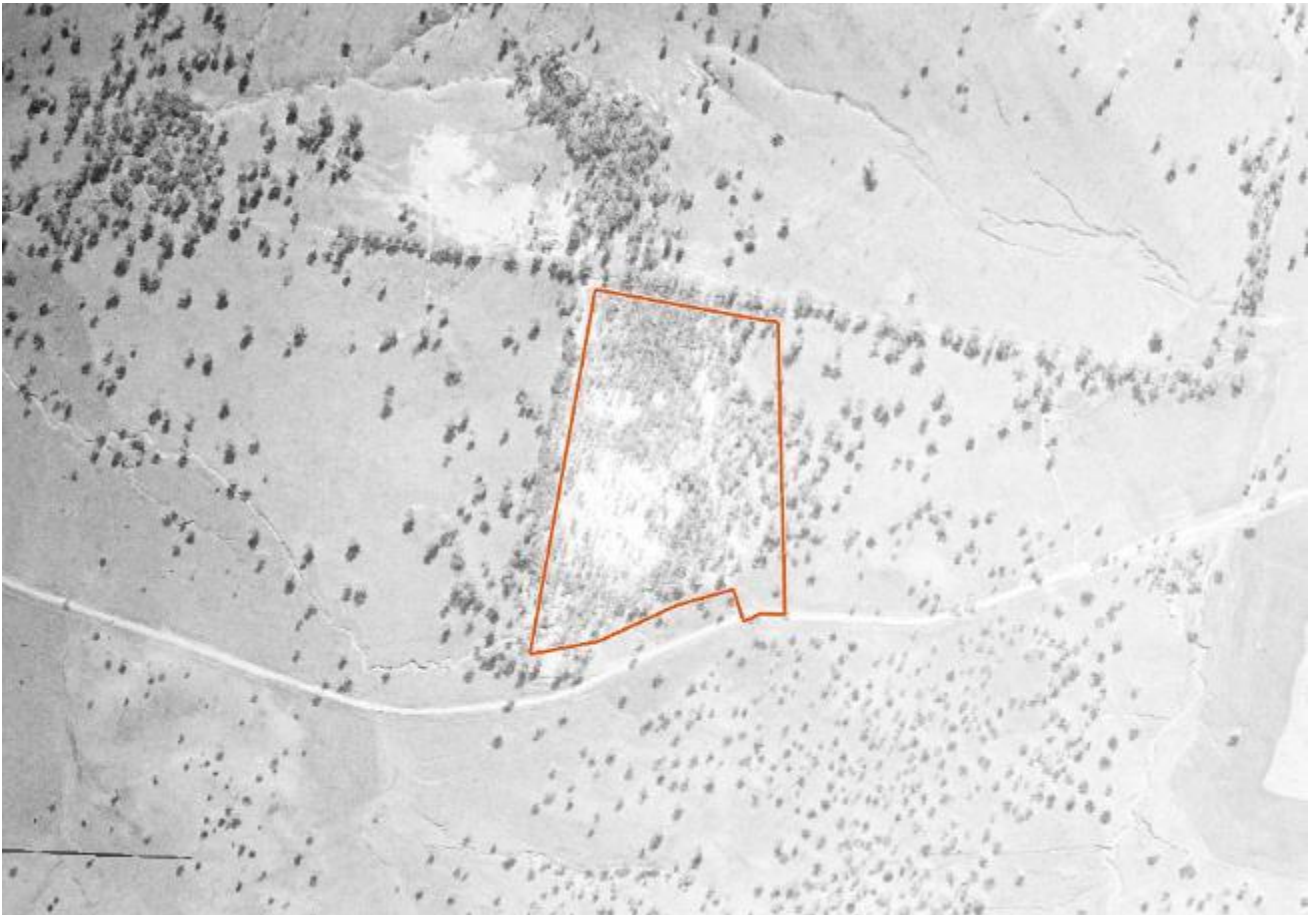


Photo 6 Aerial photograph dated to 1953, with the study area indicated by the red boundary (Source: NSW Spatial Services)

An aerial photograph dated to 1970 shows that the study area has been altered with soil excavation (Photo 7). It is between 1953 and 1970 that the site became used as a gravel quarry, although the exact date of this transition could not be determined from the literature or from local sources. In some areas, distribution patterns and densities of the large vegetation has shifted and the dirt tracks are more clearly defined.



Photo 7 Aerial photograph dated to 1970, with the study area indicated by the red boundary (Source: NSW Spatial Services)

An aerial photograph dated to 1990 shows that the study area has been continued to be used as a gravel quarry and further vegetation clearance has occurred (Photo 8).



Photo 8 Aerial photograph dated to 1990, with the study area indicated by the red boundary (Source: NSW Spatial Services)

ERM Resource Planning (1994) conducted an archaeological survey of the lot adjacent to the north of the current study area. In their report, they referred to the existing Council gravel quarry that existed in the northern portion of the current Biosis study area (Photo 9). The Willow Tree Gravel Company has been trading as an operational quarry since 1994 to the present day (Figure 2).

