WEST DAPTO PACKAGE 3: PART 3A CONSISTENCY ASSESSMENT
WATER AND WASTEWATER SERVICES, NSW

Aboriginal Archaeological Assessment

Test Excavation Report

Prepared for Sydney Water

Wollongong Local Government Area

January 2024

Ref. 2232

KELLEHER NIGHTINGALE CONSULTING PTY LTD
Archaeological and Heritage Management
ACN 120 187 671

Suite 505-507, 155 King Street
SYDNEY NSW 2000
Phone 02 9232 5373

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1 Introduction

1.1 Project background

Sydney Water is undertaking the planning, construction and delivery of various water and wastewater servicing infrastructure within the West Dapto Urban Release Area (WDURA) and Adjacent Growth Areas ('the Project'). Aboriginal cultural heritage values for the project were previously assessed by Biosis (2012) as part of the Environmental Assessment (EA) preparation:

> Biosis Research Pty Ltd, 2012. Water and Wastewater Servicing of the West Dapto Urban Release Area and Adjacent Growth Areas: Aboriginal Heritage Assessment and Impact Management. Report prepared for Sydney Water.

The Project was granted Concept and Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* by the Department of Planning and Infrastructure in 2013 (MP09_0189). The existing approval applies to land mapped within the Project Approval boundary and includes water and wastewater alignments that follow the EA field assessment corridors. Project Approval was subject to a number of conditions, including specific conditions relating to Aboriginal heritage. These are contained in conditions C32 and C36 of the Project Approval.

Condition C32 states that:

> Impacts to Aboriginal heritage identified in Tables 25 and 26 of Appendix F in the document listed under condition B2(b) shall be minimised to the greatest extent practicable through both detailed design and construction. Where impacts are unavoidable, works shall be undertaken in accordance with condition C36 and the actions to manage construction Aboriginal heritage required by condition E6(b).

Condition C36 states that:

> Prior to the commencement of pre-construction and construction activities affecting the Aboriginal archaeological sites identified in Table 25 and Table 26 of Appendix F in the document listed under condition B2(b), the Proponent must:
>
> (a) undertake an Aboriginal archaeological investigation program using a methodology prepared, in consultation with the OEH (Aboriginal heritage) and the Registered Aboriginal Stakeholders, and to the satisfaction of the Director-General.
>
> (b) report on the results of the Aboriginal archaeological investigation program, including recommendations (such as for further archaeological work), in consultation with the Registered Aboriginal Stakeholders, the OEH and to the satisfaction of the Director General, and shall include, but not necessarily be limited to:
>
> (i) consideration of measures to avoid or minimise disturbance to Aboriginal objects where objects of moderate to high significance are found to be present;
>
> (ii) where it cannot be avoided, recommendations for any further investigations; and
>
> (iii) management and mitigation measures to ensure there are no additional impacts due to pre-construction and construction activities.
>
> (c) Undertake any further archaeological excavation works recommended by the results of the Aboriginal archaeological investigation program.
>
> Within twelve months of completing the above work, unless otherwise agreed by the Director General, the Proponent shall submit a report containing the findings of the excavations, including artefact analysis, and the identification of final storage place for Aboriginal objects, prepared in consultation with the Registered Aboriginal Stakeholders, the OEH (Aboriginal objects) and to the satisfaction of the Director-General.

Tables 25 and 26 in the Biosis 2012 report, as referred to in Condition 32, contain (respectively) site-specific recommendations for previously identified archaeological sites/PADs along the alignment, and; recommendations for areas of high, moderate and low archaeological sensitivity as identified in a series of Figures contained within the report.

Schedule E of the Project Approval ('Construction Environmental Management') also contained specific provisions regarding the inclusion of Aboriginal heritage matters within the Construction Environmental Management Plan (CEMP):

Condition E6. As well as the general requirements of an EMP as outlined in condition E5, the following shall be addressed:

(b) Aboriginal Heritage

(i) actions to manage identified Aboriginal objects directly and indirectly impacted by construction, developed in consultation with registered Aboriginal stakeholders prior to any archaeological or salvage works commencing, including but not limited to:

- management measures and strategies for protection, monitoring, salvage, archival recording and/or conservation of sites and items that will be directly or indirectly impacted during construction;
- procedures for dealing with previously unidentified Aboriginal objects (excluding human remains) including cessation of works, assessment of significance and determination of appropriate management measures, involvement of a suitably qualified archaeologist and consultation with the Department and registered Aboriginal stakeholders, actions required to enable construction to recommence and notification to the OEH, in accordance with section 89A of the *National Parks and Wildlife Act 1974*, and the department;;
- procedures for dealing with human remains, including cessation of works in the vicinity of the remains and notification of relevant stakeholders, including NSW Police, the department and the OEH;
- training and induction processes for construction personnel on site identification, protection and conservation of Aboriginal cultural heritage;
- procedures for ongoing stakeholder consultation and involvement for the duration of the project; and
- procedures for monitoring and reporting effectiveness of management measures, including reporting of non-compliance.

Schedule E also contains provisions for mitigative salvage excavation and subsequent reporting at certain sites:

Condition E10 states that:

> Prior to the commencement of pre-construction and/or construction activities that will impact the Aboriginal archaeological sites identified in Table 6-22 of the document listed under condition B2(b), the Proponent shall undertake an archaeological salvage program using a methodology prepared in consultation with the registered Aboriginal stakeholders, and to the satisfaction of the Director-General. This work shall be undertaken by an appropriately qualified archaeological heritage consultant.
>
> Within two years of completing the salvage, unless otherwise agreed by the Director General, the Proponent shall submit a report containing the findings of the salvage, including artefact analysis, and the identification of a final repository for any Aboriginal objects, prepared in consultation with the Aboriginal stakeholders and to the satisfaction of the Director-General.

Table 6-22 of the EA, as referred to in Condition E10, contains the same seven previously identified sites/PADs as listed in Table 25 of Biosis 2012. None of these sites/PADs are located within the study area for the current assessment.

1.2 Current assessment

Sydney Water is constructing infrastructure in sections to support the staged development of the WDURA and the Adjacent Growth Areas (AGAs) and meet the future water and wastewater demand of these urban release areas. The proposed West Dapto Package 3 works are required to manage the future demand expected from the development of the Cleveland precinct.

Sydney Water has refined a preferred water and wastewater servicing option for the West Dapto Package 3 of the WDURA (Figure 1). The proposed works are to be partially undertaken under the existing MP09_0189 approval and partially under a Review of Environmental Factors (REF) assessed under Division 5.1 of the NSW *Environmental Planning and Assessment Act 1979.* The current assessment and this report relate specifically to works being undertaken using the existing Project Approval, referred to as 'WD3 Part 3A'. Works to be undertaken under the REF ('WD3 REF') are to be assessed separately and are not considered in this report.

Kelleher Nightingale Consulting Pty Ltd (KNC) undertook a preliminary archaeological assessment for the proposed West Dapto Package 3 infrastructure (KNC 2023a), comprising a consistency assessment for the Part 3A portion and a due diligence assessment for the REF portion. The assessment found that the works proposed under the existing Part 3A Project Approval intersected an area of Aboriginal archaeological sensitivity along [redacted], sections of which were previously identified in the EA as areas of high sensitivity.

The approved recommendation for areas of high archaeological sensitivity, as listed in Biosis 2012 Table 26, is:

> "If the areas of high archaeological sensitivity identified in Figure 45 to 52 can not be avoided by the proposed alignments, additional subsurface testing will be required to determine the nature and extent of known sites, and the location of additional sub-surface deposits within the area." (Biosis 2012: 206).

It was identified that in accordance with the conditions of Project Approval, further Aboriginal heritage assessment under Condition C36 would be required for the section of the proposed corridor along [redacted]. None of the sites referred to in Condition E10 were located within the proposed WD3 Part 3A work area and this Condition therefore did not apply.

As a result, KNC were engaged by Sydney Water to prepare an Aboriginal archaeological assessment for the WD3 Part 3A study area, including a test excavation program in accordance with the existing Project Approval and test excavation methodology for the Project as per the Biosis report, and the Heritage NSW *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water NSW (DECCW) 2010a).

This report presents the findings of the assessment and evaluates the resulting consistency with the Project Approval.

2 Investigators and contributors

This archaeological assessment has been undertaken by the personnel in the following table.

Table 1. Investigators and contributors

Contributor	Organisation	Role
[redacted]	KNC	Project Director, Advisor, Review
[redacted]	KNC	Site Supervisor, Artefact Analysis, Reporting
[redacted]	KNC	GIS Mapping

2.1 Aboriginal community consultation

Registered Aboriginal Stakeholders for the WDURA project were contacted and notified of the proposed test excavation at the identified [redacted] Area of Archaeological Sensitivity. Stakeholders were informed that the test excavation would be undertaken in accordance with the existing Project Approval and test excavation methodology for the Project as per the Biosis report and the Heritage NSW *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (letters dated 21/03/2023).

Stakeholder representatives from the Illawarra Local Aboriginal Land Council (ILALC), James Davis and Woronora Plateau Gundungara Elders Council assisted with fieldwork.

The test excavation report and consistency assessment was provided to all stakeholders for review and comment (letters/emails dated 12/09/2023). No further feedback or additional information was received from stakeholders.

3 Location and scope of activity

The West Dapto Package 3 works are situated in the suburbs of Dapto, Horsley and Cleveland in the Wollongong Local Government Area (LGA), approximately 12 kilometres southwest of the Wollongong CBD. Figure 1 shows the location of the wider proposal (incorporating both WD3 Part 3A and WD3 REF sections).

WD3 Part 3A
Proposed works under the existing Project Approval consist of the construction and operation of water and wastewater mains that would likely involve a combination of conventional open trenching and trenchless methods (e.g. horizontal directional drilling) in sensitive locations. These works comprise the study area for the consistency assessment (the current document). The study area also includes the proposed construction compounds and associated access for the proposal.

WD3 REF
Proposed works under the REF comprise 4.6 km of wastewater mains and upgrades to an existing wastewater pumping station (SP1012). These activities are assessed separately (KNC 2023b) and are not included in this consistency assessment report.

Figure 2 shows the 'study area' for this assessment, which comprises the WD3 Part 3A works area.

Figure 3 shows the general alignment of the WD3 Part 3A area (shown in blue as 'Consistency Assessment') and the WD3 REF area (shown in red as 'REF alignment' and 'REF SP1012') in relation to the field assessment corridors used in the EA (Biosis 2012).

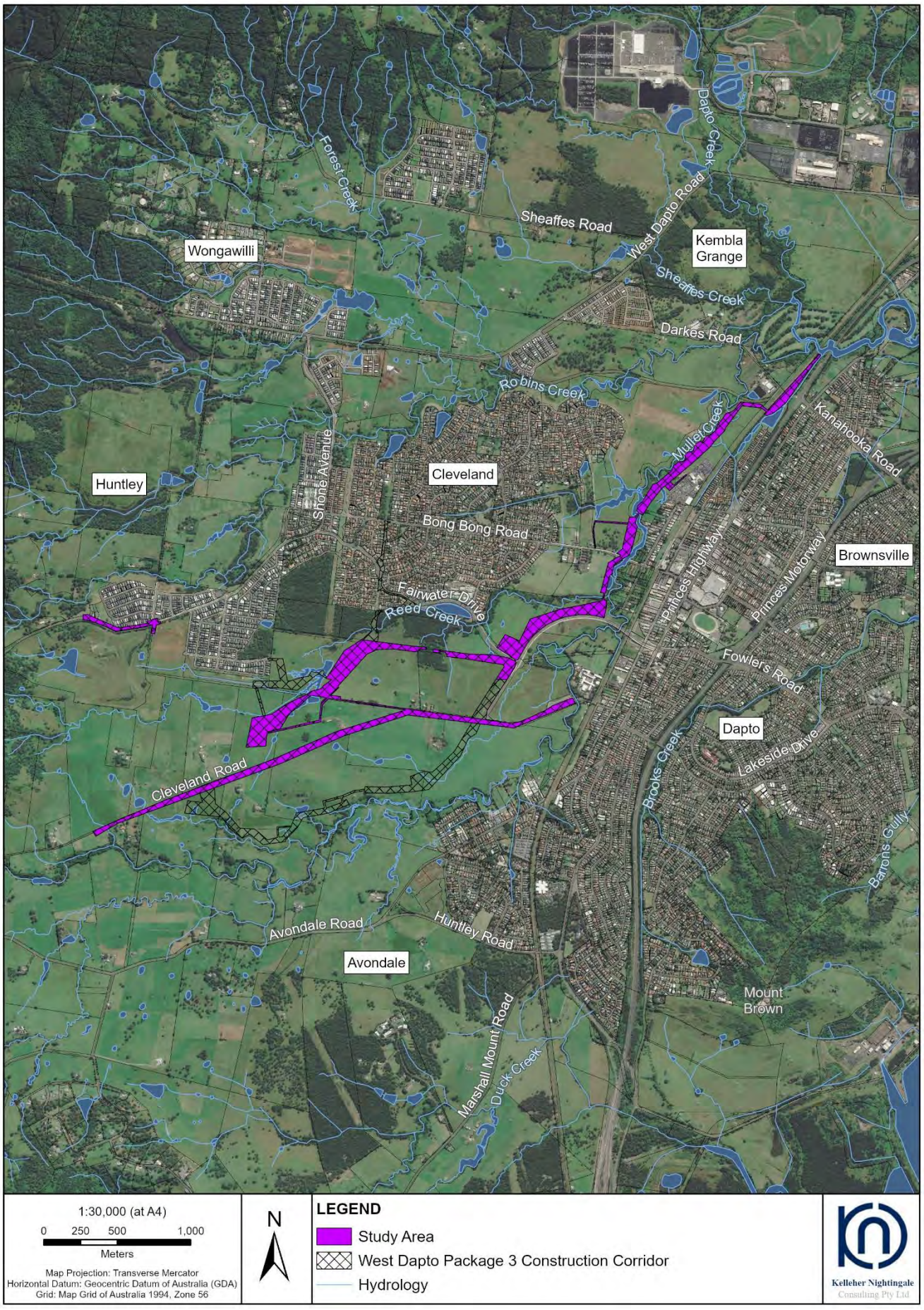


Figure 1. West Dapto Package 3 overview

Figure 2. Detail of the study area (WD3 Part 3A area)

Figure 3. West Dapto Package 3 alignments and EA field assessment corridors

4 Previous Archaeological Work

4.1 Database Search (AHIMS)

The Aboriginal Heritage Information Management System (AHIMS) is a database operated by Heritage NSW and regulated under section 90Q of the *National Parks and Wildlife Act 1974*. AHIMS contains information and records related to registered Aboriginal archaeological sites (Aboriginal objects, as defined under the Act) and declared Aboriginal places (as defined under the Act) in NSW.

A search of the AHIMS database was conducted in August 2023 (Client Service ID 807456). Search parameters encompassed the whole of the West Dapto Package 3 area and were the same as used previously for the consistency assessment (KNC 2023a). Searches were undertaken in order to identify and confirm registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the WD3 Part 3A study area. The search results are attached as Appendix A. The AHIMS Web Service database search was conducted within the following coordinates (GDA, Zone 56):

Eastings: [redacted]
Northings: [redacted]
Buffer: 0 metres (search area coordinates included an extensive buffer)

The AHIMS search results showed:

[redacted]	**Aboriginal sites are recorded in or near the above location**
[redacted]	**Aboriginal places have been declared in or near the above location**

The distribution of AHIMS recorded Aboriginal sites within these coordinates is shown on Figure 4. The frequencies of site types within the AHIMS database search area are listed in Table 2.

Table 2. Site features and context from AHIMS database search

Site Context	Site Feature	Number	*Frequency (%)*
Open	Aboriginal Ceremony and Dreaming	[redacted]	[redacted]
	Artefact	[redacted]	[redacted]
	Artefact; Potential Archaeological Deposit (PAD)	[redacted]	[redacted]
	Modified Tree (Carved or Scarred)	[redacted]	[redacted]
	Potential Archaeological Deposit (PAD)	[redacted]	[redacted]
	Shell	[redacted]	[redacted]
Total		[redacted]	***100%***

[redacted]

Several further sites have been previously recorded within 100 metres. The nature of previously recorded sites and previous archaeological investigations in the area are discussed further in section 4.3.

4.2 Other heritage registers and databases

Other sources of information including heritage registers and lists were also searched for known Aboriginal heritage in the vicinity of the study area. These included:

- State Heritage Register
- State Heritage Inventory
- Wollongong Local Environmental Plan 2009
- Roads & Maritime and Sydney Water Section 170 Heritage and Conservation Registers
- National Heritage List
- Commonwealth Heritage List
- Australian Heritage Database (Register of the National Estate – Non-statutory archive) and
- Australian Heritage Places Inventory (Register of the National Estate – Non-statutory archive).

No Aboriginal archaeological sites or Aboriginal heritage items were recorded on these databases within the study area.

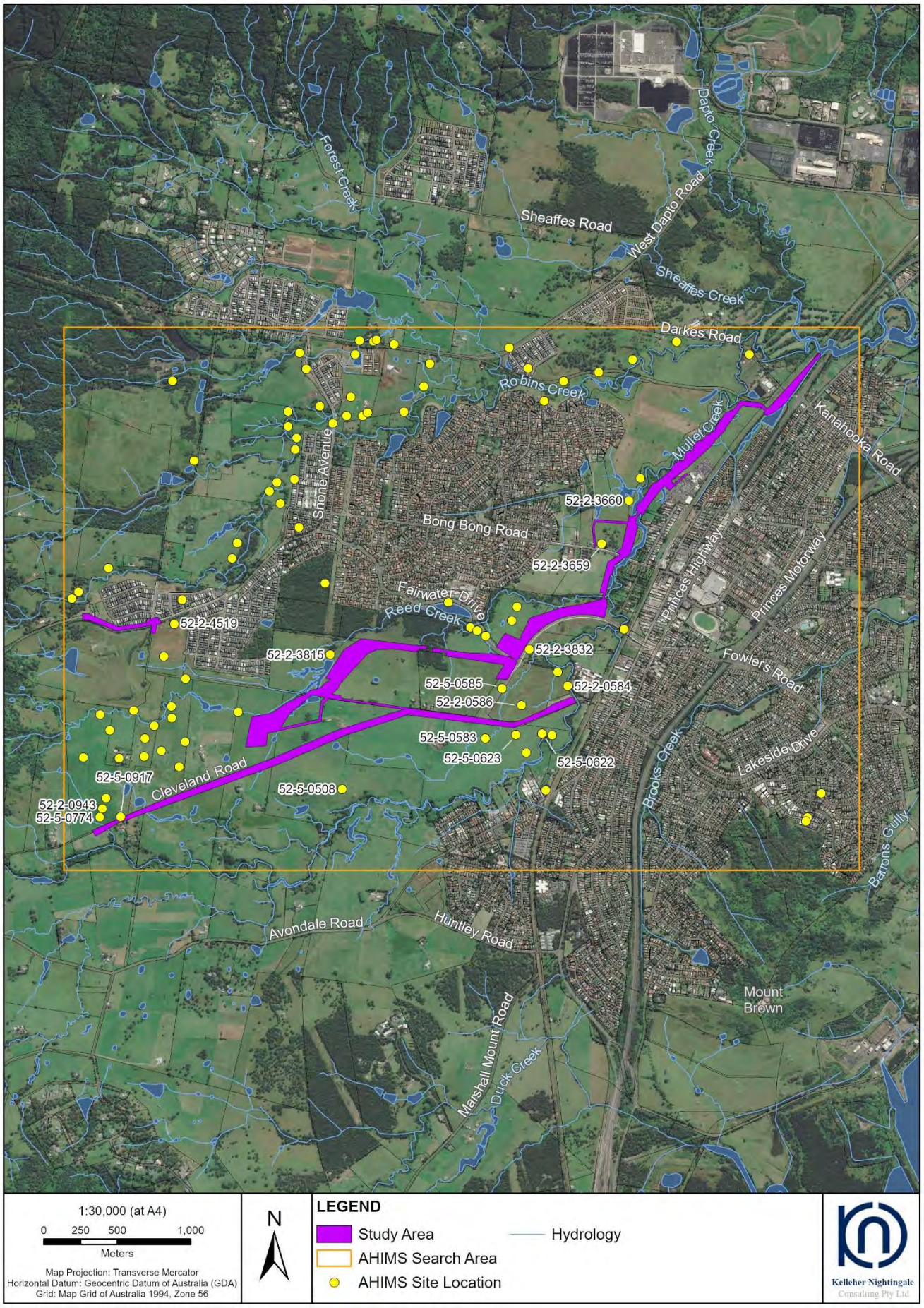


Figure 4. AHIMS search results

4.3 Previous archaeological assessments

Archaeological investigations are reliant on items that provide physical evidence of past human activities known as artefacts and their contextual associations. Artefacts which have survived to the present day are likely to represent a small portion of the objects that were used by Aboriginal people with even the most robust organic materials unlikely to survive in contexts older than 6,500 years (Attenbrow 2002: 3).

The most numerous artefacts at Aboriginal archaeological sites in the Illawarra Region are made from stone and were discarded in both open landscape settings (known as open camp sites, artefact scatters or isolated artefacts) and closed landscape settings (known as rock shelters). Open context sites are often palimpsests in which chronological association between stone artefacts and any datable features that may be present are difficult to determine (see Attenbrow 2002; White 2018). Rock shelters are generally more likely to preserve the chronological association of artefacts within distinct deposits; however, they are restricted to areas with suitable geology and topography which are unknown to occur within the current study area.

Several archaeological investigations have been undertaken within and in the vicinity of the study area. Previous archaeological investigations have primarily been undertaken as part of planning for residential development and infrastructure projects to support the ongoing urbanisation of the region. A summary of the relevant studies is presented in this section.

West Dapto Release Area Aboriginal Heritage Management Plan
An Aboriginal Heritage Management Plan (AHMP) was completed in 2006 for the West Dapto Release Area (WDRA) Master Planning process and included the current study area (Australian Museum Business Services (AMBS) 2006). The AHMP presented the results of a review of the available archaeological, ethnographic, environmental and historical data, an archaeological survey and an archaeological test excavation program.

Archaeological survey was undertaken over four weeks in 2004 to verify the accuracy of the existing information on previously recorded sites, to survey a sample of the landforms within the area and to target areas identified as being of archaeological and social/cultural interest. The survey covered approximately 104 hectares and sampled all landforms identified within the WDRA. A total of 189 stone artefacts were identified at 20 sites during the survey. The sites were situated on alluvial flats (n=17), hill slopes (n=19), spur crests (n=98) and streams (n=55).

The archaeological test excavation was undertaken in two stages (Stage 2 and Stage 3). The first stage (Stage 2) consisted of 100 test pits, each measuring one square metre, that were excavated across landforms within the [redacted] catchment areas. An additional 36 test pits were excavated within the two areas where town centres were proposed by the preferred WDRA development scenario.

A total of [redacted] artefacts were recovered from 75 of the 136 test pits excavated. Artefact density was generally low across the tested area with most test pits containing less than five artefacts. A large proportion of the artefacts were recovered from a single test pit (n=146), which was also the only test pit that contained over [redacted] artefacts. The artefacts were primarily recovered from test pits that were excavated within the [redacted] with the test pits excavated within the [redacted] Excluding the localised high artefact density recovered within a single test pit, the majority of stone artefacts were recovered from test pits excavated on alluvial flats. Over half contained subsurface deposits with an average artefact density of less than three artefacts per square metre and 98 percent contained deposits with less than [redacted] artefacts per square metre.

[redacted]

The archaeological investigations identified 70 Aboriginal archaeological sites within the WDRA. The sites consisted of [redacted] artefact scatters, [redacted] isolated artefacts and four locations where seven cultural modification trees with bark removal scars were identified. The results were used to develop a model for predicting Aboriginal archaeological potential within the WDRA based on environmental and landform context. In general, moderate to high potential was expected for landforms along major creeklines, spur crests within major creek corridors, benched footslopes of the escarpment hills adjacent to creeklines and along the lower order tributaries of major watercourses. Other areas of potential included wetlands and elevated alluvial flats along permanent or semi-permanent watercourses.

The current study area was assessed as displaying high potential along [redacted], low to moderate potential on elevated landforms further back from the watercourses, and very low to low potential along the disturbed existing road corridors and driveways. AMBS recommended that future development of the WDRA conserve sites where possible and manage any unavoidable impacts through impact mitigation works, including salvage excavation where appropriate.

WDURA and AGA Water and Wastewater Servicing

An Aboriginal heritage assessment was undertaken to inform the Environmental Assessment (EA) for proposed water and wastewater infrastructure for the WDURA and AGA (Biosis 2012). The assessment included a review of previous archaeological investigations, ethnohistoric records and landscape context within the WDURA and AGA precincts (Concept Area) which encompassed the current study area. A total of 139 previously recorded Aboriginal archaeological sites were identified within the Concept Area. The sites consisted of artefact scatters, isolated artefacts, shell middens, culturally modified trees, and areas of PAD.

The assessment utilised the predictive model which was developed during the WDRA AHMP with adaptations for areas beyond the WDRA (Biosis 2012: 82). The levels of archaeological potential shown on the predictive model were defined by Biosis (2012:90) as:

- High: areas associated with major creek lines, raised flat landforms such as ridges and hills, where disturbance has been minimal and it is believed that an intact sensitive landscape exists
- Moderate: areas incorporating minor creek lines and waterways where less intrusive post-contact disturbance has occurred, such as light vegetation clearing and pasture enhancement, with sites likely to reflect temporary habitation of a localised area
- Low: areas that have been identified as having specific locations where there has been a high degree of disturbance since the arrival of non-Aboriginal people, where the impact has been to the extent where no intact deposits are believed to be present. Areas may also include steep slopes or plains away from water sources. Artefacts found in this area are likely to be isolated, representative of 'background scatter', or in a highly disturbed context

The current study area intersected areas assessed as displaying high, moderate and low sensitivity/potential (Biosis 2012:90) on the predictive model. Within the current study area, areas of high potential included landforms immediately adjacent to [redacted] Areas of moderate potential were located between the major creeklines and road network across undeveloped pasture and agricultural land. Areas of low potential were present within the road corridors and across properties with greater land use disturbance.

A detailed assessment of the Project Approval Area, and the proposed pipeline service corridors and associated infrastructure areas was also undertaken. The Project Approval Area consisted of the parts of WDURA that had been rezoned for development in the Wollongong LEP 2010 (West Dapto) and required infrastructure prior to development. The assessment identified 50 Aboriginal archaeological sites within the Project Approval Area of which seven were located within proposed pipeline service corridors and associated infrastructure areas. An archaeological survey was undertaken of the proposed pipeline service corridors encompassing 25 metres on either side of the proposed pipeline alignments and 100 metres around the perimeter of proposed reservoirs, pumping stations and other ancillary infrastructure sites, including most of the current study area located within the Project Approval Area (refer Figure 3 field assessment corridors).

The results of the archaeological assessment informed the development of sensitivity mapping for the alignment corridors within the Project Approval area. Areas mapped as displaying 'high sensitivity' would require further assessment prior to any impacts from the project. The current WD3 Part 3A study area intersects some of the mapped areas of high sensitivity along [redacted] The assessment concluded that given the indicative nature of the infrastructure corridors and the proponents preferred option of avoiding impact to Aboriginal heritage sites, with detailed planning the Aboriginal heritage sites could be avoided. As a result, no site specific mitigation or management measures were provided; however, general management recommendations were made and the key management strategy was for the avoidance of impact to Aboriginal heritage sites through detailed design of the development, which should be implemented wherever practicable. The Project was granted Concept and Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* by the Department of Planning and Infrastructure in 2013 (MP09_0189). Project Approval was subject to a number of conditions, including specific conditions relating to Aboriginal heritage. These are contained in conditions C32 and C36 of the Project Approval (see Section 1.1) and include the require for further archaeological investigation within areas of high sensitivity.

McPhail Lands, West Dapto

Archaeological investigations were undertaken for the then proposed subdivision and development of rural properties adjacent to [redacted] Road at Horsley (Archaeological & Heritage Management Solutions (AHMS) 2012). The investigation area was located [redacted]

Fairwater Drive Extension

Archaeological investigations were undertaken prior to the extension of Fairwater Drive and Fowlers Road from Sierra Drive at Horsley in the west to Cleveland Drive at Cleveland in the south (Biosis 2010). The investigations assessed [redacted] The assessment included consultation with the Aboriginal community, an archaeological survey and an archaeological test excavation. Aboriginal community consultation identified a fig tree, Cleveland Road FT 2 (AHIMS 52-2-3832), [redacted]

The investigations identified five areas of PAD (Cleveland Road PAD 1-5) and a further three areas of archaeological sensitivity (Cleveland Road Test Site 1-3, subsequently Cleveland Road AFT-6-8) were identified based on the predictive model developed as part of the WDRA AHMP. [redacted]

A test excavation program comprising 46 test pits was undertaken at the five areas of PAD and three areas of archaeological sensitivity. Soils within the tested areas were predominantly shallow loams overlying basal clay with deeper sandy deposits within a test pit on the bank of an unnamed tributary and within two test pits that were excavated within a former drainage channel. [redacted] Artefact density was generally low across all tested areas with average artefact densities <1 artefact per square metre and no more than four artefacts within any one test square. [redacted]

[redacted] t was recommended that the proponent seek an AHIP if impacts to the sites would be unavoidable, however no salvage work was recommended on the basis of the low assessed archaeological significance.

[redacted] **Extension**

Archaeological investigations were undertaken prior to the extension of Fowlers Road from the Princes Highway at Dapto in the east to Fairwater Drive at Cleveland in the west (Biosis 2015). [redacted] The investigations included archaeological survey and archaeological test excavation.

No surface stone artefacts were identified within the investigation area during the archaeological survey. Ground surface visibility was limited to exposures within informal roads and tracks, areas of demolition, small erosion scours in the vicinity of creeks and beneath the dripline of trees. Visible ground surface disturbance was generally located in the north-eastern and south-western portions of the investigation area where remnants of demolished structures were observed. An underground gas pipeline was also noted in the north western portion of the investigation area. The investigation area was assessed as having archaeological potential due to the proximity of [redacted], favourable topography and archaeological context.

An archaeological test excavation program was subsequently undertaken within the investigation area in order to determine the nature and extent of subsurface archaeological deposits if present. A total of 116 test pits each measuring 50 x 50 centimetres were excavated on a 20 metre interval grid across the investigation area. The deposit within the test pits was generally moderately deep, friable clayey loam overlying clayey silt and basal clay with deeper sandy deposits within the test pits excavated in the eastern portion of the investigation area adjacent to [redacted]. Several test pits excavated in the vicinity of the existing Fowlers Road corridor and within the area of disturbance identified in

the north-eastern portion of the investigation area contained a thin disturbed deposit that included road gravels and clay nodules above basal clay. A total of [redacted] artefacts were recovered during the test excavation program from one test pit (TP 155). TP 155 was located on an elevated flat on the eastern side of [redacted], between the [redacted]. A portion of the site was subsequently destroyed under an AHIP for the works. The absence of stone artefacts within the majority of the other excavated test pits was attributed to fluvial activity and past land use practices (Biosis 2015: 63).

[redacted] **Precinct**

Several archaeological investigations have been undertaken as part of the planning for the proposed redevelopment of rural properties adjacent to [redacted] between Horsley in the north, and [redacted] in the east and south (Biosis 2020; 2023). The investigation area, known as the Cleveland Road Precinct, included portions of the study area, around [redacted], Cleveland Road and Fowlers Road, traversing the floodplain landforms adjacent to [redacted] and several minor tributaries. The investigations included a review of previous archaeological investigations and environmental context, archaeological survey and test excavation.

The archaeological surveys identified two previously unrecorded isolated surface artefacts (CR IF 1-2), [redacted] Isolated find CR IF 1 was identified [redacted] The identified areas of PAD were situated on [redacted] No artefacts were identified within the current study area during the surveys; however, one of these areas of PAD (CR PAD 5) was identified [redacted]

A test excavation program was undertaken at seven of the identified areas of PAD (renamed as CR PAD 1 -7), with a total of 230 test pits investigated. [redacted]

[redacted] The test excavation program at CR PAD 1 consisted of 38 test pits that were excavated at 20 metre intervals along six transects. [redacted]

The test excavation program at CR PAD 2 (AHIMS 52-2-4582) consisted of 34 test pits that were excavated at 20 metre intervals along five transects. The area was located [redacted] Although the site was previously recorded on AHIMS as CR PAD 2 (AHIMS 52-2-4582) (Figure 4), it was nominated as site CR AD 4 following the test excavation (Biosis 2023: 51). As of August 2023 this additional recording is not registered on AHIMS.

CRS PAD 3 (described in the test report as CR PAD 3) was located [redacted]. A total of 45 test pits were excavated across three transects, with [redacted]. As of August 2023 this additional recording is not registered on AHIMS.

CR PAD 4 was located on [redacted] Previously registered AHIMS sites 52-2-1688 and 52-2-3831 [redacted] PAD 5 (AHIMS 52-2-3765, previously tested with no artefacts recovered see: Biosis 2010) were within the mapped CR PAD 4 area. A total of 24 test pits were excavated across five transects, with [redacted]

Artefacts consisted of a variety of raw material (chert, mudstone, petrified wood and quartz); artefact types present included flakes and flake fragments. The site was nominated as CR AD 5. As of August 2023 this additional recording is not registered on AHIMS.

CR PAD 5 (originally recorded during survey as CR PAD 3) was located on a flat to the [redacted] adjacent to the current study area, north of the historical railway easement. A total of 21 test pits were excavated across three transects on a 20 metre interval. Transect 1, located adjacent to the [redacted], exhibited significantly waterlogged conditions. No artefacts were recovered at CR PAD 5. [redacted]

CR PAD 6 (originally recorded during survey as CRS PAD 4) was located on [redacted] A total of 16 test pits were excavated across two transects on a 20 to 40 metre interval. [redacted]

CR PAD 7 (originally recorded during survey as CRS PAD 2) was located [redacted]. A total of 45 test pits were excavated across five transects at a 40 metre interval, with four artefacts recovered from two test pits. [redacted] The PAD was nominated as two distinct sites: artefact scatter site CR AD 8, and isolated find site CR AD 9. As of August 2023 these additional individual recordings are not registered on AHIMS.

The assessment noted that the results of the test excavation program and other assessments in the [redacted] catchment display some discrepancies with the results of the widescale assessment of the WDRA undertaken by AMBS. In particular, the presence of artefacts within the test pits excavated on alluvial flats within the [redacted] (62.5%) was noted as being significantly higher than recovered from more recent test excavation programs (Biosis 2020; 2023). The assessment determined that instead of a relatively frequent dispersed low artefact density across the alluvial flats within the [redacted] catchment, the investigation area contained localised low artefact density sites on these landforms (Biosis 2015: 48-49). The sites would consist of low density artefact scatters that contain low archaeological significance. The results were interpreted as indicating the alluvial plains were utilised by past Aboriginal people as a "resource gathering zone rather than areas of intensive occupation" (Biosis 2020: 49; Biosis 2023: 78).

Dapto Land Review

Archaeological investigations were undertaken within lands owned by [redacted] in the [redacted]. The investigation area encompassed the western portion of the current study area and the crest, flat, open depression and slope landforms of [redacted] The investigations included archaeological survey and test excavation.

[redacted]

An archaeological test excavation was undertaken at several of the identified areas of PAD including [redacted] WD2 AS01: WD3 PAD 07 (AHIMS 52-5-0772) and WD3 PAD 08 (AHIMS 52-5-0774). WD3 PAD 07 [redacted]

WD3 PAD 08 was located [redacted]

West Dapto Package 3 Water & Wastewater Servicing: Aboriginal heritage consistency and due diligence assessment
Kelleher Nightingale Pty Ltd was commissioned by Sydney Water to undertake a consistency and due diligence assessment of the proposed West Dapto Package 3 infrastructure in 2023. Consistency assessment was undertaken for infrastructure within the Project Approval Boundary and water infrastructure within the Project Approval Boundary (Water Only). Due diligence assessment was undertaken for the remainder of the proposed wastewater infrastructure outside the Project Approval areas. The assessment included background review and site inspection.