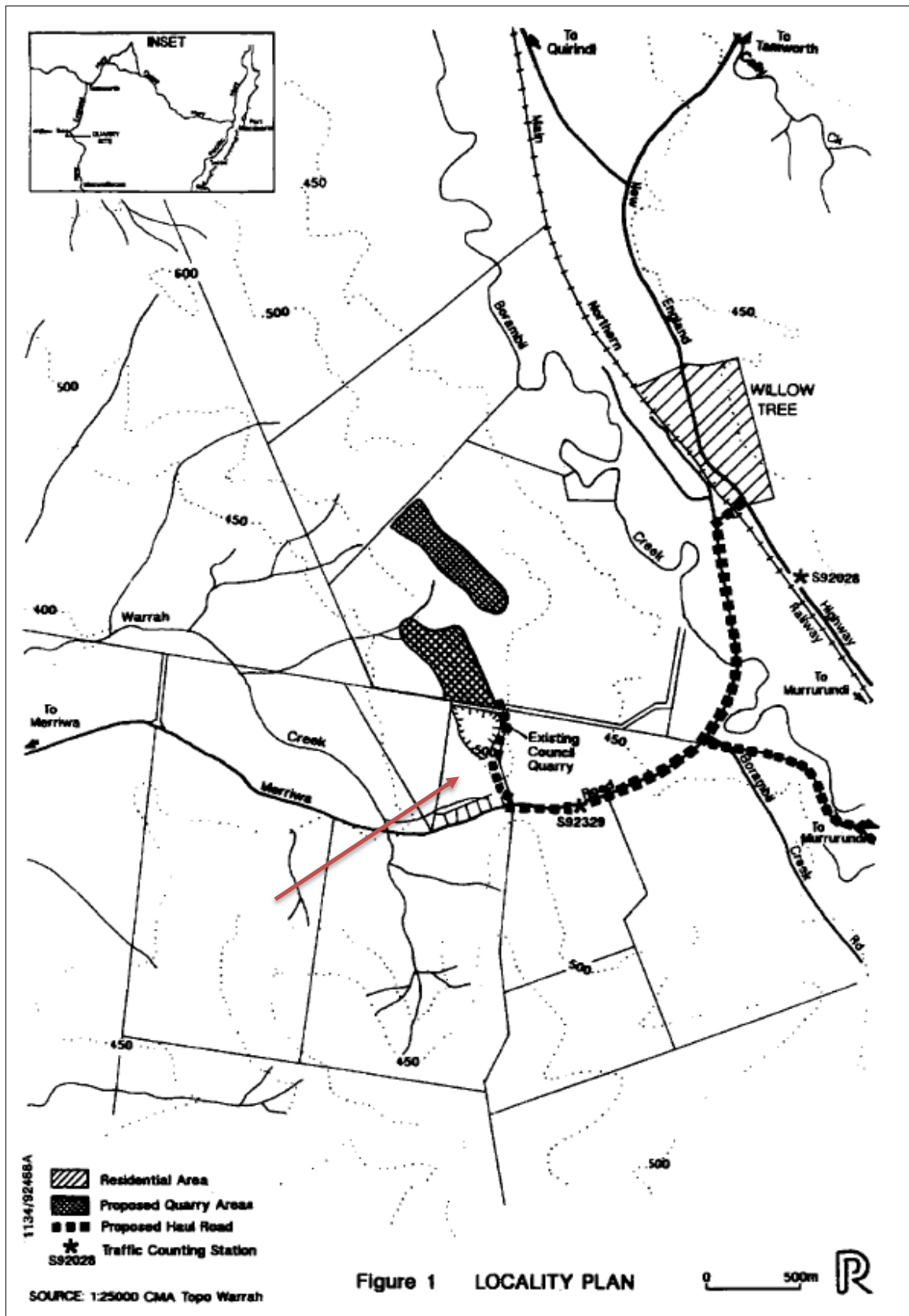


Photo 9 Map showing gravel quarry in existing study area and expansion of quarry into neighbouring lot. Arrow pointing to current study area (Source: ERM Resource Planning 1994, pp. 3)

3 Aboriginal context

3.1 Ethnohistory and contact history

It is generally accepted that people have inhabited the Australian landmass for the last 65,000 years (Clarkson et al. 2017). Dates of the earliest occupation of the continent by Aboriginal people are subject to continued revision as more research is undertaken. Within the Hunter Valley region, dates that indicate the length of Aboriginal occupation of the area have been obtained from multiple sites. A radio carbon date of 7,750 years before present (± 120 years) was obtained from a shelter site near the head of the Goulburn River at Bobadean, near Ulan (Griffith 1992, pp. 2).

Despite a proliferation of Aboriginal heritage sites there is considerable ongoing debate about the nature, territory and range of pre-contact Aboriginal language groups in the greater Upper Hunter region. These debates have arisen largely because, by the time colonial diarists, missionaries and proto-anthropologists began making detailed records of Aboriginal people in the late-19th century, pre-European Aboriginal groups had been broken up and reconfigured by European settlement activity. The following information relating to Aboriginal people on the Upper Hunter region is based on such early records.

Our knowledge of Aboriginal people and their land-use patterns and lifestyles prior to European contact is mainly reliant on documents written by non-Aboriginal people. These documents are affected by the inherent bias of the class and cultures of their authors, who were also often describing a culture that they did not fully understand a culture that was in a heightened state of disruption given the arrival of settlers and disease. Early written records can however be used in conjunction with archaeological information and surviving oral histories from members of the Aboriginal community in order to gain a picture of Aboriginal life in the region.

Exploration of the Hunter Valley region began relatively early in the life of the NSW colony. First contact between Aboriginal people and Europeans in the Newcastle district would have occurred in the very early 1800s when the area was designated as a penal colony. Fortunately, fairly detailed accounts of the Aboriginal occupation of the Newcastle area have survived and give a reasonable account of the language, lifestyle, culture, resource utilisation and contact history of the Awabakal people (Manyard 2000). Early settlers, missionaries and military personnel including Reverend Lancelot Threlkeld, Reverend Middleton, William Scott, Robert Dawson, Edward Parry, and Lieutenant Coke left accounts of the lives of the Awabakal people in the Newcastle district. Included are accounts of early post-contact occupation, violence and dispossession (Manyard 2000).

Recorded sightings of Aboriginal groups in the area date back as far as 1801, with Grant sighting several Aboriginal groups on his travels, often with their canoes or at campfires (Grant J 1803, pp.162–163). Early accounts related a fairly amicable co-existence between the Awabakal people and the early convict settlers in the district (DECCW 2010d, pp. 16). In 1826, Dawson reported sighting an Aboriginal hunting party at Lochinvar, in the process of encircling a kangaroo (Dawson R 1830, p.8). Early ethnographic evidence also notes the use of fire by local groups. In 1826, Threlkeld (in Gunson N 1974, p.206) observed local groups burning off the grass in some areas in order to stimulate new growth, in preparation for a hunt, as animals gathered to eat the new shoots.

Since the arrival of European colonists, the movement of Aboriginal people began to be increasingly restricted. Conflict between Europeans and Aboriginal people due to competition over the same resources led to violence. During the 1830s and 1840s, violence and dispossession resulted in massacres of Aboriginal people (Platt 1824:1, in Biosis 2014). European colonisation denied access to hunting grounds, isolating Aboriginal groups from their traditional territories (DECCW 2010d, pp. 16). At the same time diseases such as small pox were having a devastating effect on the Aboriginal population (Attenbrow 2010, pp. 17). Death,

starvation and disease were some of the disrupting factors that led to a reorganisation of the social practices of Aboriginal communities after European contact. The formation of new social groups and alliances were made as Aboriginal people sought to retain some semblance of their previous lifestyle.

3.2 Regional context

Several Aboriginal cultural heritage surface and sub-surface investigations have been conducted throughout the Newcastle region of NSW. There has been a rise in focus on cultural heritage assessments in NSW due to ever increasing development, along with the legislative requirements for this work and greater cultural awareness of Aboriginal cultural heritage.

Dyall (1971) conducted research on Aboriginal occupation sites along the Newcastle coastline, approximately 177 kilometres south-east of the study area, and provided an overview of site types and locations within the area. Dyall identified that the majority of campsites were located on ocean, estuarine, or Lake Macquarie waterfronts. Prior to the heavy industry in Newcastle, Dyall noted that shell middens extended all the way from Port Waratah to Sandgate along the river front. Shell types included pipi, oysters, whelks and cockles, with those located within estuarine environments along the Hunter River also containing shellfish, waterfowl and fish. A review of stone tool sites identified that stone sources were likely gathered from a variety of places, with chert and tuff from Nobby's and Glenrock, quartzite from Ham's Beach sandstone from Murdering Gully and Birdie Beach, volcanic rock from Birubi Point, Stockton and Port Stephens, in addition to yellow ochre at Mereweather Beach. Artefact types included flakes, scrapers, cleavers, Bondi points, geometric microliths, and various cores.

Based on the number of sites within the area and their sizes, Dyall estimated that the population of Aboriginal people within the Newcastle region was in the thousands. He recorded a number of campsites to be within the vicinity of the study area. Although it is not specified what type of sites they are, they are likely midden sites that Dyall refers to.

Mills and Wilkinson (1994) conducted an archaeological survey for the Shortland Wastewater Treatment works, located approximately 164 kilometres south-east of the study area. Background research identified no previously recorded AHIMS sites located within the study area, however a number of open camp sites, and grinding groove sites were identified within close proximity. A predictive model was developed based on previous assessments in the area, stating that:

- Open stone scatters are most likely to be found on ridge areas.
- It can be inferred from previous studies that Aboriginal evidence is unlikely to be found within swampy areas.
- Scarred trees may be present in the area if any mature trees remain.
- Rocks in Ironbark Creek could have axe grinding grooves.