The majority of previous recorded sites within the AHIMS search area were [redacted]. Archaeological predictive modelling for the West Dapto Release Area and the WDURA and AGA Water and Wastewater Servicing project identified landforms within the study area in the vicinity of [redacted] and its tributaries as areas of high archaeological potential. However, the results from subsequent archaeological test excavations within the [redacted] catchment area indicated that while Aboriginal archaeological material is present within these areas, the Aboriginal archaeological sites containing stone artefacts situated on alluvial landforms adjacent to [redacted] contained low artefact densities that were limited in extent. The study area was also noted to have been subject to varying levels of subsurface disturbance from past land use practices. Construction of modified drainage channels, transport and utility corridors, and structures in addition to fluvial activity from [redacted] and its tributaries were considered likely to have disturbed the subsurface deposit in these areas.

Site inspection was completed along all sections of the proposed alignment. Overall, it traversed paddocks and several transport corridors including the [redacted] between the urban areas of Dapto and Horsley. Visible disturbance was generally low and limited to tracks and erosion scours while transport and utility corridors, dams, structures and creek channels exhibited high visible disturbance. The road corridor and rural properties exhibited high levels of visible disturbance and the ridge slopes were unfavourable for the preservation of subsurface archaeological deposits.

Large embankments of the former Illawarra Harbour and Land Corporation Railway Line which extended along an east-west orientation to a bend in [redacted], storage tanks, hardstand areas and rubble from associated structures were present within the rail corridor. The embankment also appeared to have modified the drainage within the area and created a swampy area where water had been funnelled through gaps in the embankment. The study area between the bend in [redacted] and Stockyard Crescent traversed elevated flats with low visible disturbance. An area of potential archaeological deposit (CR PAD 3) had previously been identified in this area across an elevated flat on the inside of a bend in [redacted]. Testing of the eastern part of the area (then referred to as CR PAD 5) (Biosis 2023) did not recover any artefacts however the field assessment determined that the CR PAD 3 area extended south across the elevated flats within the study area adjacent to the creek, from the bend to the confluence of several tributaries, on the basis of better landform and low levels of visible disturbance. This area corresponds with one of the high sensitivity areas identified by Biosis in the WDURA project EA and falls within the current WD3 Part 3A study area.

The alignment also traversed several elevated terrace landforms adjacent to [redacted]s. These landforms were identified as areas of PAD and designated '[redacted]' on the basis of landform and low levels of visible disturbance. This area corresponded to the high sensitivity zone previously identified by Biosis in the WDURA project EA and falls within the current WD3 Part 3A study area. An additional area of potential archaeological deposit (CRS PAD 4) had also previously been identified across an elevated flat adjacent to [redacted] within the south-western portion of the assessment area. The visual inspection determined that the area of PAD extended to the east and west across similar landforms within the assessment area on the basis of landform and low levels of visible disturbance. This PAD area also incorporated the majority of the portion tested as CR PAD 6 by Biosis in 2023 and subsequently identified site CR AD 7. This PAD is not within the current WD3 Part 3A area.

No surface artefacts were identified during the visual inspection of previously recorded site WD2 AS01 (AHIMS 52-5-0917). The site area [redacted] had been disturbed by a drainage channel and was assessed as having low archaeological potential. The landform on the [redacted] had been disturbed by the construction of a driveway and residential structures in addition to landscaping. The portion of the crest and adjoining saddle landform extending north from the road was assessed as having the potential for subsurface archaeological deposits based on low levels of visible disturbance and nearby test excavation results from WD3 PAD 07 and 08 to the north.

The alignment also traversed the previously identified CRS PAD 2 area. Visibility was low due to dense high grasses and no surface artefacts were identified. The area of PAD exhibited low visible surface disturbance beyond the road corridor and adjacent utilities corridor, stockyards and dam. The assessed CRS PAD 2 area encompassed the higher ground of the spur crest and did not include the portion previously tested as CR PAD 7 (Biosis 2023) and subsequently identified as archaeological site CR AD 8 however it did include CR AD 9.

Overall, the assessment identified one Aboriginal archaeological site and four areas of PAD that were located at least partially within the assessment area. The results of the assessment were consistent with the findings of the Project EA and other previous archaeological investigations which have identified Aboriginal archaeological sites on elevated alluvial landforms bordering the larger creek corridors and ridge crest landforms.

Recommendations for the project were developed based on whether identified sites/PADs were within the existing Project Approval and the nature of the proposed impacts based on the proposed infrastructure alignments. They were as follows:

- [redacted] and CR PAD 3 fell within areas listed in the EA as displaying high sensitivity. In accordance with the Conditions of Project Approval, further investigation of these areas in the form of a test excavation was required if they could not be avoided by the proposal. [The current report addresses the requirement for test excavation within [redacted]. Testing within CR PAD 3 was undertaken as part of the WD3 REF assessment (refer KNC 2023b). No artefacts were recovered and it was determined the area is not an Aboriginal archaeological site. Additional test excavation for the WD3 Part 3A works was therefore not required.]

- CRS PAD 2 was primarily outside the Project Approval Boundary and these landforms were not originally assessed as part of the EA sensitivity mapping. Previous testing within the lower part of the PAD established the presence of Aboriginal objects (outside the study area). The portion of the remaining PAD was considered to display high archaeological sensitivity and its identification was consistent with the predictive model used by Biosis during assessment for the EA. Further investigation of this area in the form of a test excavation was recommended if it could not be avoided by the proposal, consistent for the Project Approval requirements for areas of high sensitivity. [NB subsequent changes to the project and division of works between Part 3A/REF sections have removed potential impacts to CRS PAD 2, see Section 4.4 below].

- [redacted] (AHIMS 52-5-0585) was not an Aboriginal archaeological site and required no further investigation or assessment.

- CRS PAD 4 and WD2 AS01 were located within the Project Approval Boundary (Water Only); however, potential impact to these archaeological features at that stage of project planning was to be from the REF wastewater alignment, which was not included in the existing Project Approvals. If CRS PAD 4 and WD2 AS01 could be avoided, no further assessment would be required for the portion of the study area outside the relevant Project Approval area and according to the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010b) the proposed works could proceed with caution in these areas.

- If CRS PAD 4 and WD2 AS01 could not be avoided, additional archaeological assessment would be required. Additional archaeological assessment would include a test excavation program to determine the nature and extent of any subsurface archaeological deposits and the impact of past disturbance on the deposits. Further archaeological assessment would be conducted in accordance with the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b). [NB subsequent changes to the project and division of works between Part 3A/REF sections removed potential impacts to WD2 AS01, see Section 4.4 below].

4.4 Archaeology within the WD3 Part 3A study area

Based on the review of background information, no previously recorded Aboriginal archaeological sites, artefacts or Aboriginal objects were located within the current WD3 Part 3A study area. Subsequent changes to the WD3 alignments and division of works between Part 3A/REF sections removed potential impacts to WD2 AS01 and CRS PAD 2 from the WD3 Part 3A works, and test excavation for the WD3 REF works confirmed CR PAD 3 does not constitute an Aboriginal archaeological site (KNC 2023b).

The WD3 Part 3A works therefore intersect one remaining area of high archaeological sensitivity/PAD: [redacted] of Archaeological Sensitivity. This was located on [redacted]. During the site inspection, the area was covered in short grass with patches of regrowth tall trees. Some small disturbances were observed due to informal tracks, stock trampling and installation of fences. The site occupation model for the area indicates that [redacted]

As identified by the findings of the consistency assessment, it was determined that test excavation of the area would be required under the conditions of Project Approval. Potential impacts to other Aboriginal archaeological features under the WD3 REF are considered in a separate assessment (refer KNC 2023b).

Figure 5. Due diligence and consistency assessment results (KNC 2023a) with current WD3 Part 3A study area.

5 Landscape Context

5.1 Geology and soil landscape

The Illawarra Coastal Plain is a subregion of the Sydney Basin. The Sydney Basin is a large geological feature that stretches from Batemans Bay north to Newcastle and west to Lithgow. The formation of the basin began between 300 to 250 million years ago when river deltas gradually replaced the ocean that had extended as far west as Lithgow. The oldest, Permian layers of the Sydney Basin consist of marine, alluvial and deltaic deposits that include shales and mudstone overlain by coal measures. Broughton Formation (Pshr) geology, a late Permian member of the Shoalhaven Formation underlies the ridge crests and slopes of the study area (Figure 6). Broughton Formation geology was the result of the influx and deposition of volcaniclastic and volcanic material into a marine environment and comprises feldspathic lithic sandstone, conglomerate, minor siltstone and intercalated volcanic rocks (Trigg and Campbell 2016: 185-186).

The lower lying areas of the study area adjacent to [redacted] and its tributaries contain deposits derived from deltaic, estuarine and alluvial landscape systems during the Quaternary Period as a result of the impact of climate, oceanographic regime and sea level variations on the geological setting (Troedson 2016). The Quaternary deposits form a mixture of fluvial sands, gravels, silts, clays and mud in various proportions and compositions depending on the associated depositional system. The study area is located within the non-tidal alluvial plain and is characteristic of the upstream parts of alluvial valleys. It traverses Quaternary floodplain (Qaf) deposits around [redacted] and its small tributary drainages consisting of silts, clays, fluvial sands and gravels; Quaternary alluvial and colluvial fans (Qavf) of fluvial sand, silt, gravel and clay located along sections of [redacted], a Quaternary terrace (Qat) formation north of the [redacted] confluence and an older Pleistocene alluvial terrace (QPat) south of this confluence. Younger Holocene deposits occur within the Holocene floodplain (Qhaf), located around [redacted] at the northern portion of the study area alignment, north of [redacted].

Soil landscapes within the study area are influenced by underlying the geology and topography of the landscape. The study area traverses the erosional Shellharbour and Albion Park soil landscapes, and the swamp Fairy Meadow soil landscape as characterised by Hazelton (1992).

The *Fairy Meadow Soil Landscape* (Hazelton 1992: 97-9) is present within the majority of the study area, located around [redacted] within the western portion of the study area, as well as around [redacted] (Figure 6). It is a swamp landscape located on alluvial plains, floodplains, valley flats and terraces below the Illawarra Escarpment, with relief <10 meters and slopes <5%. Underlying are Quaternary sediments, and soils are usually moderately deep alluvial loams on terraces, with podzolics on the drainage plains. On terraces soils consist of up to 20cm of massive brownish black sandy loam, occurring as topsoil (Horizon A), overlying >40cm of massive brown sand to sandy loam, occurring as both topsoil and subsoil (Horizon A and B) (Hazelton 1992: 98). Boundaries between soil layers may be gradual or clear. Swampy soils are at least seasonally wet, with water tables frequently close to the surface. Soil parent material includes large amounts of accumulated decayed organic matter.

The *Shellharbour Soil Landscape* (Hazelton 1992: 58-60) is present along a section of [redacted] in the western portion of the study area. It is an erosional landscape located on rolling low hills with long sideslopes and broad drainage plains, with relief 20-50m, slope gradient <20% and occasional rock outcrops. Red Podzolic soils occur on lower slopes and drainage plains, consisting of up to 40cm of dull reddish brown sandy clay loam overlying >50cm of brown heavy clay.

The *Albion Park Soil Landscape* (Hazelton 1992: 40-2) is present along [redacted] at the western end of the study area (Figure 5). It is also an erosional landscape, located on crests with short steep upper slopes grading onto long gently inclined footslopes, with relief 60-100m and footslopes gradients 5-15%. Moderately deep podzolic soils occur on crests, while shallow soloths occur on slopes and drainage lines.

Albion Park soils are principally derived from underlying Shoalhaven Formation geologies, while Shellharbour soils are derived from underlying volcanic lithic sandstones. Both soil landscapes are susceptible to localised mass movement and erosion hazards, with Shellharbour soils displaying a particularly high erodibility. The capacity of the three soil landscapes which occur within the study area to conserve archaeological deposits varies due to topography and the impact of natural processes and land use activities. Fairy Meadow soils often accumulate material from both colluvial and fluvial deposition processes, while Albion Park and Shellharbour soils are more frequently subject to surface movement and erosion, leading to a dissipation of sediment and exposure of often-decontextualised archaeological material within the eroding landscape. Archaeological integrity within the Fairy Meadow soils depends strongly on flooding and the effects of modern land use disturbance.

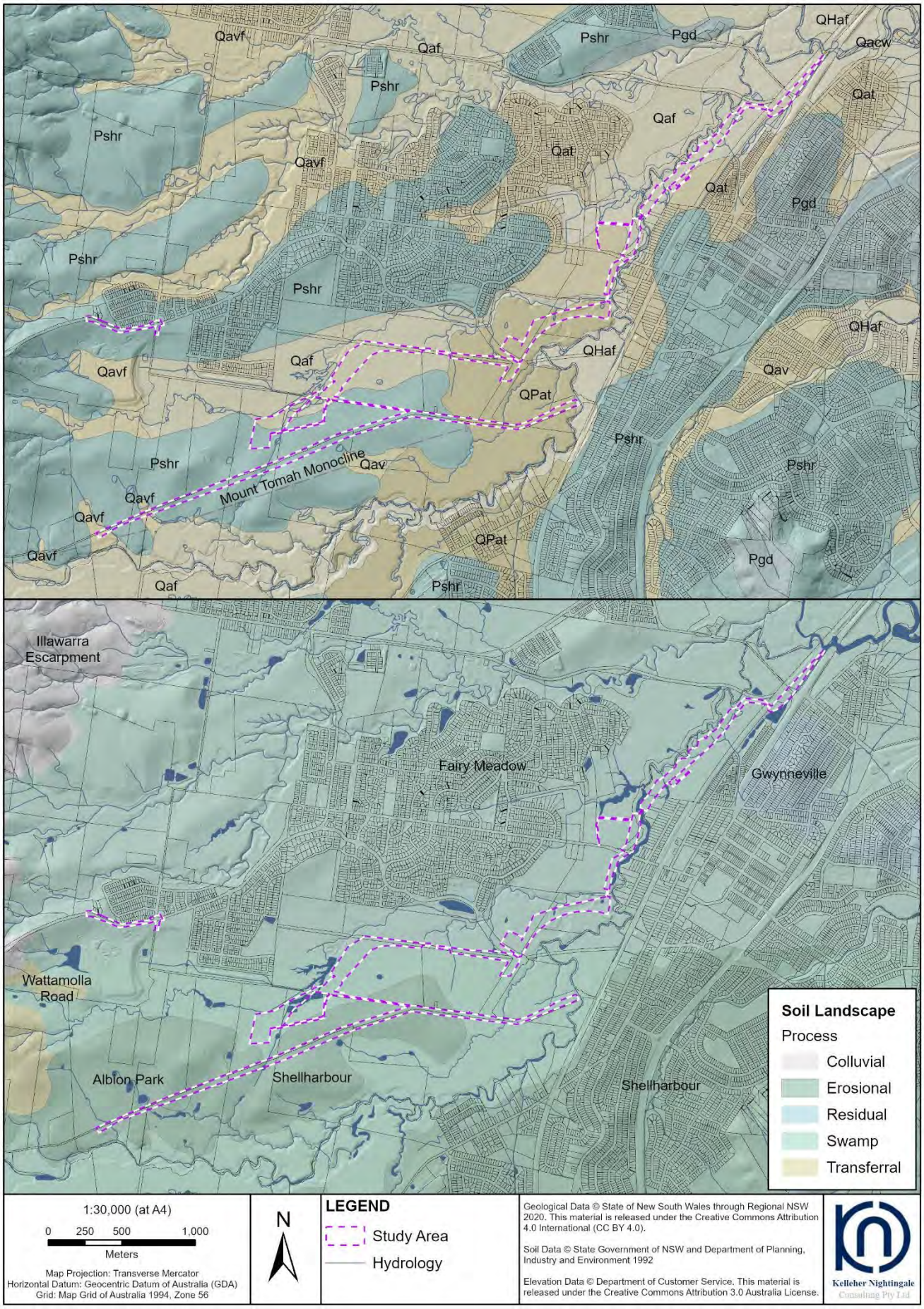


Figure 6. Geology and soil landscapes of the study area

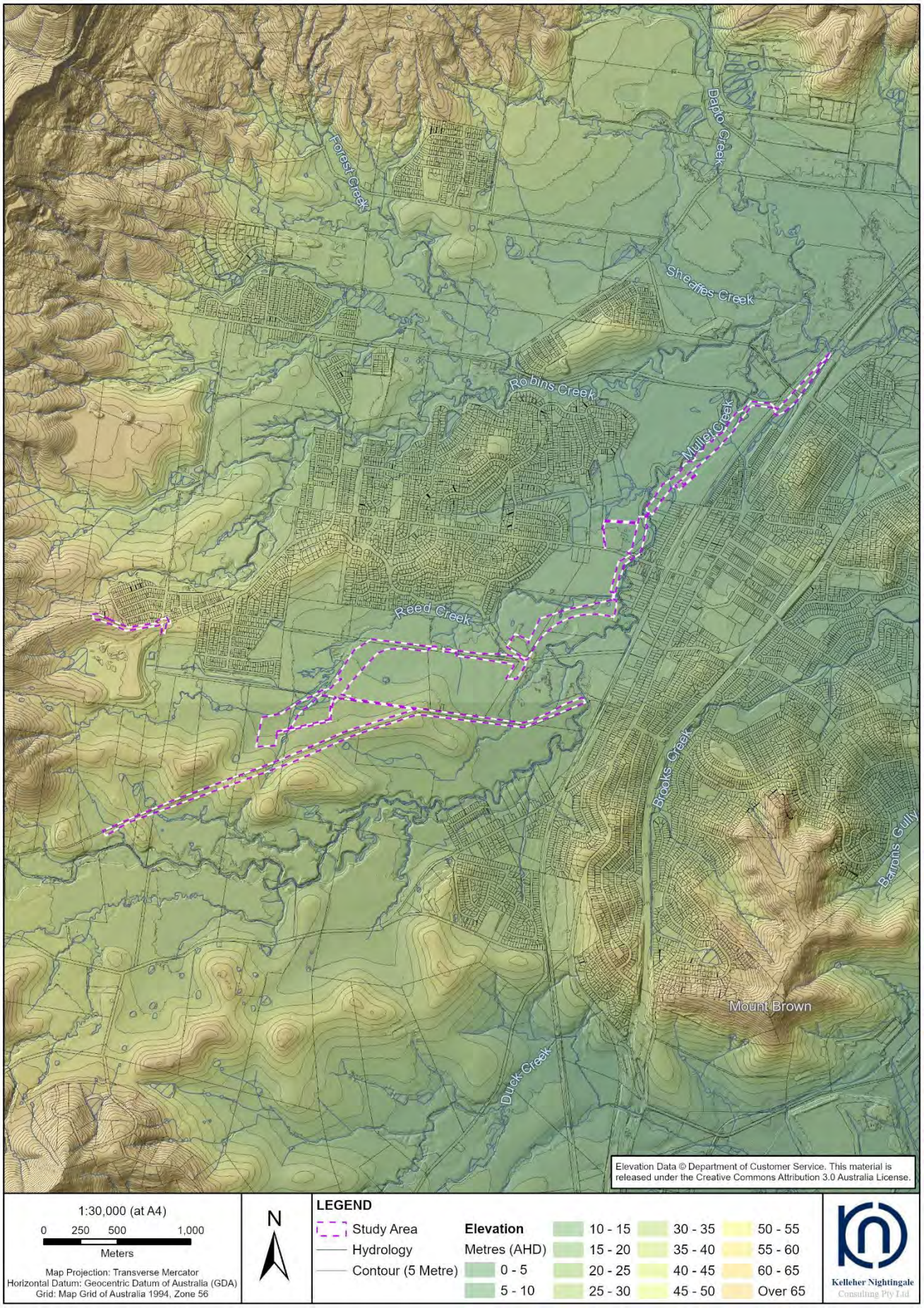


Figure 7. Topography of the study area

5.2 Topography and hydrology

The study area is located within the western portion of the Illawarra Coastal Plain. The Illawarra Coastal Plain encompasses the low rolling hills and broad drainage plains that separate the Illawarra Escarpment in the west from the Tasman Sea in the east. The study area traverses the catchment areas of [redacted] and several tributary creeks, including [redacted], [redacted] flows from its headwaters below the Illawarra Escarpment approximately 3.3 kilometres to the west of the study area in a generally east and north-east direction into Lake Illawarra, approximately three kilometres to the east of the study area. [redacted] is a 1st to 2nd order tributary creek that flows into [redacted] within the central section of the study area alignment. Hydrology of the region has been altered by historic and modern land use. Online dams, various drainage works and channelisation of sections of the waterways within the vicinity of the study area has altered the natural flow and flood regime of the local area.

The Coastal Plain below the Illawarra Escarpment is an undulating alluvial plain, with gentle to moderate slopes and extensive floodplains of the various waterways draining towards Lake Illawarra. The steep upper catchment conditions provide for dynamic flooding and geomorphic conditions: flooding is frequent and floods tend to be very flashy, with rapid rises and falls. The effects of flooding have been noted and investigated across the Lake Illawarra catchment from as early as the 1860s (Wollongong City Council 1976). Over time, the effects of vegetation clearance and increased rates of erosion and bank failure means channel width in certain reaches of the tributary streams is now up to three times as wide as previously recorded. Increased sedimentation loads and migration of the stream channels has also altered the nature and location of the watercourses.

Landforms within the northern part of the study area have been shaped by the development of this creek system and include alluvial flats within the creek floodplains, elevated alluvial terraces along the margins, drainage depressions, and gently to moderately inclined slopes leading up to broad, rounded crests and ridges (Figure 7). Steeper landforms occur in the south western part of the study area along Cleveland Road, which intersects a ridgeline running east into the alluvial plain. This ridgeline contains crests, saddles and moderately steep slopes off the spur crests overlooking the [redacted] floodplain below. The western end of the study area crosses the saddle of a small spur which runs south east from the main ridge.

5.3 Vegetation

Vegetation within the study area has been extensively modified by European land use practices. Prior to 1788, a mixture of native vegetation communities would have extended across the entirety of the Illawarra Plain with distribution determined by a combination of factors including soil, terrain and climate. The NSW National Parks and Wildlife Service (NPWS) in collaboration with other agencies and government bodies have produced bioregional assessment studies for specific areas in order to identify, describe and map vegetation communities and fauna habitats. These assessments were undertaken in order to provide an identification of conservation values. The study area is located within the Illawarra Escarpment and Coastal Plain assessment area (2002). The study area has been extensively cleared of native vegetation and is generally characterised by pasture grasses with scattered regrowth trees. Several remnant original vegetation communities (albeit somewhat degraded) have been identified. These give an indication of the natural resources that would have been available to past Aboriginal people in the area.

Coastal Grassy Red Gum Forest (MU23) (NPWS 2002: 126-8) occurs on undulating plains and escarpment foothills. It is mapped within and in the vicinity of the northern portion of the study area close to [redacted], as well as within some patchy areas around Cleveland Road and in proximity to [redacted]. The dominant component of the canopy is Forest Red Gum *(E.tereticornis)* and Narrow-leaved Stringybark *(E.eugenoides)*. Coastal Grey Box *(E.bosistoana)* is unique to this community. The ground cover features a dense cover of grasses and herbs including Kidney Weed *(Dichondra repens)*, Tick-trefoil *(Desmodium varians)*, Weeping Grass *(Microlaena stipoides* var. *stipoides)*, Scurvy Weed *(Commelina cyanea)*, Tussock *(Poa labillardieri* var. *labillardieri))*, Hedgehog Grass *(Echinopogon ovatus)*, Paddock Lovegrass *(Eragrostis leptostachya)*, Windmill Grass *(Chloris divaricate* var. *divarivcata)*, Bluegrass *(Bothriochloa decipiens)* and Chocolate Lily *(Dichopogon strictus)*.

Floodplain Wetland (MU54) (NPWS 2002: 208) occurs on broad depressions on alluvial soils in the [redacted]s. It is mapped within close proximity to the study area alignment around the natural swamps and depressions of [redacted] and its drainage network. Wetland reeds and rushes present include Bulrush *(Typha orientalis)*, Common Reed *(Phragmites australis)* and Tall Spikerush *(Eleocharis sphacelate)*. These wetlands might have once been extensive *Melaleuca* or Swamp Oak forests with only patchy swampy soils remaining. The extent of the wetlands varied depending on the climate, with areas contracting during dry periods and expanding during wet periods. Less dominant species include Common Rush *(Juncus usitatus)*, Water Ribbons *(Triglochin procera)* and Water Primrose *(Ludwigia peoploides* subsp. *montevidensis)*.

Lowland Woolybutt-Melaleuca **Forest (MU24)** (NPWS 2002: 129-31) forms a distinct component of the Illawarra Lowlands Grassy Woodland Endangered Ecological Community listed on Part 3 of Schedule 1 of the *Threatened Species Conservation Act (1995)*. This community is likely to have been extensively distributed across the flat plains and gentle

slopes at Dapto, at low elevations between 10 and 35 metres Australian Height Datum (AHD); however, extensive clearing has reduced this community to small fragmented patches of remnant vegetation. It occurs around [redacted] and in very small patches in proximity to [redacted]. This vegetation community is characterised by the presence of Woolybutt *(Eucalyptus longifolia)*, White Stryngybark *(E.globoidea)*, a dense subcanopy of White Feather Honeymyrtle *(Melaleuca decora)* and an occasional occurrence of Blackbutt *(E.pilularis)*. Grassy understorey is characterised by presence of Poison Rock Fern *(Cheilanthes sieberi)*, Hedgehog Grass *(Echinopogon caespitosus)*, Golden Star *(Hypoxis hygrometrica)* and Flax Lily *(Dianella longifolia)*.

Coastal Swamp Oak Forest (MU36) (NPWS 2002: 163-4) occurs in estuarine environments that include low-lying areas on the coastal floodplain and on fringes of lakes and lagoons; it is adjacent to the [redacted] within the study area alignment. This community supports a simple forest structure with only a mat of herbs, rushes and sedges covering the ground below a monospecific stand of Swamp Oak *(Casuarina glauca)*. The understorey characteristics can be variable depending on the balance of freshwater and brackish influences. Regular component of the understorey is Common Reed *(Phragmites ausutralis)*, with Sea-rush *(Juncus kraussii)*, and ground cover including Scutch Grass *(Cynodon dactylon)*, Scurvy Weed *(Commelina cyanea)*, Sea Primrose *(Samolus repens)* and Lesser Joyweed *(Alternanthera denticulata)*.

The study area has been affected by historical land clearing activities. Regrowth native vegetation is limited to the areas adjacent to creek banks and is scattered across the gentle slopes throughout the study area. The majority of the creek banks are covered in weeds and exotic plants introduced in the recent past.

5.4 Land use history

The first European free-settlers started arriving into the West Dapto area in 1816-1817, after Surveyor Meehan referred to [redacted] in his field-book toward the end of 1816. The name of the district was not as yet known as Dapto and the origin of the name is one of the great debates in the Illawarra's history. On the 5th December 1816 Meehan marked out 1,300 acres of the first land grant to Richard Brooks, a sea captain. His land, afterwards known as "Exmouth", had a frontage to Lake Illawarra from Brooks Creek to near Tallawarra, extending west to Mullet Creek, located adjacent to the current study area and visible on the Kembla Parish map (Plate 1: Portion Number 16). In the West Dapto area a grant was made to George Johnston in 1817, known as 'Macquarie Gift'. Other important early grants are echoed in the names of surrounding suburbs, including Avondale, Horsley, Penrose and Marshall Mount. Smaller lots of 100 acres were also granted to veterans along Dapto Creek.

The majority of the study area is located within the Parish of Kembla, within only the northern portion east of Mullet Creek within the Parish of Calderwood (with the boundary between the two parishes being the creek). Maps of both parishes outline the boundaries of the land grants in the study area (Plate 1). A land grant made to Colonel George Molle by Governor Macquarie on 11 September 1817, is located around today's Cleveland Road; the size of this grant was modest (300 acres) in comparison to other large areas granted by Macquarie in the area (such as the abovementioned 1300 acres to Richard Brooks). Molle was Lieutenant Governor of the Colony and Commandant of the Forces at that time, and Macquarie and he had been fellow campaigners in the Peninsular Wars. The other early land grant covering the study area was to George William Paul, 600 acres, covering the southern portion of the study area around Cleveland Road. To the immediate north of the George William Pal's land, 100 acres was granted to Rev. James Stack on 1 May 1839, while to the north of Molle's parcel of land, 200 acres was granted to James Blanch on 20 February 1839, and 300 acres to Edward Robert Stack (Rev. James' brother) on 20 May 1837, called 'Reed Creek'.

Road surveys conducted during the mid-19th century confirmed that the recipients of the grants either quickly disposed of the land to willing buyers or installed tenants with varying degrees of success. George William Paul, a Sydney merchant, disposed of his 600 acres even before the grant was issued. A series of subdivisions and conveyances then followed, until Maurice Fitzgerald bought 300 acres in 1841 and sold 145 acres soon after. It is assumed that he built the homestead, 'Cleveland House', a nearby European heritage item of local significance, listed on the Wollongong LEP 2009 (HI 5950). This historical building, from which the suburb got its name in 1993, is located south of the study area, north of Mullet Creek and south of its tributary. The house changed owners and tenants on numerous occasions, with the most prominent local resident/occupier being Maurice Madden, who bought it in 1888. He operated a dairy farm at the property until his death in 1909. Madden was one of the founding directors of the Dairy Farmers Co-operative Milk Company Limited, which produced and delivered milk for local Sydney markets. He was also described as "one of the most successful farmers in Illawarra" (*South Coast Times and Wollongong Argus*, 16 January 1909). The property changed owners twice in the 20th century until it was eventually sold to the Dapto Pastoral Company in 1974.

The suburb of Horsley was named after the property granted to Lieutenant William Frederick Weston of 500 acres located on Mullet Creek in 1818 (visible on Plate 1 north of Robert Edward Stack's land). He named the property "West Horsley" after his home in Surrey, England. West and his wife Elizabeth were the first free settlers to personally take up land in the Illawarra. After his early death in 1833, the land that was promised to him was finally issued by Governor Gipps to his daughters, Elizabeth Weston and Augusta Brooks on 13 March 1842, who divided the land into two properties, 'Horsley' belonging to Elizabeth, and 'West Horsley' belonging to Augusta.

In 1876 John Lindsay purchased 'Horsley' and five years later purchased 'West Horsley'; he named the entire property 'Horsley'. Lindsay was an outstanding dairy farmer in the Illawarra for many years and contributed greatly to the improvement of breeding of dairy cattle. The farm also made cheese and butter for which they won prizes at local shows and the first prize at the Royal Easter Show.

The part of the current study area that lies east of Mullet Creek is shown on the Calderwood Parish maps within two land grants. Portion number 18, located at the northernmost part of the study area (Plate 1) was the western part of 'Mullet Creek Farm', a grant of 300 acres given to George Brown on 1 May 1833. Another part of the 'Mullet Creek Farm' (Portion number 20) was located to the immediate north-east, consisting of 100 acres and fronting the southern banks of Mullet Creek. South of the 'Mullet Creek Farm' and north of Brooks Creek was a portion of 500 acres, granted to another person named also George Brown, referred to as George Brown II. It was granted at the same time, on 1 May 1833. His property was known as 'Daisy Bank', commemorated in the naming of the southern part of the Fowlers Road extension as Daisy Bank Drive.

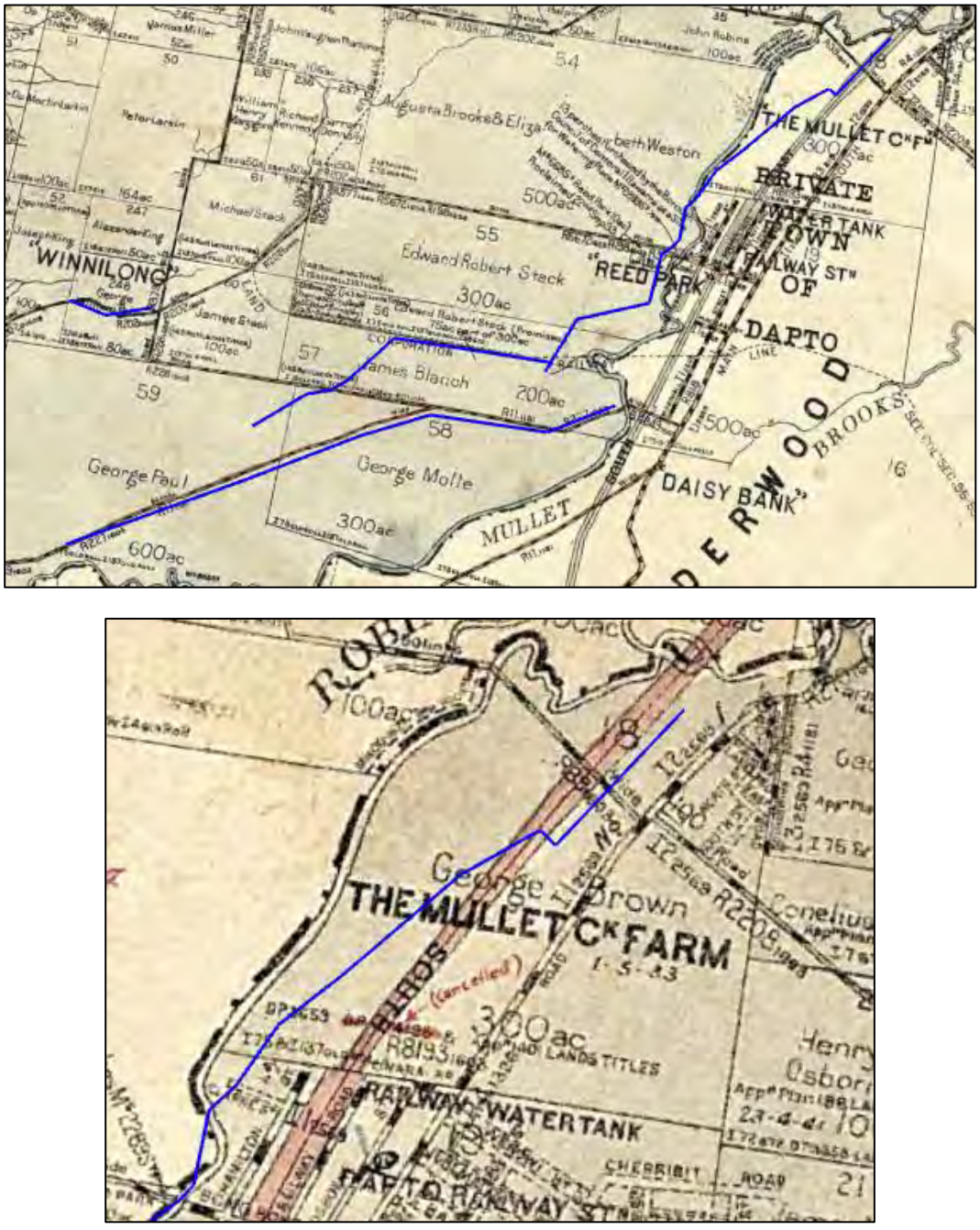


Plate 1. (Top) Kembla Parish Map, Land & Water Conservation reference number 138062. (Bottom) Calderwood Parish Map, Land & Conservation reference number 138051. Approximate location of the study area in blue.

A section of the study are alignment runs along the old Illawarra Harbour and Land Corporation Railway, shown on the Kembla parish map (Plate 1) and visible on an aerial photograph from 1966 (Plate 2, centre). The line was completed by 13 December 1895 originally to transport coal "from a colliery, later known as Fleming's Mine", located west of today's West Dapto Public School, to a proposed "harbour works at Lake Illawarra". However, in 1893 it was reported that "the prospect of Lake Illawarra being converted into a harbour, which three years ago appeared so bright, seems now to have altogether vanished" (*Wollongong Argus*, 16 August 1893), and the whole scheme was abandoned and never executed. It was thought that the rail carried only one train: that which carried a party for its opening (McDonald 1976: 70). After its abandonment, the crossing over the main line was removed in 1910 and local farmers moved in and squatted on the rail bed. Although small portions of the railway are still visible in some areas, no associated historical fabric of significance has been identified. Most of the Fowlers Road alignment east of the Princes Highway has been built on the foundation of this railway line.