A number of sites were identified during the survey, including two silcrete artefacts located on an embankment nearby a pond and six isolated silcrete and chert flakes, cores, and scrapers within road reserves. No sites were identified within the area surveyed to the north of the study area, within the Steelwork Golf Links. High disturbances were noted within this area. Salvage of the identified sites was recommended.

Kuskie (1997) conducted an archaeological assessment of the land between the New England Highway, John Renshaw Drive, and Lenaghans Drive, located approximately 159 kilometres south-east of the study area. Background research identified that artefact scatters had the potential to be identified nearby watercourses on level elevated locations, with evidence of focused occupation on simple and basal slopes bordering –

wetland landforms. Based on predictive modelling from previous archaeological assessments within the region, it was noted that low density scatters of artefacts are likely to occur on all elevated portions of the property, with occasional areas of high density. A field survey of the area identified twelve locations containing archaeological evidence, including seven stone artefacts and five isolated finds of silcrete, tuff, greenstone, and basalt. Tool types included broken flakes, flaked pieces, blades, cores, and a ground edge hatchet. These sites were identified on ridge crests and simple slopes, including those bordering wetlands. Half of the sites were located within 100 metres of a water sources. A previously recorded artefact scatter and isolated artefact were also relocated. Although the survey was impacted by low visibility due to ground coverage, it was concluded that most landforms within the property contained moderate or high potential for archaeological deposits. It was suggested that higher density deposits may occur closer to wetland areas (within 50 metres).

Junburra Aboriginal Consultancy Services (1999) undertook a field investigation of the Merriwa River and Coulsons Creek Catchment System, approximately 63 kilometres south-west of the current study area. No surface Aboriginal artefacts and sites were discovered during the survey, and this was attributed to the absence of eroded landscape features within the study area and the dense vegetation which obscured the ground surface. Junburra Aboriginal Consultancy Services (1999) noted that the lack of sites seen during the survey does not discount the presence of Aboriginal sites within the study area.

Biosis (2006) completed an archaeological survey for the proposed third Hunter River crossing at Maitland, approximately 140 kilometres south-east of the study area. Background research conducted for this assessment identified the site fell within the residual Rivermead and Beresfield soil landscapes, and the Alluvial Hunter soil landscape. A review of previous floodplain and geomorphological assessments conducted within close proximity to the proposed river crossing identified the course of the Hunter River within the Maitland area changed dramatically over a period of approximately 78 years between 1877 and 1955 (Biosis 2006, pp. 8). The section of the Hunter River between Maitland and Morpeth was reduced from 27 kilometres to 9 kilometres as a result of meanders being cut off. The installation of levee banks along the Hunter River also resulted in major modifications to the landscape and the river itself. The levees caused increased sediment deposition within the river bed, as sediment which would normally be redeposited within the floodplains during minor flood events became trapped (Biosis 2006, pp. 9).

Based on the results of the background research completed by Biosis, a predictive model was developed. Landform units such as oxbows, small terraces and the river edge were more likely to have been used for extended occupation. Residual soil landscapes were also assessed as having reasonable potential to contain intact archaeological deposits; however, extensive disturbance from flooding events and European land modification and development will have resulted in archaeological deposits being redistributed and/or destroyed. Biosis therefore identified that there was low to moderate potential for Aboriginal sites to be located within the study area (Biosis 2006, pp. 19–21). Biosis undertook an archaeological survey of the study area in order to test the predictive model developed. It was noted that the survey conditions were very poor, and the assessment did not locate any Aboriginal objects within the study area (Biosis 2006). The proposed location for the crossing was highly disturbed from historical modification and occupation, and Biosis determined the majority of the study area had low archaeological potential as a result. One area of low to moderate potential was identified within a residual river terrace. The archaeological investigation results were considered consistent with predictive modelling for the area, with artefacts composing of mostly silcrete artefacts upon upper to lower slopes and crests.

Biosis (2019) conducted an Aboriginal and historical archaeological constraints assessment for 31–33 Bourke Street, Maitland, located approximately 139 kilometres south-east of the study area. Research identified that the site was located within a residual landscape, thus holding the potential to contain intact archaeological deposits. It was noted that predictive modelling conducted for the study area indicated that Aboriginal archaeological sites are frequently located within flat, elevated landform units in close proximity to water, and

other natural resources such as flora and fauna and raw stone material. Aboriginal sites and objects have been recorded previously in low lying areas within the Maitland region; however, they are generally situated within close proximity to secondary landforms such as crests, ridgelines, and spurs, and are within close proximity to lower order tributaries of the Hunter River. However, previous archaeological assessments identified high levels of flooding in the study area and high level of disturbance from development. No further investigation was recommended.

Eureka Heritage (2019) conducted a preliminary ADDA for the proposed re-development of land in High Street, Maitland for the Council Administration Office, located approximately 138 kilometres south-east of the current study area. The High Street study area consisted of a sealed car park, vacant land and a number of lots with existing historical and modern buildings. A detailed review of the landscape, archaeological, and ethnographic context was completed as part of this assessment. Predictive modelling conducted by Eureka Heritage determined that Aboriginal sites and objects will be found through the Central Lowlands Region of the Hunter Valley and are found across all landforms within the region. Eureka Heritage summarised that the following landform features were indicative of Aboriginal occupation and activity:

- Low-gradient drainage depressions.
- Well-drained (foot) slopes that provide dry camp locations.
- Creek terraces.
- Low gradient simple slopes adjacent to drainage depressions, particularly higher order streams.
- Elevated areas, such as spur crests or ridge crests that might offer broad outlooks or vantage points.
- Resource rich habitats with high biodiversity, such as wetland areas.
- Mature native (eucalyptus) trees (for manufacture of wooden implements and/or for ceremonial carving).
- Sandstone outcrops alongside creek lines (axe-grinding).
- Rock shelters (camping, rock art or in association with ceremony).
- Rocky outcrops (for procuring raw materials for stone tool manufacture).
- A source of fresh water.

Eureka Heritage determined that the High Street study area contained low potential to contain evidence of Aboriginal occupation or archaeological deposits. The study area displayed high levels of previous disturbance in the form of land clearance, historical and recent development, and frequent high velocity flood events. The study area was located within a level landform unit, however it is low lying and flood prone. While the study area was situated within close proximity to permanent water, Eureka Heritage determined that the resource-rich wetland environments of Telarah Lagoon and Wentworth Swamp, with their reliable water source and sheltered aspect, would have been the preferred location for long term occupation within the Maitland area.

3.3 Local context

Typically local reports are defined as occurring within 10 kilometres of the study. However, a relatively low number of Aboriginal cultural heritage investigations have been conducted within this region. As a result, this section has been expanded to include studies which occur within approximately 40 kilometres of the study area. Most of these investigations were undertaken as part of development applications and included surface investigations. These investigations are summarised below.

Brayshaw (1983) conducted an archaeological survey of the proposed Camerons Dam site on the Page River, approximately 29 kilometres south-east of the study area. The purpose of the survey was to inform the NSW Water Resources Commission of the presence of any archaeological sites within the proposed development area and to establish the need for testing. According to Brayshaw (1983), this survey was the first archaeological investigation conducted in the area. The survey located nine open, Aboriginal artefact scatter sites, which consisted several lithic artefacts. Artefacts included flakes, backed artefacts and cores, made from basalt, mudstones, silcrete and chert. The wide array of raw material types was attributed to the complex geology of the surrounding areas. It was concluded that the number of artefacts found was in part attributed to the lack of erosion in the alluvial and colluvial soil landscapes present. The study recommended that further investigation be undertaken in areas of the proposed development that were not part of the current survey, and that test excavations would be necessary at seven of the sites.