Following the granting of early land parcels in the area, initial settlers' activities in the region included timber clearance and the development of mixed farming. Agricultural pursuits were focused on wheat farming between the 1840's and 1850's, with the establishment of various flour mills along the major creeklines of the region. The viability of the wheat industry was short-lived, eventually crippled by drought in the 1850's and the spread of rust. The frequent flooding of the alluvial plains where the crops were sown also contributed to the decline. Dairying eventually took over as the primary agricultural pursuit, with the Dapto area particularly suited to this activity due to the cool damp climate and lush pastures. The use of cattle for the production of beef and milk increased after 1887. Producers supplied various local butter and cheese factories located close to the transport link provided by the railway. Dairying throughout West Dapto continued through the 20th century leaving a significant imprint on the cultural landscape. Mining and industrial pursuits also left their mark on West Dapto in the form of the Dapto Smelting Works and Wongawilli Colliery and village.

Following soon after European arrival and the establishment of the first farms on granted lands, the local landscape started to change rapidly, mainly for agricultural purposes. Activities included land clearing, grazing and dairying. Review of historical aerial photographs (Plate 2) indicates that the area has previously been stripped of native vegetation with only areas around Mullet Creek covered in trees and patchy areas north of Cleveland Road. As the population increased and land use intensified, land was subdivided into smaller lots, formal roads established with infrastructure, and many residential and farm outbuildings were also constructed. The area within the current Reed Park was already modified and used for most likely sporting activities as a large oval is discernible on the early aerial (Plate 2). Waterways, including Mullet Creek and Reed Creek and their small drainages were altered, and dams were constructed in order to control flood events and capture water for agriculture. The anabranch of the Mullet Creek north of Bong Bong Road is clearly visible as well as small drainages and anabranches to the north of the study area (Plate 2, centre and middle images). Historical aerial photos indicate the broad changes in the landscape, including vegetation clearing, infrastructure and establishment of formal and informal roads. Numerous small dams that are currently associated with Reed Creek are not visible on the aerial from 1961 indicating they were constructed/modified during the last 60-65 years.

Overall, the entire study area has been subject to some level of historical disturbance, varying in its nature and intensity. Portions of the proposed alignment located within the road corridors have gone through significant disturbances resulting from existing utilities and infrastructure installation, road construction, and driveways to rural residential dwellings. Significant earthworks would have caused outright removal/displacement of any cultural material that might have been present in these areas. These areas would have very low to nil archaeological potential for any subsurface archaeological material. Minor to moderate disturbances in the recent past include vegetation clearance and low to moderate intensity agriculture. Natural disturbance factors such as erosion and soil movement, particularly in higher gradient areas where clearance of original vegetation accelerates erosion, gully and stream bank erosion (incision) along the waterways, and the effects of flooding and alluvial processes along the creeks, including reworking of older alluvial deposits and more recent creek systems particularly around Mullet and Reed Creeks, would have caused replacement/removal and mixing of subsoil deposits.

Plate 2. 1966 aerial photograph, (top-bottom) northern, central and southern sections. Approximate location of the study area in blue. NSW Government Spatial Services, 2023

6 Regional Character and Predictions

Previous archaeological field surveys and excavations across the region have provided data on artefact distribution, site typology and lithic raw material use that assist in considering what may be expected archaeologically-speaking to occur within the study area.

Aboriginal occupation of the wider Sydney region is likely to have spanned at least 20,000 years, although dates of more than 40,000 years have been indicated from artefacts found in gravels of the Cranebrook Terrace on the Nepean River. Late Pleistocene occupation sites have been identified around the fringes of the Sydney Basin and from rock shelter sites in adjoining areas: dates of 13,000 BP at Shaws Creek in the Blue Mountain foothills; 11,000 BP for Mangrove Creek and Loggers Shelter and c. 20,000 BP at Burrill Lake on the South Coast (Attenbrow 2002).

The Illawarra region provides a number of resources used by Aboriginal people. Ethno-historical information indicates that the area was occupied by speakers of the Dharawal language group. Tangible evidence of this occupation is reflected across the Illawarra Coastal Plain by numerous recorded sites in the region. Open sites predominate, as the underlying geology of the Coastal Plain is not conducive to the formation of rock shelters or outcropping suitable for grinding grooves. Artefact occurrences, detected as isolated finds or surface and/or subsurface archaeological deposits, the most common site type in the region. Previous studies have demonstrated the relationship between artefact densities and landform utilisation. Relatively elevated landforms along the margins of creeks, especially those offering permanent water, and wetlands, or along the crests of spurs and ridgelines, would have been favourable for occupation by Aboriginal people. Sites tend to be situated at or close to ecotones – the areas where different environments meet. This is reflected in the archaeological record by higher artefact densities recorded at these sites, potentially reflecting repeated or more intensive use of these locations. Ridge and spurlines, which afford effective through-access relative to the surrounding landscape, tend to contain more frequent and larger sites. The crests of low relief spurs that extend into and across valley floor flats are likely to be a focus for occupation due to their well-drained and elevated context in close proximity to a range of exploitable environments. Isolated finds can occur anywhere across the landscape and may represent deliberate discard of artefacts, random loss or the remains of dispersed artefact scatters.

Previous archaeological assessments have shown that certain landforms have a higher likelihood of retaining subsurface archaeological deposits. The model that has been postulated for the WDRA area indicates that the highest artefact densities could be expected along 2nd order streams, followed by 1st order streams, spur crests and hillslopes (AMBS 2006: 244). The current study area was mapped as an area of high archaeological potential (AMBS 2006: Figure 25a), as Mullet Creek is one of the creeklines that provided a permanent source of water and the area is located within the elevated alluvial flats suitable for camping (AMBS 2006: 266). This is often reflected in the archaeological record by higher artefact densities recorded at these sites, potentially reflecting repeated or more intensive use of these locations.

The Aboriginal heritage assessment undertaken for the WDURA EA (Biosis 2012) included a desktop level assessment of Aboriginal archaeological sensitivity within the Concept Approval Area which was refined for the Project Approval Area following field survey. The sensitivity assessment was based upon previous studies in similar landscapes, known sites within the region, the predictive model developed for the study, knowledge of recent land use and the results of the field survey. The current study area falls within an area initially mapped as 'high archaeological sensitivity' on the desktop-level Concept area mapping (Biosis 2012: Figure 8), and between two areas of 'high archaeological sensitivity' on the subsequently more refined Project area mapping (Biosis 2012: Figure 50). These areas were defined as "Areas associated with major creek lines, raised flat landforms such as ridges and hills, where disturbance has been minimal and it is believed that an intact sensitive landscape exists". The high sensitivity areas identified in the EA generally correspond to CR PAD 3 and the Mullet Creek Area of Archaeological Sensitivity as identified in Figure 5. Subsurface archaeological deposit may therefore be expected to occur within the study area, however is likely to be variably affected by disturbance factors, and requires further assessment including test excavation to characterise its nature and extent.

Regional archaeology has been variably impacted by historical and current land use practices as well as by natural processes. Preservation of archaeological sites in open contexts is difficult because of the adverse effects of erosion, floods and disturbance from various human activities. Conversely, ground surface visibility is often increased by these processes, leading to increased identification of artefacts in these areas. Previous studies have underscored the relationship between particular landforms and ground disturbance as key factors in the location of archaeological sites. High value archaeological sites will occur where significant soil deposits remain largely intact and archaeological context is preserved, notwithstanding artefact frequencies. The current study area has been used in the recent past for mainly pastoral activities. This is likely to have involved shallow surface disturbance through vegetation clearance, ploughing, stock trampling and erosion. These activities will have an impact on the survival of and level of preservation of Aboriginal sites, causing some disturbance to sub-surface archaeological deposits but unlikely to have removed them in their entirety. Areas that have been cleared, ploughed or areas which have been gone through fluvial disturbance would still contain archaeological material, but would lack spatial or vertical integrity. The most likely site types to be present in the study area are therefore low to moderate density artefact scatters. It can be expected that higher-value archaeological deposit will be restricted to areas where these disturbances are limited.

7 Archaeological Test Excavation

The Aboriginal heritage due diligence and consistency assessment undertaken for the West Dapto Package 3 works (KNC 2023a) identified two areas of archaeological sensitivity likely to be impacted by the WD3 Part 3A works: CR PAD 3 and [redacted] Area of Archaeological Sensitivity. It was determined that further archaeological investigation of these areas would be required in accordance with the conditions of Project Approval.

Testing within CR PAD 3 was undertaken as part of the WD3 REF assessment (refer KNC 2023b). No artefacts were recovered and it was determined the area is not an Aboriginal archaeological site or area of high archaeological sensitivity. Additional test excavation for the WD3 Part 3A works was therefore not required and this area is not considered further for the current assessment.

The WD3 Part 3A works thus intersected one remaining area of high archaeological sensitivity/PAD: [redacted] of Archaeological Sensitivity. This was located on elevated, terraced alluvial flats along [redacted], a third order creek line and a permanent water source.

Test excavation was consistent with existing recommendations developed by Biosis for the WDURA project, namely that areas identified as displaying high archaeological sensitivity would require further assessment prior to any potential impacts from the project. Archaeological test excavation was carried out by KNC in May 2023, in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a) ('*Code of Practice*'). Aims, methodology and results of the test excavation program are presented below.

7.1 Aims

The primary aim of the test program was to determine if intact archaeological deposits were present, and to assess the nature, extent and significance of any deposits. Testing excavation focused on defining the boundary of any subsurface archaeological deposit in relation to artefact distribution and disturbance from land use practices or natural processes.

This information is of assistance in interpreting the archaeological landscape that remains in the study area and aids detailed planning and management of the archaeological resource and potential impacts from the project. The sampling area was restricted to ensure an adequate sample without having significant impact on the archaeological value of the any identified sites.

7.2 Methodology

The test program was undertaken in accordance with the existing Project Approval and test excavation methodology for the Project as per the Biosis report, and the *Code of Practice*.

Field methodology was developed and carried out in accordance with Requirement 16a of the *Code of Practice* and the existing excavation methodology for the project in Biosis 2012. The test excavation program was specifically designed to target questions of artefact survivability through assessing the intactness of the deposit. The proposed test area was vegetated with short exotic pasture grass species with patchy areas of native regrowth vegetation. Land use in the area has included farming, grazing and other agricultural practices. As a result, the area has been exposed to mild disturbance.

The [redacted] Area of Archaeological Sensitivity ([redacted] AAS) is located on a range of distinct alluvial flats and elevated terraces adjacent to [redacted]. These terraces and elevated flats were separated by Bong Bong Road and a series of small drainage lines that flow into [redacted] from the south, east and west across the study area alignment.

Test transects were placed across these areas and within the area of proposed impact in order to determine the location and extent of any archaeological deposits. Test excavation focused on assessing the boundary of the archaeological areas in relation to the impact corridor and assessing the portions of the landform areas which had no archaeological exposure. NB: the proposed impact corridor has been refined following the test program – Figures 28-29 show the test excavation results using the previous study area corridor which was current at the time of the fieldwork.

At each test excavation area, a site datum was recorded and test excavation units were spaced along transects at 10-40 metre intervals. In accordance with the project methodology and the *Code of Practice*, each test excavation unit measured 50cm x 50cm and squares were evenly distributed to sample the extent of the area. The coordinate of the north west corner for each excavation unit was recorded using a handheld GPS receiver in GDA 94 Zone 56. The test units were then given the name 'TS' for Test Square, followed by an arbitrary unique identifying number (e.g. TS 1, TS 2, TS 3).

Plate 3. [redacted] AAS at Reed Park, facing south-west, flagged TS 4, 5 and 6. [redacted] banks to the left and artificial channel marked in foreground.

Plate 4. View south east across floodplain and elevated flat west of the [redacted] anabranch, and terrace in the distance; excavation in progress at TS 14 at right, and at TS 17 and 18 on the terrace in the distance.

Plate 5. Terraces along the eastern side of [redacted], facing north; flagged TS23 and 26, excavation in progress at TS 24 in the distance.

Plate 6. Terrace at the northernmost portion of [redacted] AAS, flagged TS 40 in the foreground, facing south east, drainage lines demarcating terrace to the left and right.

The first excavation unit was excavated in 5cm spits onto a culturally sterile deposit. Based on the results of the first excavation square, subsequent squares in each area were excavated in either 5cm or 10cm spits until culturally sterile soils were reached. The information from each test excavation square, including a detailed deposit description, excavated features and unit depths, was recorded by the excavators onto standardised excavation unit recording sheets. At the end of the excavation program, all squares were photographed and soil section profiles were drawn.

All excavation was undertaken using hand tools. Care was taken during the excavation to have as minimal impact to surrounding vegetation as possible. All excavated material was placed in buckets and sieved as close to the test square as practical. All excavated soil was dry sieved using a combination of nested 5mm and 2.5mm wire mesh screens. Artefacts retrieved from the excavation were retained for further analysis (see Appendix B, Lithics Database). Where artefacts were identified during excavation (i.e. *in situ*), measurements were taken of the artefact's position and depth in the excavation unit, as well as its relation to any other features such as charcoal, baked clay, tree roots or other evidence of disturbance. All test squares were backfilled with the sieved soil from that particular test square. The surface grass and its roots were carefully placed/replanted on top of the backfilled test excavation units after excavation. The excavation took place between 9 and 19 May 2023.

7.3 Results

Test excavation at [redacted] AAS aimed to determine if subsurface archaeological deposits existed within the area of impact and to test their integrity, extent and significance. A total of seven distinct terraces and areas of elevated alluvial flats were tested; these were separated by either natural drainage lines or existing roads. The nature and extent of observed disturbance varied in relation to previous land use and natural factors. Test transects were placed in areas of lower apparent disturbance and were within the proposed impact area. NB: the proposed impact corridor has been refined following the test program – Figures 28-29 show the test excavation results using the former study area corridor which was current at the time of the fieldwork.

The southernmost portion of the [redacted] AAS was located within the eastern part of [redacted], south of [redacted]. The alluvial flat landform extended from [redacted] in the north to the [redacted] confluence in the south (Plate 8). The entire area was within a significantly modified landscape due to the installation of sports fields; the area was flat with dry turf and grass cover. An above ground transmission line runs north-south across the study area with transmission poles located along its eastern boundary. One small artificial cut drainage channel ran north-south from Bong Bong Road to the [redacted] dam located at the centre of the study area alignment (Plate 3). Another small drainage was also noted running east into the dam. Review of the historical aerial (Plate 2) indicates that modifications to [redacted] have taken place during the recent past however the extent of these could not be observed on the surface. The creek banks were covered in dense regrowth native and exotic vegetation, with very few mature trees. A total of 10 test squares were placed on a 20 to 40 metre interval across the area of impact along the western side of [redacted]. One test square (TS 5) was placed between [redacted] and the artificial channel in an area that was slightly more elevated in order to establish if natural soils adjacent to the creek banks were still present. The area to the south of [redacted] is a distinct elevated flat between [redacted] to the east and a channel to the west and south; three test squares (TS 1-3) were placed in this area, with TS 3 located within the vegetated strip adjacent to the creek banks (Plate 7).

Plate 7. South of Bong Bong Road, excavated TS 1 in the foreground, excavation in progress at TS 2 in the background, marked location of TS 3 to the left adjacent to [redacted] banks, facing south.

Plate 8. Alluvial flat at the southern end of Reed Park, north of [redacted] confluence, facing south, excavated TS 8 in the foreground, with excavation in progress at TS 9 and 10 in the background.

The portion of [redacted] AAS located north of Bong Bong Road was within landforms associated with [redacted] and a former anabranch, extending north east from Bong Bong Road for approximately 240 metres. Landforms included floodplain and a slightly elevated flat to the west of the anabranch channel, and a terrace between this anabranch and [redacted] proper (Plate 4). The very low lying floodplain landform was overgrown in medium grass cover with a few informal vehicle tracks running from west-east and north-south. A total of three test squares were placed in this area (TS11-12 and 16) on a 40-60 metre interval. The western boundaries of the study area were located across a slightly elevated flat where three further test squares were placed on a 10 to 40 metre interval (TS 13-15) (Plate 9). The area to the south of TS 15 was noted to have been subject to previous disturbance evidenced by undulating ground and mounds of soil; therefore, no test excavation was completed in this section. A total of five test squares (TS 17-21) were placed on the terrace between [redacted] and the anabranch channel to the west. Test excavations were limited to the area of proposed impacts, with one test square (TS 20) placed within a small strip of raised land to the immediate south of the anabranch confluence (Plate 10). The entire area was covered in short cut pasture grass with trees limited to around creek banks.

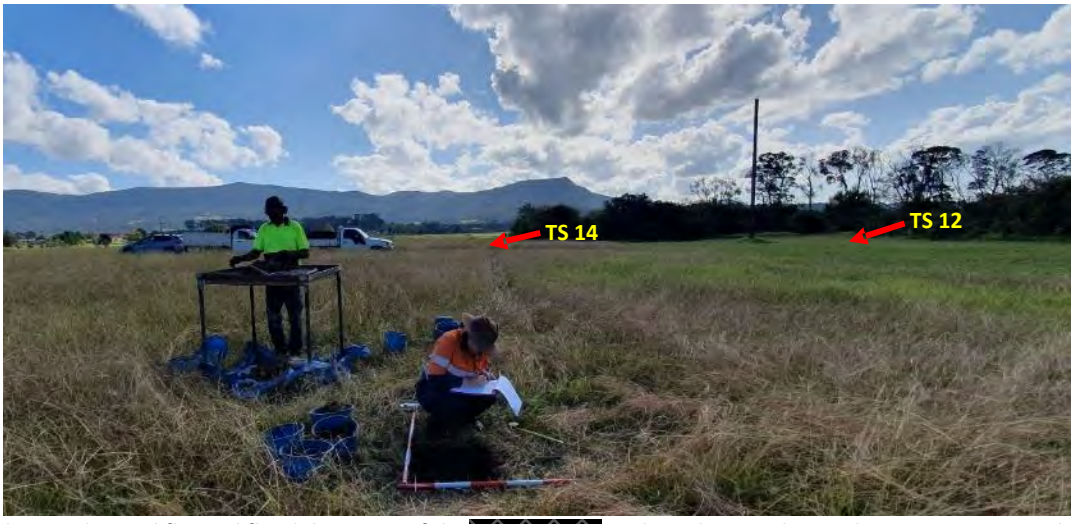


Plate 9. Elevated flat and floodplain west of the [redacted] anabranch, recording and sieving at TS 15 in the foreground, flagged TS 14 and 12 in the background.

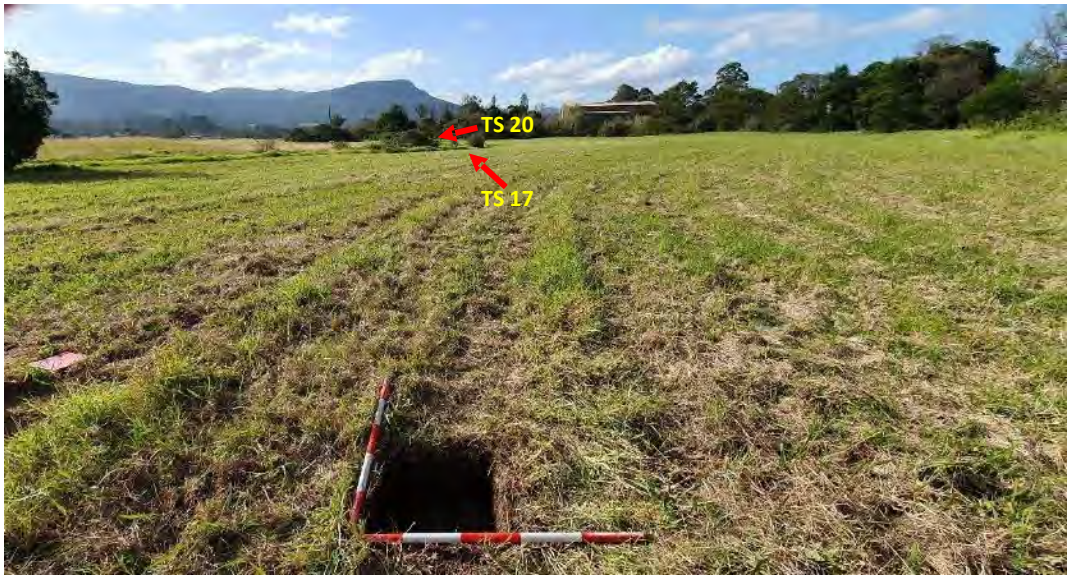


Plate 10. Terrace between [redacted] and its anabranch, facing south, excavated TS 18 in the foreground, with flagged TS 17 in the background and excavation in progress at TS 20 in the distance.

On the eastern side of [redacted], four distinct terraces located north of [redacted] and west of [redacted] were subject to test excavation as part of the identified [redacted] AAS. The terraces were separated by small drainage lines, all part of the [redacted] catchment running mainly north-west or west into the creek. A few small dams were also constructed on some of these drainage lines for pastoral uses. Review of early aerials indicated that the majority of these drainage lines were natural landscape features, with only one likely to be artificial. This section of the test area was extensive, covering an approximately 450 metre stretch of the creekside landforms.

The southernmost terrace was bordered by a residential area to the south and a small drainage line to the north (Plate 11). It was covered in short pasture grass with a few regrowth trees scattered and denser cover located around the creek banks. Visible disturbance included an existing sewer alignment and a fenceline, both running west-east. A total of seven test squares (TS 22-28) across two transects were placed on a 20 to 40 metre interval. All transects were oriented south-west – north-east following the proposed alignment orientation. Two transects 20 metres apart were placed south of the fenceline with a total of five test squares (TS 22 – 26), while one transect with two test squares 20 metres apart was placed north of the fenceline (Plate 11).

One test square (TS 29) was placed on a very small terrace demarcated by two small drainage lines, one running east-west and one slightly larger with a small dam running south-north into [redacted] (Plate 12). The entire terrace was covered in short pasture grass with no noted areas of disturbance and trees located around the creekline. The relatively large terrace to the north was transected by a small artificial drainage line running east-west associated most likely with an observed vent pole. Three test squares (TS 30-32) were placed south of the drainage line, while six test squares (TS 33-38) were placed north of the drainage line (Plate 13). All test squares were placed on a 20 metre interval, with one test square (TS 38) placed ten metres to the east in order to adequately test the proposed impact area across the landform. The terrace was covered in short pasture grass with a few informal pedestrian and animal tracks throughout that have resulted in some surface erosion and mixing of the sandy soils.

Plate 11. Terrace on the eastern bank of [redacted], facing north, excavated TS 22 in the foreground, with excavation in progress at TS 25 to the right and flagged TS 23 and 24 in the background.

Plate 12. Two terraces on the eastern side of [redacted] facing north: excavated TS 28 in the foreground, with excavation in progress at TS 29 on a separate terrace in the background.

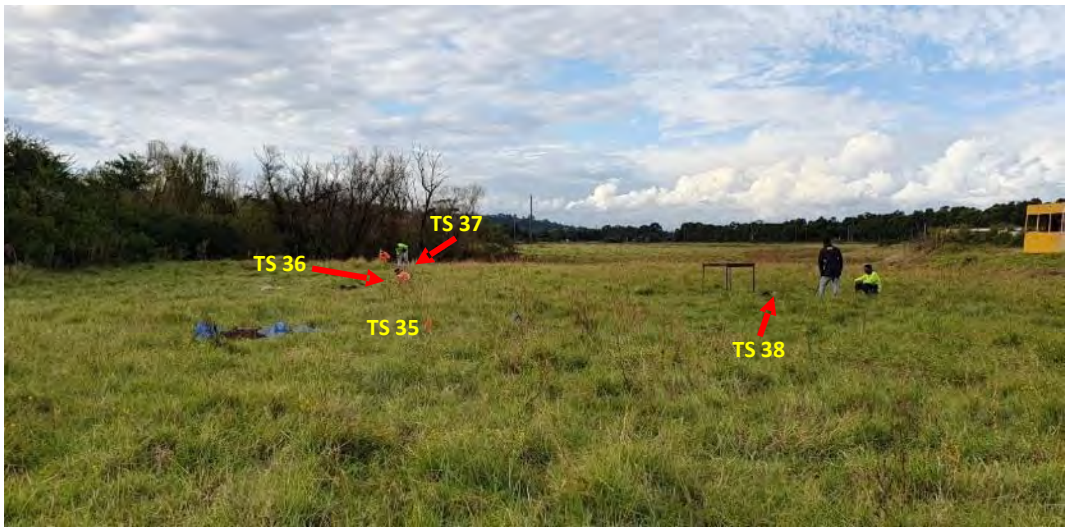


Plate 13. Terrace north of the artificial drainage, facing north; excavated TS 35 in the foreground, recording at TS 36 and excavation at TS 37 in the background, flagged TS 38 to the right.

The northernmost portion of the [redacted] AAS was located on a terrace approximately 160m long to the south of Darkes Road. The terrace is located adjacent to sections of small former anabranch channels off the main creek, which bend into almost oxbow formations and currently form low-lying swampy closed depressions. Review of historical aerials confirm these are natural drainage features and likely represent former creek channels; review of the Calderwood Parish map indicates this section of [redacted] may have migrated west (Plate 1). The drainage features had extensive erosion along their banks with the edges of the terrace also eroding. Another small drainage is located to the south of the terrace (Plate 6). A total of four test squares (Ts 39-42) were placed at both the eastern and western ends of the terrace. Two transects with two test squares each on a 20 metre interval were placed approximately 85 metres apart within the proposed impact area.

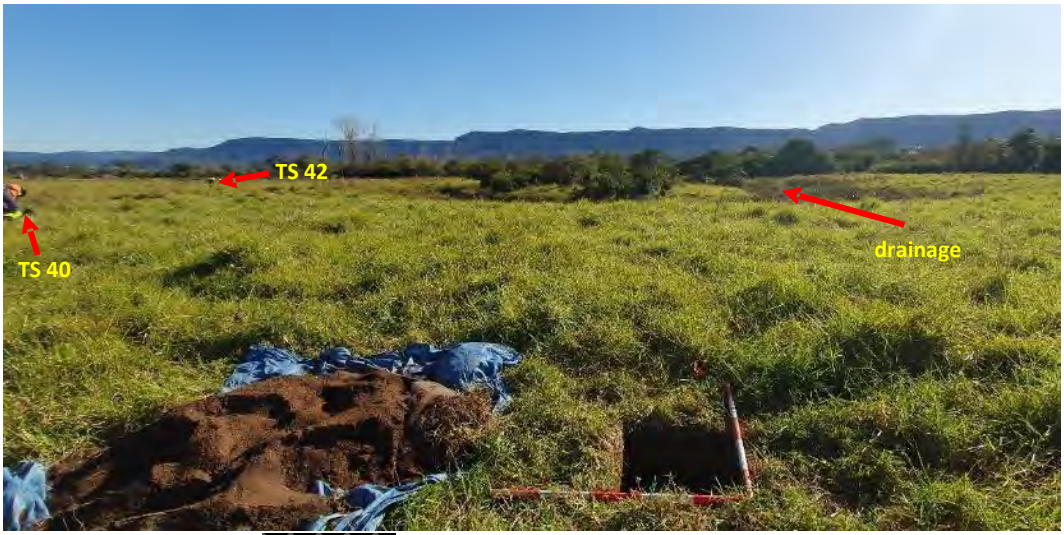


Plate 14. Terrace south of the [redacted] anabranch, facing south west, excavated TS 39 in the foreground, with excavation in progress at TS 40 in the background, and TS 42 in the distance.

7.3.1 Soils, stratigraphy and disturbance

The [redacted] AAS test area encompassed extensive alluvial flats and terraces along both sides o [redacted] Soil profiles varied significantly in relation to the nature and extent of both natural and anthropogenic processes.

Soil profiles within Reed Park were mainly found to be subject to previous disturbance stemming from significant land modifications throughout the park. Only one test square (TS 4) located further from the creek banks revealed a natural soil profile from 10cm depth consisting of yellow brown sandy loam to 20cm overlying yellow brown sandy clay to the clay base at 30cm (Figure 9). All other test squares revealed introduced fill material to the base (Figure 10-11) or mixed fill with some natural soils (Figure 8). The clay base was reached at an average depth of 20cm, with the shallowest soils recorded at TS 7 (10cm). Two test squares (TS 6 and 9) contained asbestos at about 5cm depth, and their excavation was ceased due to safety.

I. 0-14cm: Grey sand. Loose. Humic, frequent root systems. Diffuse boundary to:
II. 14-50cm: Mixed layer. Grey sandy silt with high sand content mixed with grey and yellow clay. High disturbed. Introduced fill material mottled with some natural soil. Abundant Fe/Mn, blue metal gravel, large rocks and gravel and decomposing sandstone fragments inclusions. Tree roots throughout. High compaction. Continuing to the base.

Figure 8. TS 3 west section and soil profile description

I. 0-2cm: Humic layer, frequent fine root systems. Turf grass. Diffuse boundary to:
II. 2-20cm: Dark red brown sandy loam. Low to moderate compaction. Green mesh included at 10cm depth covering the entire square. No other imported material at deeper layers. Infrequent small gravel inclusions. Diffuse boundary to:
III. 20-30cm: Yellow orangy brown sandy clay. Fe/Mn nodules <2% inclusions. Diffuse boundary to:
IV. Base: Yellow brown clay. Heavy. Plastic. High compaction.

Figure 9. TS 4 east section and soil profile description

I. 0-7cm: Humic layer, frequent fine root systems. Diffuse boundary to:
II. 7-22cm: Dark greyish brown loam. Introduced fill with some mixing of natural soil. Small blue metal gravel inclusions. Moderate compaction. Clear boundary to:
III. 22-26cm: Pale yellow sand. No gravel inclusions. Loose. Clear boundary to:
IV. 26-30cm: Dark brown clay. Some loam content. Gravel and blue metal inclusions. Clear boundary to:
V. Base: Dark brown clay. Plastic. High compaction.

Figure 10. TS 5 south section and soil profile description

I. 0-3cm: Humic layer, frequent fine root systems. Diffuse boundary to:
II. 3-19cm: Greyish brown sandy loam. Low compaction. Infrequent nodules of ironstone/manganese <2cm ~1%. Clear boundary to:
III. 19-34cm: Pale grey, almost bleached, sandy clay loam. Increased content of yellow brown clay. Size and frequency of ironstone/ manganese nodules to ~50%. Diffuse boundary to:
IV. Base: Yellow brown mottled clay. Scattered roots still visible, bioturbated.

Figure 11. TS 8 west section and soil profile description

Soil profiles encountered across the alluvial flats and floodplain north of Bong Bong Road on the western side of [redacted] and its small anabranch were relatively homogenous and uniform. They were shallow and consisted of dark brown clay loams with higher moisture revealed within the floodplain (Figure 12). The alluvial flat, although on a slightly higher elevation than the floodplain, also had shallow moist clay loams with some gravel overlying basal clays at an average depth of 20cm (Figure 13-14).

Test squares excavated on the terrace between [redacted] and its anabranch revealed soils of varying depth and texture. Areas adjacent to [redacted] revealed the old creek bed at this location (TS 19: Figure 16) with abundant gravel and sand to the base of excavation. Significant disturbance was identified at TS 21 located approximately 20m from Bong Bong Road confirming the extent of recent landuse disturbance. A test square with natural soils was recorded at TS 20 (Figure 17), located adjacent to the confluence of [redacted] and its anabranch, indicating that some intact soils are still present on the terrace. Soils were highly compacted and homogenous dark brown silty clay loams, a result of Holocene fluvial deposits. Areas further from the creek banks (TS 18: Figure 15) had shallower clay loam soils with a high clay content to the basal clay layers.

I. 0-14cm: Dark brown clay loam. Humic, frequent root systems. Very greasy and moist. Diffuse boundary to:
II. 14-30cm: Dark brown clay loamy silt. Increase in patches in yellow clay from 16cm depth. Very greasy and moist. High compaction. Diffuse boundary to:
III. Base: Dark brown clay loamy silt. High clay content. Water seepage, highly saturated.

Figure 12. TS 11 west section and soil profile description

I. 0-5cm: Dark grey sandy clay loam. Humic, frequent fine root systems. Moist. Diffuse boundary to:
II. 5-14cm: Dark grey sandy clay loam. Moist. High clay content. Undulating. Diffuse boundary to:
III. 14-28cm: Yellow clay. Plastic. Heavy. High compaction.

Figure 13. TS 13 north section and soil profile description

I. 0-6cm: Humic layer, frequent fine root systems. Grey brown sandy clay loam. Diffuse boundary to:
II. 6-10cm: Grey brown sandy clay loam. Low to moderate compaction. Infrequent small gravel inclusions <5%. Diffuse boundary to:
III. 10-25cm: Grey sandy clay loam. High clay content and increasing with depth. Gravel increasing to <10%. Moist. Diffuse boundary to:
IV. Base: Yellow orange clay. High compaction. Some gravel still inclusions.

Figure 14. TS 14 south section and soil profile description

I. 0-9cm: Humic layer, frequent fine root systems. Dark brown silty clay loam. Diffuse boundary to:
II. 9-33cm: Homogenous dark brown clay loam. High clay content. Greasy, heavy clay at 16cm depth. High compaction. Diffuse boundary to:
III. Base: Mottled orange and yellow clay. Plastic. Heavy. Moist.

Figure 15. TS 18 west section and soil profile description

I. 0-5cm: Humic layer, frequent fine root systems. Dark brown sandy clay loam. Diffuse boundary to:
II. 5-18cm: Dark brown sandy clay loam. Moderate compaction. Gravel <20mm ~1%. Clear boundary to:
III. 18-44cm: Reddish brown sandy clay loam. Abundant river gravel and pebbles <20mm ~70%, and increasing with depth. Diffuse boundary to:
IV. Base: Red brown sandy clay. River gravel and pebbles inclusions. High clay content.

Figure 16. TS 19 north section and soil profile description

I. 0-10cm: Dark brown silty clay loam. Very moist. Humic. Frequent fine root system. Diffuse boundary to:
II. 10-38cm: Homogenous unit. Dark brown silty clay loam. Very moist. High clay content. High compaction, and increasing from 15cm depth. Towards the base increase in compaction. Diffuse boundary to:
III. Base: Highly compacted, cemented dark brown silty clay.

Figure 17. TS 20 north section and soil profile description

Soil profiles across the four terraces on the eastern side of [redacted] and west of Hamilton Street were relatively uniform and deep. The deepest deposits were encountered on the southern terrace adjacent to the creek bank with banded sandy deposits varying in colour and texture, consisting of dark and pale yellow brown sandy clay loams to the end clay levels at 60cm (Figure 19). Slightly shallower sandy deposits with a yellow brown coarse sand layer approximately 10cm thick were recorded at test squares on a slightly higher elevation in the northern part of the terrace and on the smaller terrace bounded by two small drainage lines (Figure 21-22). These deposits are likely the result of a distinct large-scale flooding event.

Relatively homogenous, shallow to moderately deep sandy soils were recorded within the larger terrace transected by the artificial drainage line (TS 30-38) (Figure 23-24). Soils consisted of dark brown sandy clay loam overlying a thin layer of yellow brown sandy clay to basal clay levels between 34cm and 48cm.

I. 0-9cm: Dark brown silty loam. Humic, frequent root systems. Slightly moist. Diffuse boundary to:
II. 9-40cm: Yellow brown (Munsell 7.5YR 4/4) sandy silt loam. Slightly moist. Low compaction. Diffuse boundary to:
III. 40-60cm: Dark brown silty sand. Some clay content. Charcoal patches throughout, burnt tree root. Diffuse boundary to:
IV. Base: Dark brown sandy clay. Moderate to high compaction.