Davies (1991) undertook an archaeological survey of the proposed optic fibre cable route that was to be constructed between Tamworth and Scone. The route would reach a length of 138.3 kilometres and would transect the town of Willow Tree just before its half way point, approximately 1.68 kilometres north-west of the study area. The survey was divided into four sections, with Section 2 covering 34.8 kilometres between Glengarry and Willow Tree, and Section 3 covering 43.15 kilometres between Willow Tree and Rock Hill. Only one Aboriginal site was discovered in these sections of the route. A single, retouched flake made from banded chert was found on the eroded banks of a gully. The artefact site was positioned in the centre of the proposed optic fibre cable route, and upon recommendations, the route was moved 30 metres to the east. It was noted that in both of these sections, a large portion of the survey was hampered by low ground surface visibility as well as extensive disturbances in the form of European horticultural activities.

Gaynor (1992) conducted an archaeological survey of a proposed cattle feedlot on Windy Station, approximately 36.3 kilometres north-west of the study area. The development was proposed by the AACo, with the station established in 1833. The station remains the only surviving component of the original Warrah grant. The results of the survey concluded that the proposed development should be able to proceed with caution, as they were unable to locate any Aboriginal cultural sites. This was attributed to the extensive levels of disturbances witnessed during the survey. Gaynor (1992) noted that any intact archaeological deposits would have been destroyed by the initial phases of land clearance, and furthermore by ongoing cultivation of the land.

Griffith (1992) conducted an archaeological survey of two small, basalt hills near Mount Tingaroo, on the lower slopes of the Liverpool Ranges, approximately 18 kilometres south of the study area. The aim of the survey was to identify any Aboriginal sites in within proximity to the proposed development of a hard-rock quarry. The area had been extensively cleared of native vegetation and were being used for stock grazing at the time. The survey involved a systematic search for Aboriginal sites and artefacts, with archaeologists focusing on creeklines and gullies for grinding groove sites, mature trees for scarring and outcrops for evidence of quarrying. Despite the stringent methods, no Aboriginal sites were located during the survey, and the proposed development was permitted to proceed with an unexpected finds protocol in place.

ERM Resource Planning (1994) undertook an archaeological survey of the proposed gravel quarry at Willow Tree, adjacent to the north of the current study area. The proposed gravel quarry was to be constructed adjacent to the northern border of the quarry that was within the current Biosis study area. The survey focused on finding evidence of past human occupation in the forms of axe grinding grooves, culturally modified trees, rock shelters and over hangs with occupational deposits and artefacts. ERM Resource Planning did not locate any Aboriginal sites or cultural evidence during the survey. Upon discussions with the Aboriginal site officers, the investigators were informed that within the areas surrounding the Liverpool Ranges, there are more known sites further west of the study area.

Archaeological Surveys & Reports Pty Ltd (2004) conducted an archaeological survey of the proposed open cut coal mine, approximately 4 kilometres south of Werris Creek and approximately 29.5 kilometres north-

west from the current study area. The study area is within a north-west, south-east trending ridgeline in a soil landscape that was predominantly comprised of fine- to medium-grained sandy soil derived from the underlying sandstone geology. The survey was generally effected by dense grassy vegetation coverage, however there was ample visibility and ground exposure to deem the survey effective. The survey located one Aboriginal site on the southern portion of the ridge, and comprised at least 25 axe grinding grooves, mostly aligned north-south. It was concluded that the grooves were made at different times, suggesting that the site was occupied for extended periods of time. The recommendations of the survey were that no mining or works were to occur within 100 metres of the grinding groove site until the potential impacts of mining closer to the site were better understood.

Envirosciences Pty Ltd (1994) undertook an archaeological survey of a proposed open cut zeolite mine in Quirindi, located approximately 20 kilometres north-east from the study area. The land under investigation was at the time being used for cattle grazing and residential purposes. Background research of the region determined that the soils were highly erosional and that there were limited known Aboriginal sites. The survey was unable to locate any Aboriginal sites or evidence of past occupation, and construction of the zeolite mine was recommended to proceed.

3.3.1 Identified Aboriginal archaeological sites

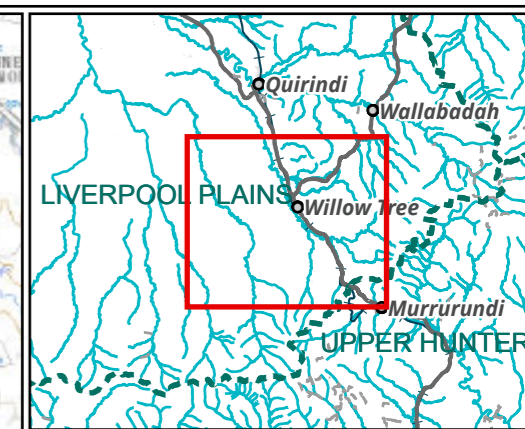
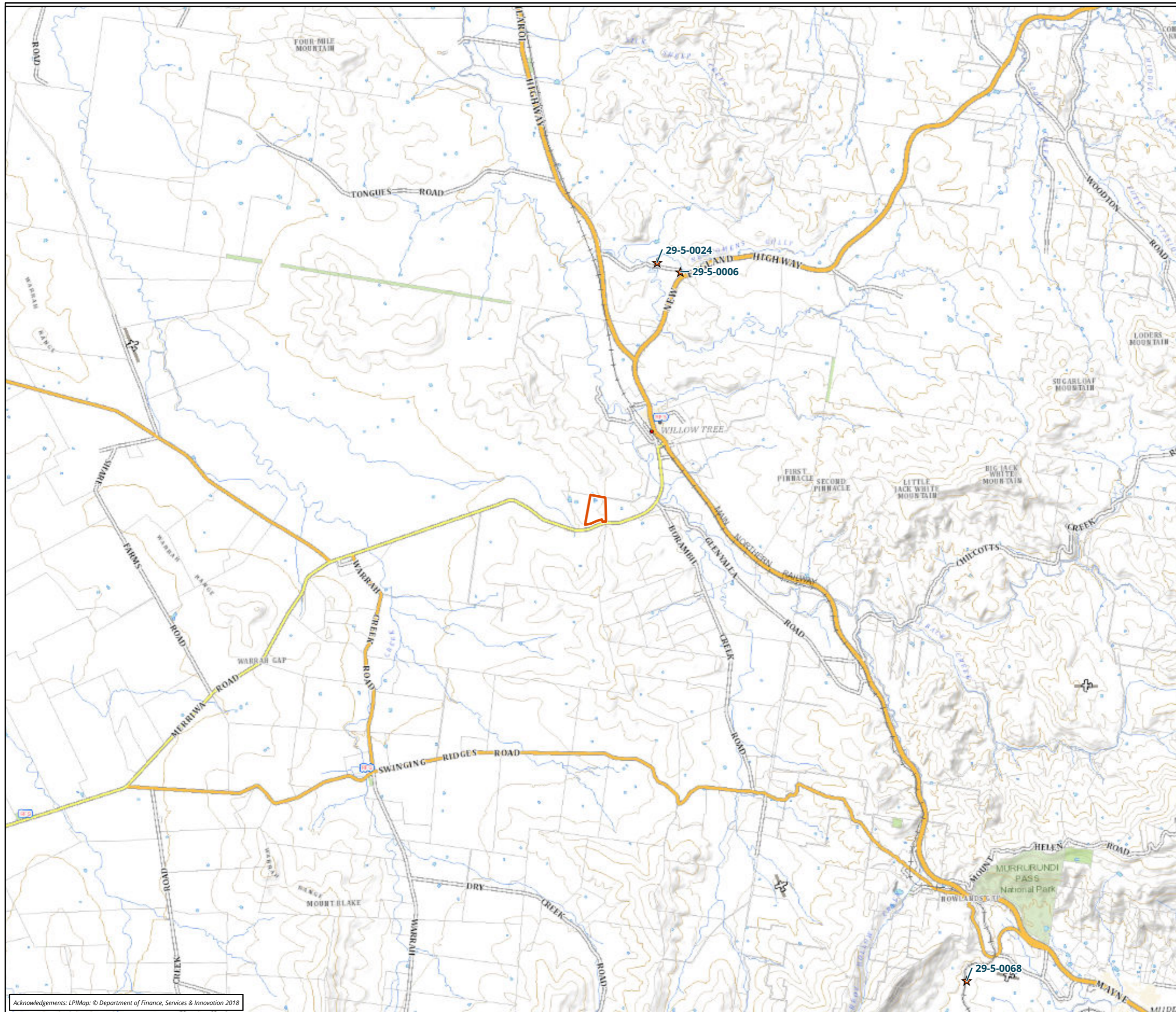
An extensive search of the AHIMS database was conducted on 5 May 2022 (Client service ID: 680412). The search identified three Aboriginal archaeological sites within a 10 kilometre search area, centred on the proposed study area (Table 3). Basic searches of the AHIMS data base were completed up to a 50 kilometre search area, however no additional sites were present. This is likely due to the regional positioning of the study area. None of these registered sites are located *within* or within 200 metres of the study area (Figure 7). An additional basic search was completed within 200 metres of the study area in December 2022 (Client ID: 742497) to ensure no additional sites had been recorded between May and December 2022. No sites were identified. The mapping coordinates recorded for these sites were checked for consistency with their descriptions and location on maps from Aboriginal heritage reports where available. These descriptions and maps were relied where notable discrepancies occurred.