Figure 18. TS 22 south section and soil profile description

I. 0-6cm: Pale brown sandy loam. Visible medium sand grains. Humic, frequent fine root systems. Loose. Diffuse boundary to:
II. 6-8cm: Dark brown sandy clay loam. High clay content. Dry. Moderate compaction. Diffuse boundary to:
III. 8-14cm: Dark brown sand. Some clay content. Moderate compaction. Clear boundary to:
IV. 14-17cm: Dark brown sandy clay loam. Dry. High compaction. Diffuse boundary to:
V. 17-40cm: Pale brown sandy clay loam. Diffuse boundary to:
VI. 40-52cm: Dark brown sandy clay loam. Visible medium sand grains. Clear boundary to:
VII. 52-60/62cm: Pale brown sandy clay loam. Clear boundary to:
VIII. 60/62-65cm: Dark brown sandy clay loam. High compaction. Clear boundary to:
IX. 65-70cm: Dark brown clay. Dry.

Figure 19. TS 24 north section and soil profile description

I. 0-7cm: Dark brown sandy loam. Humic layer, frequent fine root systems. Diffuse boundary to:
II. 7-35cm: Dark brown sandy clay loam. Abundant gravel inclusions. Some blue metal inclusions to 20cm depth. Low to moderate compaction. Diffuse boundary to:
III. 35-60cm: Dark brown silty loam. High clay content and increasing with depth. Small patches of charcoal at the western wall. Diffuse boundary to:
IV. Base: Yellow brown clay. Some sandy loam still included. High compaction.

Figure 20. TS 25 west section and soil profile description

Figure 21. TS 28 east section and soil profile description

I. 0-7cm: Humic layer, frequent fine root systems. Dark brown sandy clay loam. Moderate compaction. Diffuse boundary to:
II. 7-21cm: Dark brown sandy clay loam. Visible sand grains. High clay content. Moderate compaction. Clear boundary to:
III. 21-31cm: Yellow brown sand. Medium sand grains. Moist. Scattered gravel inclusions. Clear boundary to:
IV. 31-37cm: Greyish brown sandy clay loam. Increase in clay content. Thick, plastic clay. Diffuse boundary to:
V. 37-50cm: Dark brown sandy clay loam. Mottled with yellow brown sub-rounded gravel ⌀<20mm increasing from 38cm depth. Clear boundary to:
VI. Base: Mottled dark yellow brown sandy clay.

Figure 22. TS 29 west section and soil profile description

I. 0-5cm: Humic layer, frequent fine root systems. Grey brown silty clay loam. Diffuse boundary to:
II. 5-25cm: Dark brown sandy clay loam. Moderate compaction. Clear boundary to:
III. 25-29cm: Yellow orange brown coarse sand. Low compaction. Clear boundary to:
IV. 29-38cm: Mottling of dark brown sandy clay loam and yellow orange sand in bends. Moderate compaction. Diffuse boundary to:
V. 38-40cm: Dark brown silty sandy clay. Diffuse boundary to:
VI. Base: Dark brown clay. Some silt still included.

Figure 23. TS 32 south section and soil profile description

I. 0-10cm: Dark brown clay loam. Very moist. Humic. Frequent fine root system. Diffuse boundary to:
II. 10-36cm: Homogenous unit. Bioturbated. Dark brown silty clay loam. Medium sized sand grains. Moist in top 15cm. High clay content. High compaction, and increasing from 15cm depth. Towards the base increase in compaction. Diffuse boundary to:
III. Base: Dark brown clay. Highly compacted, cemented.

Figure 24. TS 36 north section and soil profile description

I. 0-9cm: Very dark brown (Munsell 7.5YR 2.5/2) sandy clay loam. Moist. Humic, frequent fine root system. Diffuse boundary to:
II. 9-37/38cm: Dark brown (7.5YR 3/3) sandy clay loam. Increase in plastic heavy clay. High compaction. Diffuse boundary to:
III. 37/38-48cm: Pale brown (7.5YR 4/4) sandy clay. Medium sized sand grains. Bioturbated. Diffuse boundary to:
IV. Base: Pale yellow red (5YR 4/6) sandy clay. Moderate compaction.

Soils on the terrace adjacent to the anabranch drainage features at the northernmost extent of [redacted] AAS were uniform and moderately deep. They consisted of dark brown silty loams overlying orangy brown clay loams with high clay content above basal clay subsoils. Very small amounts of Fe/Mn nodules indicated some waterlogging, however, the profiles suggested relatively stable soils, apart from some bioturbation.

Figure 25. TS 39 north section and soil profile description

I. 0-9cm: Dark brown silt loam. Humic, frequent root systems. Moderate compaction. Diffuse boundary to:
II. 9-30cm: Dark brown silty loam. Some clay content. Moderate compaction. Fe/Mn nodules ~2%. Some charcoal flecking along the eastern section. Diffuse boundary to:
III. 30-48cm: Orangy brown clay loam. Clay content increasing with depth. Moderate compaction. Diffuse boundary to:
IV. Base: Orangy brown clay. High compaction.

Figure 26. TS 40 east section and soil profile description

I. 0-3cm: Greyish brown clay loam. Humic, frequent fine root systems. Diffuse boundary to:
II. 3-40cm: Dark brown sandy clay loam. Visible sand grains. Dry. Moderate compaction. Fe/Mn ~~o~~<20mm ~10% inclusions. Increase in sand from 37cm depth with low compaction. Diffuse boundary to:
III. 40-60cm: Pale brown sandy clay loam. Visible sand grains increasing and loose compaction from 40 to 45cm depth. Increase in plastic red yellow patches. Increase in plastic red yellow clay at 51cm depth. Clear boundary to:
IV. Base: Pale brown light sandy clay. Increase in red yellow clay patches. High compaction.

Figure 27. TS 42 west section and soil profile description

I. 0-7cm: Dark brown clay loam. Humic layer, frequent fine root systems. Slightly moist due to recent rain. Diffuse boundary to:
II. 7-40cm: Homogenous unit. Dark brown clay loam. Moderate compaction. Clay content increasing with depth. Bioturbated throughout. Diffuse boundary to:
III. Base: Grey brown clay. Plastic. High compaction.

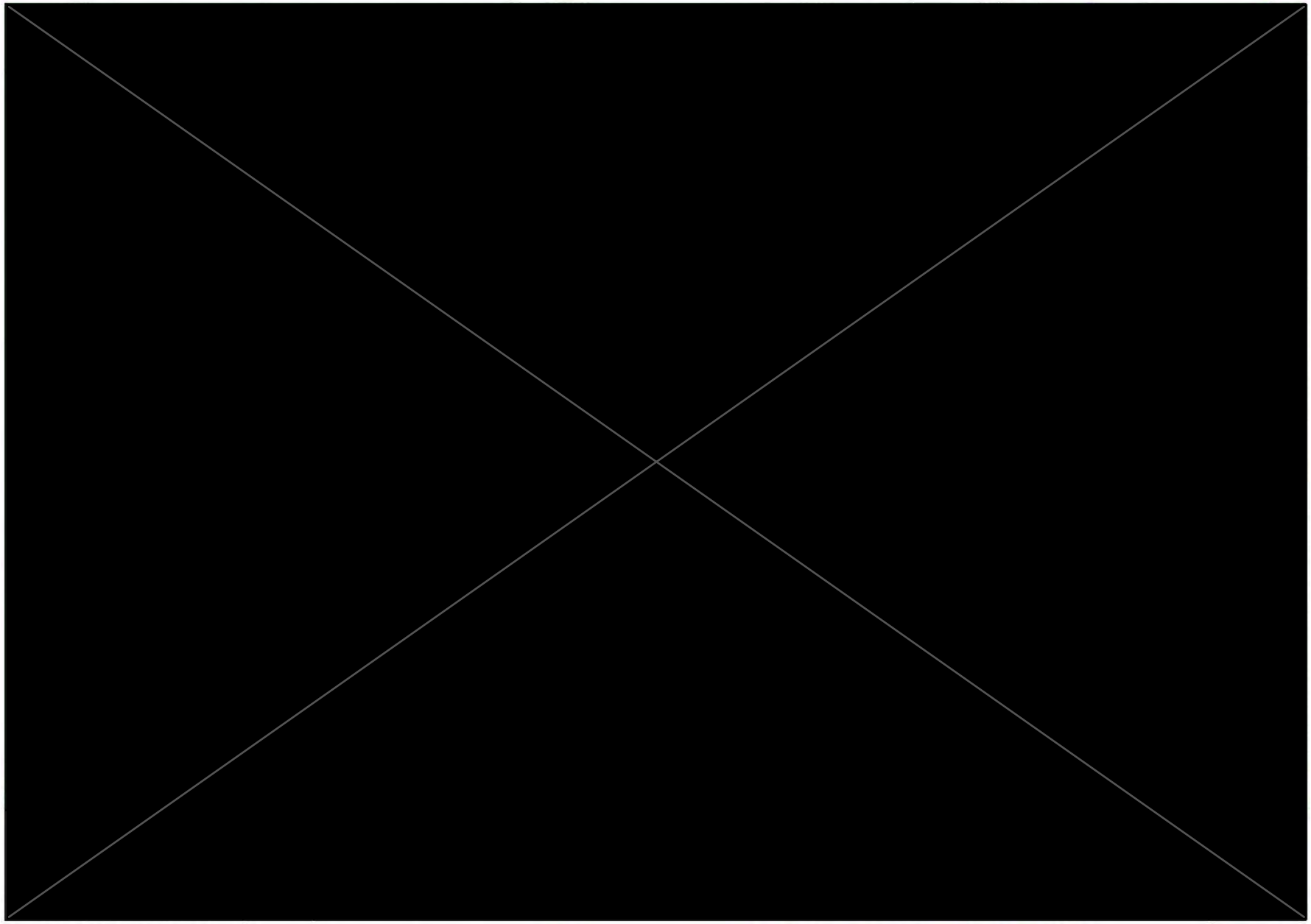


Figure 28. [redacted] AAS test square locations and artefact density (north)

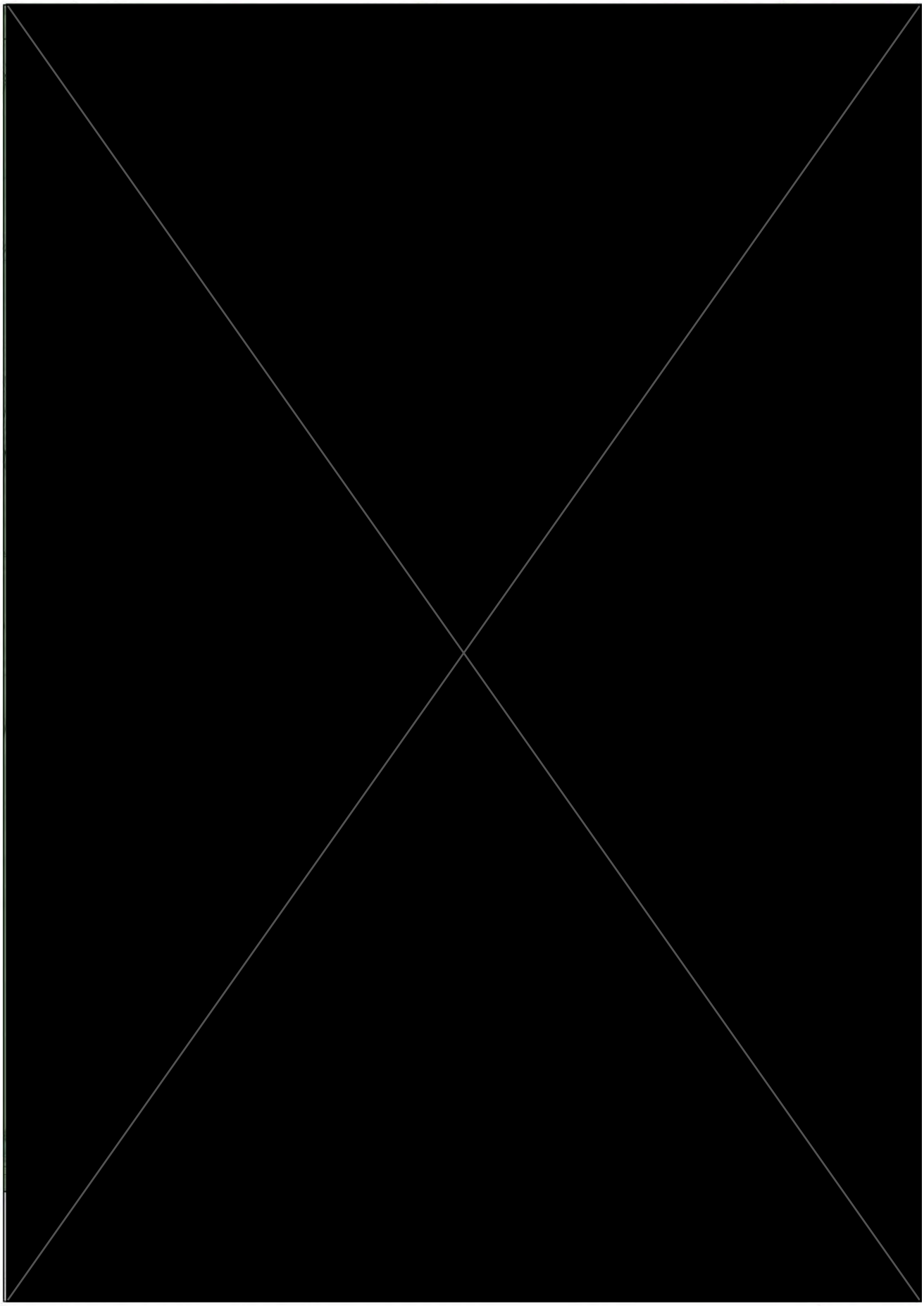


Figure 29. [redacted] AAS test square locations and artefact density (south)

7.3.2 Artefact Distribution

A total of 15 artefacts were recovered from seven out of the 42 excavated test squares at [redacted] AAS. Extrapolated to square metres, the mean artefact density across the entire tested area was very low at 1.4 artefacts/m^2. The majority of test squares (83.3%) did not contain any artefacts, while just over the half of the artefact bearing test squares (57.7%) contained only one artefact each. One test square revealed three (TS 4), while the highest number was recovered from TS 40 with a total of seven artefacts. Table 3 and Figures 28-29 show the artefact distribution across the test area.

Table 3. Test excavation artefact densities at [redacted] AAS

Test square	Total Artefacts	Test square	Total Artefacts	Test square	Total Artefacts
1	[redacted]	15	[redacted]	29	[redacted]
2	[redacted]	16	[redacted]	30	[redacted]
3	[redacted]	17	[redacted]	31	[redacted]
4	[redacted]	18	[redacted]	32	[redacted]
5	[redacted]	19	[redacted]	33	[redacted]
6	[redacted]	20	[redacted]	34	[redacted]
7	[redacted]	21	[redacted]	35	[redacted]
8	[redacted]	22	[redacted]	36	0
9	[redacted]	23	[redacted]	37	[redacted]
10	[redacted]	24	[redacted]	38	[redacted]
11	[redacted]	25	[redacted]	39	[redacted]
12	[redacted]	26	[redacted]	40	[redacted]
13	[redacted]	27	[redacted]	41	[redacted]
14	[redacted]	28	[redacted]	42	[redacted]

Artefact distribution within the [redacted] AAS test excavation area was characterised by a generally low density with two distinct areas of moderate density deposit. [redacted]

7.3.3 Lithics

Artefacts were made from a variety of raw material (Table 4). [redacted]

Table 4. Artefact raw material distribution and size at [redacted] AAS

[redacted]

The majority of artefacts (n=4 or 26.6%) were classified as complete flakes, followed by the same representation of split flakes, proximal and medial fragments, and non-diagnostic flaked angular fragments (n=2, 13.3% each). There was only one core recorded (Table 5).

Table 5. Reduction types at [redacted] AAS

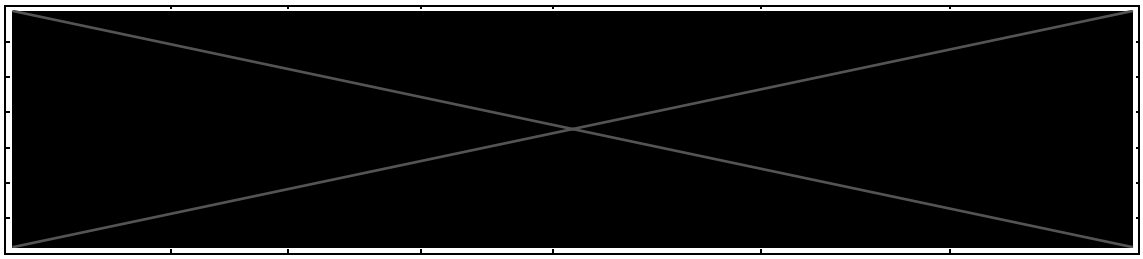


Plate 15. Silcrete flake and quartz artefacts with cortex from TS 4, spit 3 (20-30cm), ID# 1, 2 and 3.

Plate 16. Chert artefact from TS 13, spit 3 (20-30cm), ID# 5.

Plate 17. Petrified wood artefact with cortex from TS 40, spit 3 (20-30cm), ID# 10.

Plate 18. Petrified wood artefacts from TS 40, spit 3(20-30cm) and spit 5 (40-50cm), ID# 11 and 15.

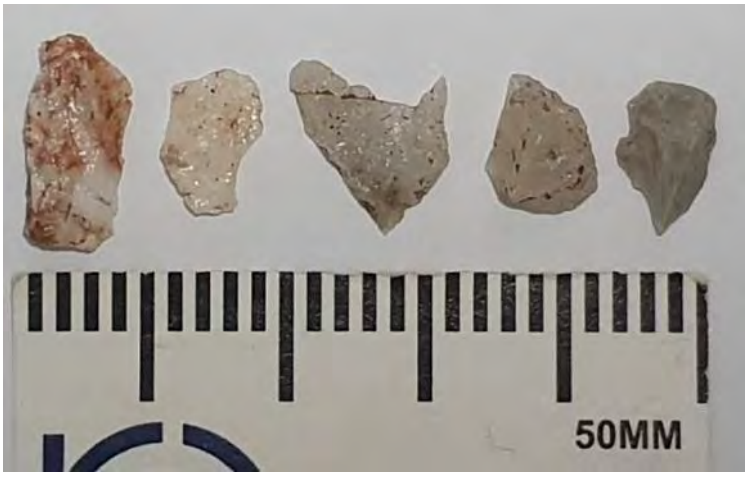


Plate 19. Quartz artefacts from TS 40, and silcrete flake from TS 39: ID# 13,14, 12, 9 and 8.