It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the list. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area.

Table 3 AHIMS sites in the vicinity of the study area

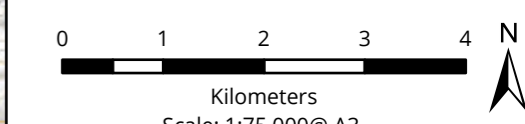
| Site type | Occurrences | Frequency (%) |
|-----------------|-------------|---------------|
| Modified Tree | 2 | 66.67 |
| Grinding Groove | 1 | 33.33 |
| Total | 3 | 100.00 |

A simple analysis of the Aboriginal cultural heritage sites registered within 10 kilometre of the study area indicates that the dominant site type is modified tree, representing 66.67% (n=2), followed by grinding groove, representing 33.33% (n=1). All the sites were located within close proximity to the reliable sources of water, in the areas with remnant native vegetation (scarred trees) or within areas of relevant sandstone outcrops for grinding grooves.



- Legend**
- Study area
 - ★ AHIMS

NOT TO BE MADE PUBLIC
Figure 7 AHIMS in the vicinity of the study area



Kilometers
 Scale: 1:75,000@ A3
 Coordinate System:
 GDA 1994 MGA Zone 56



Matter: 36975, Date: 10 May 2022,
 Drawn by: AM, Checked by: AV, Last edited by: amackegard
 Location: P:\36900s\36975\Mapping\36975_WillowTreeWMF, Layout: F7_AHIMS

3.3.2 Predictive statements

A series of statements have been formulated to broadly predict the type and character of Aboriginal cultural heritage sites likely to exist throughout the study area and where they are more likely to be located.

These statements are based on:

- Local and regional site distribution in relation to landform features identified within the study area.
- Consideration of site type, raw material types and site densities likely to be present within the study area.
- Findings of the ethnohistorical research on the potential for material traces to present within the study area.
- Potential Aboriginal use of natural resources present or once present within the study area.
- Consideration of the temporal and spatial relationships of sites within the study area and surrounding region.

Based on this information, a predictive model has been developed, indicating the site types most likely to be encountered during the survey and subsequent sub-surface investigations across the present study area (Table 4). The definition of each site type is described firstly, followed by the predicted likelihood of this site type occurring within the study area.

Table 4 Aboriginal site prediction statements

| Site type | Site description | Potential |
|--|---|---|
| Flaked stone artefact scatters and isolated artefacts | Artefact scatter sites can range from high-density concentrations of flaked stone and ground stone artefacts to sparse, low-density 'background' scatters and isolated finds. | Moderate to low: Stone artefact sites have been previously recorded in the region on level, well-drained topographies in close proximity to reliable sources of fresh water. Due to the soil landscapes and degree of disturbances, the potential for artefacts to be present within the study area is assessed as moderate to low. |
| Modified trees | Trees with cultural modifications | Moderate to low: Scarred trees are the most common site type within the vicinity of the study area. Due to extensive vegetation clearance only a small number of mature native trees have survived within easternmost part of the study area. |
| Shell middens | Deposits of shells accumulated over either singular large resource gathering events or over longer periods of time. | Low: Shell midden sites have not been recorded within the vicinity of the study area. There is a very low potential for shell middens to be located in the study area as the first order drainage line is not permanent water source. |
| Quarries | Raw stone material procurement sites. | Low: There is no record of any quarries being within or surrounding the study area. |

| Site type | Site description | Potential |
|---|---|---|
| Potential Archaeological Deposits (PADs) | Potential sub surface deposits of cultural material. | Low: PADs have not been previously recorded in the region. PADs are likely to be present within areas adjacent to water courses or on high points in undisturbed landforms. |
| Grinding grooves | Grooves created in stone platforms through ground stone tool manufacture. | Low: Suitable horizontal sandstone rock outcrops could occur along drainage lines. |
| Burials | Aboriginal burial sites. | Low: Aboriginal burial sites are generally situated within deep, soft sediments, caves or hollow trees. Areas of deep sandy deposits will have the potential for Aboriginal burials. The soil profiles associated with the study area are not commonly associated with burials. |
| Rock shelters with art and / or deposit | Rock shelter sites include rock overhangs, shelters or caves, and generally occur on, or next to, moderate to steeply sloping ground characterised by cliff lines and escarpments. These naturally formed features may contain rock art, stone artefacts or midden deposits and may also be associated with grinding grooves. | Low: The sites will only occur where suitable sandstone exposures or overhangs possessing sufficient sheltered space exist. |
| Aboriginal Ceremony and Dreaming sites | Such sites are often intangible places and features and are identified through oral histories, ethnohistoric data, or Aboriginal informants. | Low: There are currently no recorded mythological stories for the study area. |
| Post-contact sites | These are sites relating to the shared history of Aboriginal and non-Aboriginal people of an area and may include places such as missions, massacre sites, post-contact camp sites and buildings associated with post-contact Aboriginal use. | Low: There are no post-contact sites previously recorded in the study area and historical sources do not identify one. |
| Aboriginal places | Aboriginal places may not contain any 'archaeological' indicators of a site, but are nonetheless important to Aboriginal people. They may be places of cultural, spiritual or historic significance. Often they are places tied to community history and may include natural features (such as swimming and fishing holes), places where Aboriginal political events commenced or particular buildings. | Low: There are currently no recorded Aboriginal historical associations for the study area. |

4 Archaeological investigation

An archaeological investigation of the study area was undertaken on 18 May 2022 by Biosis Archaeologists Mathew Smith and Molly Crissell. The survey sampling strategy, methodology and a discussion of results are provided below.

4.1 Archaeological survey aims

The principle aims of the survey were to:

- Undertake a systematic survey of the study area targeting areas with the potential for Aboriginal heritage.
- Identify and record Aboriginal archaeological sites visible on the ground surface.
- Identify and record areas of Aboriginal archaeological and cultural sensitivity.

4.2 Survey methods

The survey was conducted on foot. Recording during the survey followed the archaeological survey requirements of the code and industry best practice methodology. Information that recorded during the survey included:

- Aboriginal objects or sites present in the study area during the survey.
- Survey coverage.
- Any resources that may have potentially have been exploited by Aboriginal people.
- Landform elements, distinguishable areas of land approximately 40m across or with a 20m radius (CSIRO 2009).
- Photographs of the site indicating landform.
- Ground surface visibility (GSV) and areas of exposure.
- Observable past or present disturbances to the landscape from human or animal activities.
- Aboriginal artefacts, culturally modified trees or any other Aboriginal sites.

Where possible, the identification of natural soil deposits within the study area was undertaken. Photographs and recording techniques were incorporated into the survey including representative photographs of survey units, landform, vegetation coverage, GSV and the recording of soil information for each survey unit were possible. Any potential Aboriginal objects observed during the survey were documented and photographed. The location of Aboriginal cultural heritage and points marking the boundary of the landform elements were recorded using a hand-held Global Positioning System and the Map Grid of Australia (94) coordinate system.

4.3 Constraints to the survey

With any archaeological survey there are several factors that influence the effectiveness (the likelihood of finding sites) of the survey. The factors that contributed most to the effectiveness of the survey within the

study area were the high levels of disturbance due to the extensive level of development from the existing waste management facility and previous quarry, along with low GSV throughout the extent of the site.

4.4 Visibility

In most archaeological reports and guidelines visibility refers to GSV, and is usually a percentage estimate of the ground surface that is visible and allowing for the detection of (usually stone) artefacts that may be present on the ground surface (DECCW 2010c). Visibility throughout the study area varied. Increased visibility (60-80%) was present throughout the northern portion of the study area, as the site was being actively utilised as a gravel quarry (Photo 10). Areas of lower visibility were generally associated with the southern portion of the study area where quarrying and mass vegetation removal had not occurred (10-15%), with grass coverage and vegetation obscuring majority of the GSV through these areas (Photo 11 and Photo 12).



Photo 10 Visibility in the northern portion of the study area and track heading to tip area, facing south



Photo 11 GSV of the north-eastern portion of the study area, facing north



Photo 12 GSV of the eastern portion of the study area, with waste materials, facing east

4.5 Exposure

Exposure refers to the geomorphic conditions of the local landform being surveyed, and attempts to describe the relationship between those conditions and the likelihood the prevailing conditions provide for the exposure of (buried) archaeological materials. Whilst also usually expressed as a percentage estimate, exposure is different to visibility in that it is in part a summation of geomorphic processes, rather than a simple observation of the ground surface (Burke & Smith 2004, pp. 79, DECCW 2010c).

Overall, the study area displayed areas of exposure of 0-10%, due to extensive levels of disturbance and vegetation. Throughout the study area, small areas of exposure were visible within areas of higher GSV, typically adjacent to informal access tracks, animal tracks or areas comprising of rocky outcropping (Photo 13, Photo 14 and Photo 15).



Photo 13 Area of gravel stockpiling, showing exposure and gravel coverage in the northern portion of the study area, facing north



Photo 14 Area of exposure on sloping landform in the southern portion of the study area, facing west



Photo 15 Ground surface within the north-eastern portion of the study area, depicting an area of low exposure near rock outcropping. Facing north-east.

4.6 Disturbances

Disturbance in the study area is associated with natural and human agents. Natural agents generally affect small areas and include the burrowing and scratching in soil by animals, such as wombats, foxes, rabbits and wallabies, and sometimes exposure from slumping or scouring. Disturbances associated with recent human action are prevalent in the study area and cover large sections of the land surface. The agents include industrial development such as the creation of gravel quarrying, artificial dams and construction of waste management facilities; farming practices, such as initial vegetation clearance for creation of paddocks and fencing and stock grazing.

The study area has been subject to extensive disturbances by human activity. These disturbances were noted during the archaeological survey and are shown in Photo 16, Photo 17, Photo 18 and Photo 19.



Photo 16 Waste management facility within the northern portion of the study area, facing south



Photo 17 Gravel stockpiling in the north-western portion of the study area, facing south-west



Photo 18 Evidence of previous mining and quarrying within the north-eastern portion of the study area, facing east



Photo 19 Waste within the eastern portion of the study area, facing south-east

4.7 Investigation results and discussion

Investigation throughout the study area comprised of a single meandering transect. Overall, the field investigation was hindered by the extensive disturbance and development throughout the northern portion of the study area and increased vegetation cover throughout the central and southern portions of the study area, which limited any potential to identify surface artefacts or predict whether any PADs were present. Survey efforts did not identify any surface artefacts or areas of PAD throughout the area.

The study area is located within the Brigalow Belt South Bioregion. There are three soil landscapes present within the study area: two erosional soil landscapes, the Glen Oak soil landscape (located along the southern boundary of the study area) and the Inverkip Road soil landscape (located throughout the southern, central and small sections of the northern portion of the study area), and a Disturbed Terrain soil landscape (located in the northern portion of the study area).

Erosional soils have a high to very high erodability rating and would therefore be susceptible to frequent soil movement. This movement would result in poor preservation of archaeological material at shallow depths but would potentially lead to exposures of any deeper archaeological deposits where topsoil has eroded away. As this soil landscape is characterised as highly erosional, the soils can be shallow, highly permeable, and have low levels of soil fertility. This would indicate that the presence of Aboriginal sites and objects may be unlikely where erosion has occurred (Chapman et al. 1989, pp. 64–67, McInnes 1997, p.45, cited by Umwelt (Australia) Pty Limited 2016, pp. 13).

The northern portion of the study area is contained within disturbed terrain. This area has been completely disturbed by activities associated with the removal of natural soils and depositing of landfill and/or gravel deposits. This soil landscape also may include mass-movement of soils, foundation and erosion hazards; poor drainage, low fertility and the presence of toxic materials (McInnes-Clarke 2002, pp. 249). This combination of disturbance indicates that the presence of Aboriginal sites and objects is very unlikely.

The archaeological survey revealed that large parts of the study area had been subject to significant ground disturbances, such as vegetation removal, tree clearance, bulk excavation, landscape modification and

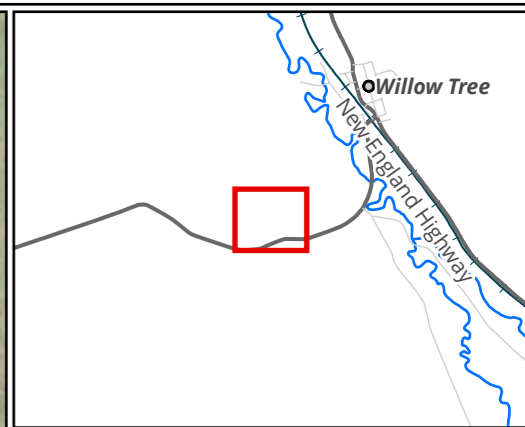
quarrying. The disturbances observed within the study area have had an influence on overall site integrity, with past human activities causing spatial and stratigraphic movements of artefacts. A review of historical aerials confirmed the extent of the disturbances identified throughout the northern portion of the study area. Between 1953 and 1970 the topography of the northern portion of the site was heavily modified and bulk excavated to enable the establishment of a gravel quarry, with the quarry still operational today. The significant land modifications, inclusive of bulk excavations, undertaken as part of this quarry would have caused the destruction and removal of cultural material throughout the landscape.

Vegetation clearance would have also caused spatial, as well as stratigraphical movements of cultural material due to the removal of trees, which would have originally been present within the study area. Following land clearance, erosion would have been extensive and caused post-depositional displacement of artefacts. Although these processes would have displaced surface and topsoil cultural material, it would not have affected deeper buried archaeological deposits.

A review of previous archaeological studies, surveys and regional predictive modelling indicates that while all landforms within the study area were utilised to some degree by Aboriginal people in the past, particular landforms contained a higher likelihood to contain archaeological material than others. These assessments concluded that:

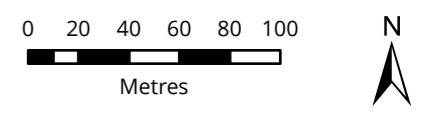
- Open artefact scatters and grinding grooves are more likely to be present on elevated landforms (such as ridge line, crests, top of slopes), whereas depressions and swamp areas were less likely to contain artefacts (Kuskie 1997, Mills and Wilkinson 1994, Archaeological Surveys & Reports Pty Ltd 2004).
- Aboriginal sites are more frequent within 100 metres of a perennial water course (Kuskie 1997).
- Sandstone outcrops alongside creek lines (axe-grinding) and rocky outcrops (for procuring raw materials for stone tool manufacture) both contained likelihood for Aboriginal sites, provided the landforms and soils were satisfactory to the retention of artefacts (Eureka Heritage 2019).
- Residual, alluvial and colluvial soil landscapes contained a higher likelihood to contain artefacts in subsurface deposits (Brayshaw 1983).

Based on the results of the survey and review of previous assessments, artefact sites are more likely to be identified in raised landforms within close proximity to creeklines (i.e. spurs, crests, ridgelines and terraces) and outside of areas that would be susceptible to water inundation, rather than lower slopes or flats adjacent to watercourses. This, in addition to the highly erosional soil landscape and disturbed terrain present throughout the entirety of the site and the extensive disturbances identified throughout the northern portion of the study area, has identified that the study area has low potential for archaeological deposits to remain intact.



- Legend**
- Study area
 - Lot
 - Survey track
- Archaeological potential**
- Low

Figure 8 Survey results



Scale: 1:3,000@ A3
 Coordinate System: GDA 1994 MGA Zone 56
biosis

36975, Date: 19 May 2022,
 Drawn by: AM, Checked by: AV, Last edited by: amackegard
 Layout: 36975_F8_SurveyResults
 Project: P:\36900s\36975\mapping\36975_WillowTreeWMF.aprx

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © Department of Customer Service 2020

5 Conclusions and recommendations

5.1 Conclusions

The results of this assessment indicate that there is low archaeological potential within the study area. No Aboriginal objects or sites were identified during the archaeological survey. The survey did however identify significant disturbances throughout the study area due to the large gravel quarry in operation within the northern portion of the site. No areas of PAD were identified within the study area. Proposed works can proceed with caution and no further archaeological investigation is required (Figure 9).

5.2 Recommendations

The following management recommendations have been developed relevant to the study area and influenced by:

- Predicted impacts to Aboriginal cultural heritage.
- The planning approvals framework.
- Current best conservation practise, widely considered to include:
 - Ethos of the Australia ICOMOS Burra Charter (2013).
 - The code.

Prior to any impacts occurring within the study area, the following is recommended:

Recommendation 1: No further archaeological assessment is required in areas of low archaeological potential

This assessment has determined that the study area contains low archaeological potential for Aboriginal object to be present. No further archaeological work is required in the study area throughout the areas identified as containing low archaeological potential subject to recommendations 2 and 3 below.

Recommendation 2: Discovery of Unanticipated Aboriginal Objects

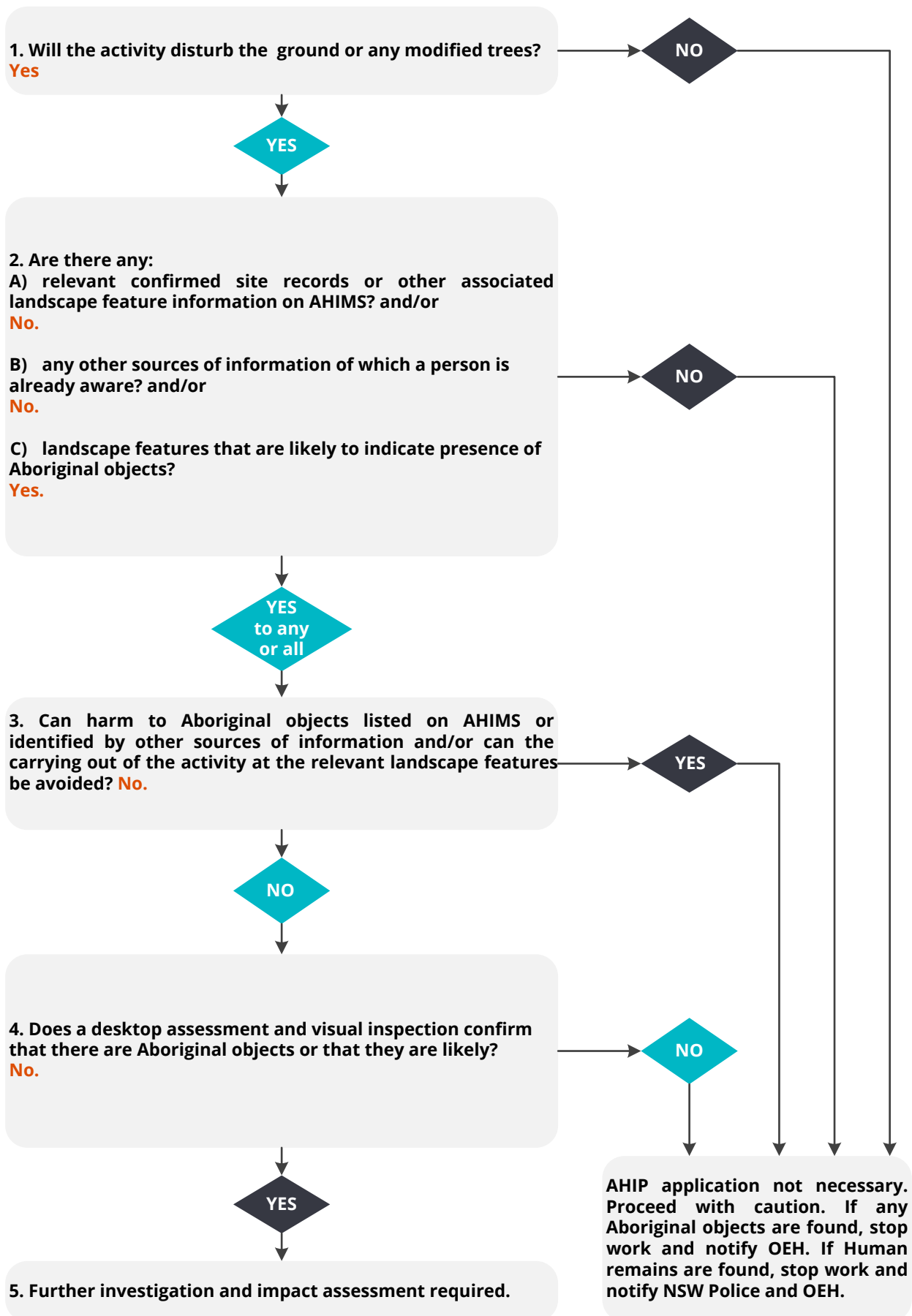
All Aboriginal Objects and Places are protected under the NPW Act. It is an offence to disturb an Aboriginal site without a consent permit issued by the Heritage NSW. Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the Heritage NSW and Aboriginal stakeholders.

Recommendation 3: Discovery of Aboriginal Ancestral Remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. Immediately cease all work at that location and not further move or disturb the remains.
2. Notify the NSW Police and Heritage NSW's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location.
3. Not recommence work at that location unless authorised in writing by Heritage NSW.

Figure 9: Due diligence flow chart



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Appendices

Appendix 1 AHIMS search results

This Appendix is not to be made public.



AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 36975 - CG

Client Service ID : 680412

| <u>SiteID</u> | <u>SiteName</u> | <u>Datum</u> | <u>Zone</u> | <u>Easting</u> | <u>Northing</u> | <u>Context</u> | <u>Site Status **</u> | <u>SiteFeatures</u> | <u>SiteTypes</u> | <u>Reports</u> |
|---------------|--------------------------|--------------|-------------|----------------|-----------------|----------------|-----------------------|--|---------------------|--|
| 29-5-0024 | Colly Creek;Tamworth; | AGD | 56 | 284400 | 6499500 | Open site | Valid | Modified Tree (Carved or Scarred) : | Scarred Tree | |
| | <u>Contact</u> | | | | | | | - | | |
| | <u>Recorders</u> | | | | | | | <u>Permits</u> | | |
| 29-5-0006 | Colly Creek;Willow Tree; | AGD | 56 | 284900 | 6499300 | Open site | Valid | Grinding Groove : - | Axe Grinding Groove | |
| | <u>Contact</u> | | | | | | | | | |
| | <u>Recorders</u> | | | | | | | <u>Permits</u> | | |
| 29-5-0068 | LRPST 1 | GDA | 56 | 291077 | 6484437 | Open site | Valid | Modified Tree (Carved or Scarred) : | | |
| | <u>Contact</u> | | | | | | | 1 | | |
| | <u>Recorders</u> | | | | | | | <u>Permits</u> | | |
| | | | | | | | | | | Australian Museum Consulting (AM Consulting) |

**** Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 05/05/2022 for Samantha Keats for the following area at Datum :GDA, Zone : 56, Eastings : 272960.892 - 293437.746, Northings : 6484114.081 - 6504768.569 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 3

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

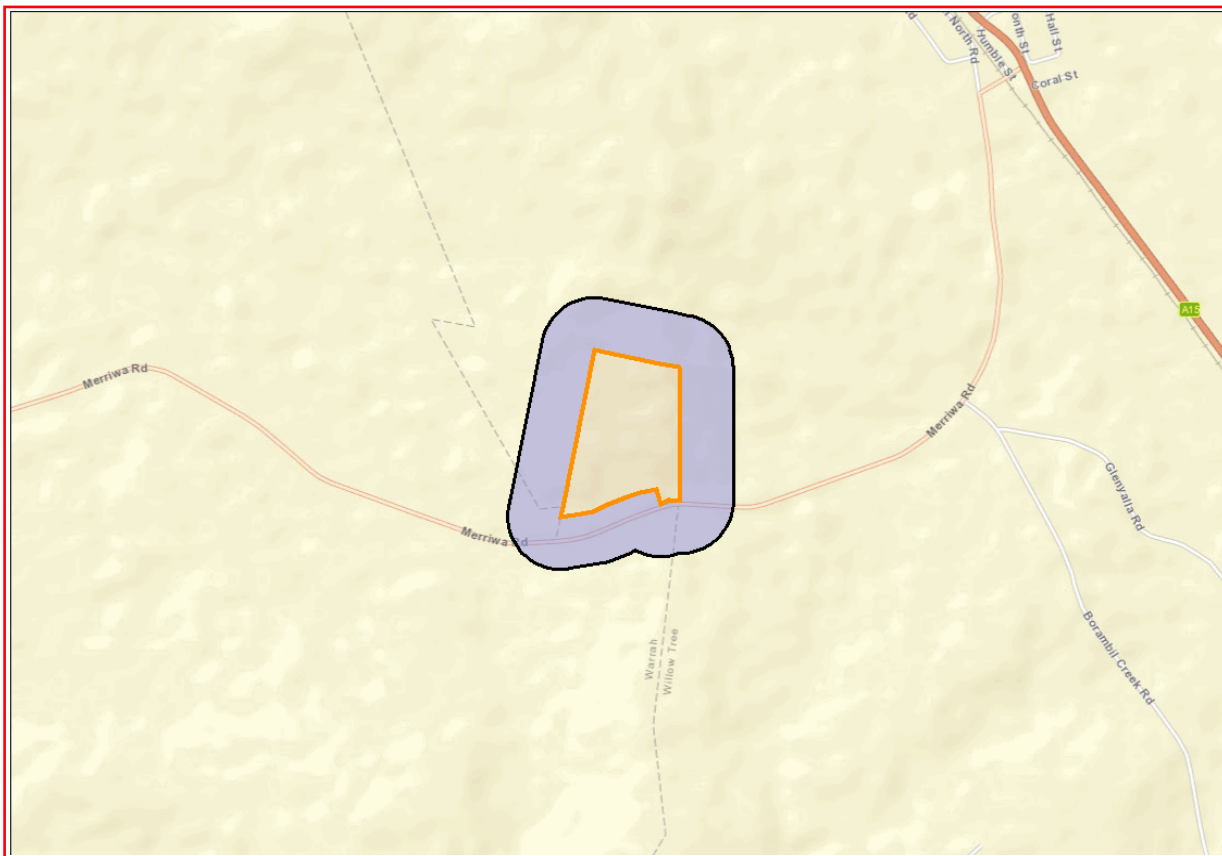
Biosis Pty Ltd - Wollongong
8 Tate Street
Wollongong New South Wales 2500
Attention: Samantha Keats
Email: ahims@biosis.com.au

Date: 22 December 2022

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 213, DP:DP1173230, Section : - with a Buffer of 200 meters, conducted by Samantha Keats on 22 December 2022.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

| | |
|----------|--|
| 0 | Aboriginal sites are recorded in or near the above location. |
| 0 | Aboriginal places have been declared in or near the above location. * |

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(https://www.legislation.nsw.gov.au/gazette\)](https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not to be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.