A relatively small percentage of artefacts retained cortex (n=5, 33.3%). The majority of the cortical artefacts displayed between 1 and 30% of remnant cortex (n=4, 80% or cortical artefacts), while the quartzite hammerstone fragment had more than 70% of cortex still remaining. Quartz had the most cortical raw material with three artefacts (Plate 15) while the single petrified wood core had 1-30% cortex remaining (Plate 20), indicating that earlier stage reduction of these raw material was taking place in the area. The sole core was recovered from TS 29, located on a small terrace adjacent to the eastern side of [redacted]. The core was retrieved from depths between 30 and 40cm from a silty to sandy clay layer overlying the basal clay. It was unifacially rotated and had a total of two negative flake scars (Plate 20).

Plate 20. Petrified wood core with cortex, from TS 29, spit 5 (40-50cm): ID# 7.

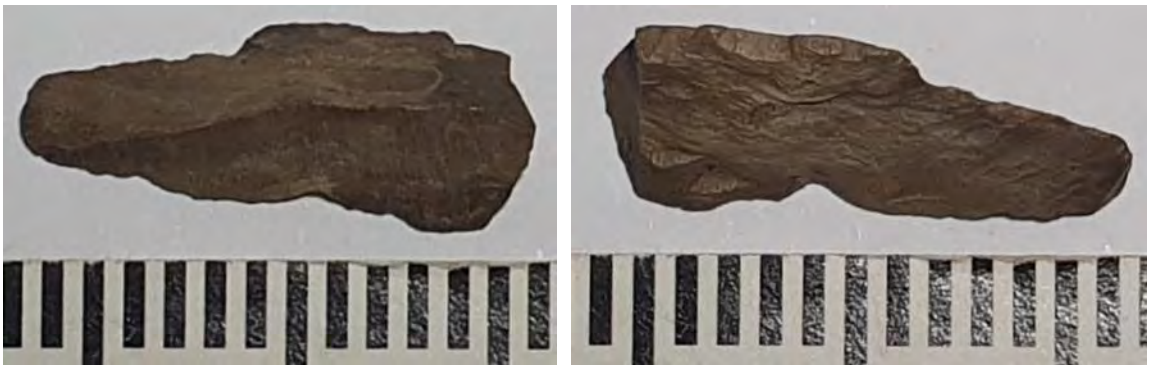


Plate 21. Petrified wood blade fragment from TS 25, spit 4 (30-40cm), ID# 6.

Plate 22. Quartzite hammerstone/grinding stone fragment, from TS 5: ID# 4.

Two fragments of formal tools were recorded at Mullet Creek AAS, a blade fragment and the hammerstone/grinding stone. The petrified wood blade fragment was recovered from TS 25, from depths between 30 to 40cm (Plate 21). It had maximum dimension of 25.14mm and its both proximal and distal ends were missing. The fragment of a quartzite hammerstone or grinding stone was recovered from TS 5, from 18cm depth (Plate 22). The artefact was fragmented and its specific use could not be determined as pecking and other usewear traces were indistinct. It was recovered from a significantly disturbed context in Reed Park, from introduced fill material mottled with some natural soils. It is likely that while the artefact derives from the local area it is not in situ and has been disturbed and redeposited by recent land use activities.

Overall, it is considered that the recovered assemblage represents scattered cultural material from the area resulting from Aboriginal land use along the creek corridor; however archaeological integrity was generally found to be poor and the recorded objects have likely been dispersed and disturbed to some degree by flooding events, bioturbation and past land use activities. Due to the presence of positive test squares across a range of separate and distinct terraces and alluvial flats around [redacted], five separate Aboriginal sites have been recorded as a result of the test excavation. These comprise artefact scatter sites [redacted] AFT 1 (TS 4 and 5) and [redacted] AFT 1 (TS 39 and 40), and isolated find sites [redacted] IF 1 (TS 13), [redacted] IF 2 (TS 25) and [redacted] IF 3 (TS 29). Although [redacted] IF 2 and 3 are relatively close to one another, they are located on two distinct terraces, and therefore have been recorded as two separate sites. It is considered likely that similar low density and dispersed artefact occurrences exist within the study area and adjacent alluvial landforms bordering the creek corridor, generally forming part of the 'background scatter' of cultural materials across the landscape. Identified site locations in relation to the current WD3 Part 3A study area, and other identified nearby sites, are shown in Figure 30.

7.4 Archaeological sites identified by the test excavation

7.4.1 [redacted] AFT 1 (AHIMS 52-2-4923)

[redacted]

7.4.2 [redacted] AFT 1 (AHIMS 52-2-4927)

[redacted]

[redacted]

[redacted]

7.4.3 [redacted] IF 1 (AHIMS 52-2-4924)

[redacted]

7.4.4 [redacted] IF 2 (AHIMS 52-2-4925)

[redacted]

7.4.5 [redacted] IF 3 (AHIMS 52-2-4926)

[redacted]

Figure 30. Identified archaeological sites within and near to WD3 Part 3A study area

7.5 Discussion

The test excavation program confirmed the presence of dispersed subsurface Aboriginal archaeological deposits across [redacted] Nine distinct terraces and areas of elevated alluvial flats were tested, separated by either natural drainage features or existing roads. The nature and extent of disturbance across these landforms varied in relation to previous land use and natural factors.

The study area encompasses landforms along both the [redacted] Landforms subject to test excavation included alluvial flats, floodplain and a terrace on the [redacted], as well as seven distinct terraces on the [redacted]. Soils present ranged from shallow clayey loams to deeper intact sandy deposits, with varying levels of previous disturbance. The alluvial flat tested within [redacted], exhibited significant levels of previous disturbance with the majority of test squares containing fill material, and only one area displaying limited disturbance and the presence of natural soils.

To the north, shallow alluvial clayey soils were recorded on the floodplain and alluvial flats along the small [redacted] anabranch to an average depth of 20cm. Small amounts of Fe/Mn nodules indicated waterlogging events. Although the area had abundant water and other resources, these low lying and saturated conditions would not be suitable for longer human occupation. Recent land use practices including ploughing and vegetation clearance have also contributed to mixing of soil deposits and their redeposition. Soils within the alluvial flats and terraces along [redacted] proper consisted of moderately deep clay loams across the terrace between [redacted], with deeper sandy deposits encountered in areas adjacent to the [redacted] resulting from Holocene alluvial deposition events.

Background review of previous archaeological studies indicates that the most common Aboriginal site types in the area are moderate to low density artefact scatters, PADs and isolated artefacts. Site occupation modelling for the general area suggests that Aboriginal land use of the area, despite being widespread, was not necessarily intensive, with artefacts located mostly on hillslopes, alluvial flats, creekside landforms and spur crests. Out of all artefacts located on [redacted] landforms, the majority were on [redacted], followed by [redacted]. The highest densities of artefacts were encountered on [redacted], followed by [redacted]. It was therefore considered that low to moderate density artefact scatters could be expected in areas that have not gone through previous significant disturbance. Previous archaeological testing in proximity to the study area indicates the presence of low density artefact scatters within similar alluvial flats and along the creeklines (AMBS 2006; Biosis Research 2012; 2023). It is not uncommon for testing in these areas to fail to recover any artefacts. Higher density and more concentrated deposits have been recorded on elevated landforms at a greater distance from the creeks such as the spur and ridge crests north of Cleveland Road. Artefact sites in the area are generally dominated by chert, petrified wood and quartz.

The sites recorded during the current assessment generally accord with the regional model established for the WDURA. A total of three isolated finds and two artefact scatters were recorded during the test excavation program across a large area of [redacted] AAS. The isolated finds ([redacted] IF 1, 2 and 3) and one low density artefact scatter (Reed Park AFT 1) represent dispersed cultural material from the general area affected by both natural processes and recent land use practices. One low-moderate density artefact scatter ([redacted] AFT 1) was located within relatively intact soil deposits on a remnant terrace adjacent to the former [redacted] anabranch. Overall, the dominant use of quartz and petrified wood as the raw material for artefact production was consistent with regional trends. A relatively low percentage of artefacts retained cortex, reflecting the likely import of raw material to the area, but some indications of early-stage reduction on locally-available raw materials suggested possible sourcing from stream pebbles. The limited number of cores and presence of some tools, as well as the prevalence of flake debris suggests that the primary production of stone tools occurred offsite, but some maintenance of tools might have occurred onsite.

According to the site prediction model areas adjacent to 3rd order creek lines with limited ground disturbance would contain low to moderate density artefacts that are evidence of repeated occupation, or focused activities, such as knapping floors and maintaining of tools. The localised moderate density at site [redacted] AFT 1 may be reflective of this more focused type of activity associated with resource gathering in the area. All of the other recorded sites (Reed Creek AFT 1, [redacted] IF 1, 2 and 3) are sporadic low density and isolated find sites, conforming to the previously established pattern that the region's most common site type are low density artefact scatters, with the highest density artefacts previously recorded adjacent to the 1st and 2nd order streams. Moderate density artefact scatter [redacted] AFT 1, although nominally located adjacent to 1st order drainage associated with the former anabranch, is 160 metres from the 4th order [redacted] watercourse proper. The combination of landform (stable terrace) and position on the edge of the primary flood zone has preserved a greater level of archaeological integrity than the other sites, which represent generally dispersed cultural materials from the local area.

8 Significance Assessment

8.1 Assessment Process

The aim of this assessment is to obtain sufficient information to allow the distribution and values of these objects and sites to be determined within the study area. This assessment concerns itself with scientific values only. Assessment criteria have been developed in line with Heritage NSW guidelines for assessing scientific value of archaeological sites. These are:

- Representativeness - all sites are representative of those in their class (site type/subtype) however the issue here relates to whether particular sites should be conserved to ensure a representative sample of the archaeological record is retained. Representativeness is based on an understanding of the regional archaeological context in terms of site variability in and around the study area, the resources already conserved and the relationship of sites across the landscape.
- Rarity – which defines how distinctive a site may be, based on an understanding of what is unique in the archaeological record and consideration of key archaeological research questions (i.e. some sites are considered more important due to their ability to provide certain information). It may be assessed at local, regional, state and national levels.
- Archaeological Research Potential - significance may be based on the potential of a site or landscape to explain past human behaviour and can incorporate the intactness, stratigraphic integrity or state of preservation of a site, the association of the site to other sites in the region (connectivity), or a datable chronology.

Site [redacted] represents a common occurrence in the region. It is a low density archaeological deposit located on an [redacted]. The site is in a deteriorated condition and has only limited areas of intact deposits. The site has a low number of artefacts and limited range of artefact types which are typical for the region. Overall, research potential is low and further investigation of the area would be unlikely to contribute further information on Aboriginal landscape use along [redacted]

Site [redacted] represents a common occurrence in the region. It is an isolated find located on an [redacted] The site is in deteriorated condition, affected by natural fluvial processes. It was assessed as having low archaeological value due to the isolated cultural material, and the disturbed nature of the deposit. The site forms part of the background scatter of cultural material across the local landscape. Research potential is low and the site is unlikely to contribute further information relevant to Aboriginal landscape use in the surrounding area.

Site [redacted] represents a common occurrence in the region. It is an isolated find located on a [redacted]. The site is partially affected by natural fluvial processes. It was assessed as having low archaeological value due to the low number and limited range of cultural material, as well as the disturbed nature of the deposit. The site forms part of the background scatter of cultural material across the local landscape. Research potential is low and the site is unlikely to contribute further information relevant to Aboriginal landscape use in the surrounding area.

Site [redacted] represents a common occurrence in the region. It is an isolated find located on a [redacted] The site is partially affected by natural fluvial processes. It was assessed as having low archaeological value due to the low number and limited range of cultural material, as well as the disturbed nature of the deposit. The site forms part of the background scatter of cultural material across the local landscape. Research potential is low and the site is unlikely to contribute further information relevant to Aboriginal landscape use in the surrounding area.

[redacted] is a low to moderate density archaeological deposit located on an [redacted]. The site displayed moderate archaeological integrity with some intact soil deposits. The site has a localised low-moderate density of artefacts and a range of artefact types which are typical for the region. There is little comparative data available from subsurface investigations of terraces adjacent [redacted] Overall, research potential is moderate and further investigation of the area would be likely to contribute further information on Aboriginal landscape use of the area.

8.2 Statements of Significance

Based on the assessment criteria outlined in Section 8.1, [redacted] represent sites of low research potential and low archaeological potential. The isolated finds and low density artefact scatter site types in the local area represent a discontinuous 'background scatter' of Aboriginal objects across the landscape, or former archaeological deposits dispersed by disturbance and/or erosion and fluvial activity. In this regard these sites may be considered representative of their type, being subsurface artefact occurrences representing Aboriginal activities across the landforms adjacent to [redacted]. Further archaeological work or investigation of the low significance sites within the study area would be unlikely to contribute further to our understanding of Aboriginal landscape use along the creek and in the wider local area, due to limited cultural material, higher levels of disturbance, and generally low archaeological integrity.

Sites that display moderate significance demonstrate higher quality archaeological information, greater density of artefacts and/or less severe landscape disturbance. Archaeological integrity of moderate significance sites is higher than low significance sites, with generally intact soils. Given the nature of land use along the wider project corridor (agricultural, pastoral, infrastructure etc.) and the natural effects of flooding, erosion and soil movement, this increases the value of sites which retain archaeological context and integrity. Assemblages from moderate significance sites demonstrate higher levels of complexity of artefact types and raw materials. Moderately significant sites are also located in spatially significant locations along the major creek corridors; representing good examples of the landform types considered most archaeologically sensitive for the Illawarra region. Site [redacted]. Site integrity was reasonably good and the site displayed a low-moderate density concentration of artefacts in an intact soil profile. While the range of artefact types and raw materials was not particularly notable, the archaeological information content of the site is higher than other areas investigated during the program, and the site displays moderate research potential.

Based on the values assessment, the following levels of significance were attached to the Aboriginal archaeological sites within the study area:

[redacted]

9 Impact Assessment

The results of the test excavation indicate that Aboriginal objects (artefacts) are likely to be impacted by the proposed WD3 Part 3A works. A total of five sites were identified within the WD3 Part 3A study area as a result of the test excavation program. A number of additional sites and PADs have also been previously recorded in the immediate vicinity.

The study area and proposed impact corridor has been refined following the field investigations and initial consistency assessment (KNC 2023a). Subsequent changes to the project and the division of works between Part 3A/REF sections have avoided potential impacts to a number of these sites, including WD2 AS01, CRS PAD 2 and the newly identified [redacted]

Based on impact assessment for the current WD3 Part 3A works corridor, four identified Aboriginal archaeological sites would be impacted (Table 6, Figure 31). The remainder of the identified sites/PADs adjacent to but outside of the study area and proposed works area would not be impacted by the proposal.

Table 6. Impact of proposed WD3 Part 3A activities on Aboriginal sites

Site Name	AHIMS number	Type of harm	Degree of harm	Consequence of harm
[redacted]	52-2-4923	Direct	Total	Total loss of value
[redacted]	52-2-4924	Direct	Total	Total loss of value
[redacted]	52-2-4925	Direct	Total	Total loss of value
[redacted]	52-2-4926	Direct	Total	Total loss of value
[redacted]	52-2-4927	None	None	No loss of value
[redacted]	52-2-3832	None	None	No loss of value
[redacted]	N/A	None	None	No loss of value
[redacted]	52-5-0917	None	None	No loss of value
[redacted]	52-5-0774	None	None	No loss of value

Figure 31. WD3 Part 3A impact area and identified Aboriginal archaeological sites

9.1 Consistency of current assessment with existing WDURA Project Approval

The current proposed works for WD3 Part 3A form part of the WDURA Project, which was granted Concept and Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* by the Department of Planning and Infrastructure in 2013 (MP09_0189).

The Aboriginal cultural heritage values for the project were previously assessed by Biosis (2012) as part of the EA. The current study area represents the portion of West Dapto Package 3 works being undertaken using the existing Project Approval.

Project Approval was subject to a number of conditions, including specific conditions relating to Aboriginal heritage. These are contained in Conditions C32, C36, E6 and E10 of the Project Approval.

Condition C32 states that:

> Impacts to Aboriginal heritage identified in Tables 25 and 26 of Appendix F in the document listed under condition B2(b) shall be minimised to the greatest extent practicable through both detailed design and construction. Where impacts are unavoidable, works shall be undertaken in accordance with condition C36 and the actions to manage construction Aboriginal heritage required by condition E6(b).

Condition C36 states that:

> Prior to the commencement of pre-construction and construction activities affecting the Aboriginal archaeological sites identified in Table 25 and Table 26 of Appendix F in the document listed under condition B2(b), the Proponent must:
>
> (a) undertake an Aboriginal archaeological investigation program using a methodology prepared, in consultation with the OEH (Aboriginal heritage) and the Registered Aboriginal Stakeholders, and to the satisfaction of the Director-General.
>
> (b) report on the results of the Aboriginal archaeological investigation program, including recommendations (such as for further archaeological work), in consultation with the Registered Aboriginal Stakeholders, the OEH and to the satisfaction of the Director General, and shall include, but not necessarily be limited to:
>
> (i) consideration of measures to avoid or minimise disturbance to Aboriginal objects where objects of moderate to high significance are found to be present;
>
> (ii) where it cannot be avoided, recommendations for any further investigations; and
>
> (iii) management and mitigation measures to ensure there are no additional impacts due to pre-construction and construction activities.
>
> (c) Undertake any further archaeological excavation works recommended by the results of the Aboriginal archaeological investigation program.
>
> Within twelve months of completing the above work, unless otherwise agreed by the Director General, the Proponent shall submit a report containing the findings of the excavations, including artefact analysis, and the identification of final storage place for Aboriginal objects, prepared in consultation with the Registered Aboriginal Stakeholders, the OEH (Aboriginal objects) and to the satisfaction of the Director-General.

In accordance with Condition C36, this report (incorporating the results of the archaeological test program) was submitted to Heritage NSW (formerly OEH) on 22 October 2023. Heritage NSW acknowledged receipt on 23 October 2023, with no further comments or feedback provided as of January 2024.

Schedule E of the Project Approval ('Construction Environmental Management') also contained specific provisions regarding the inclusion of Aboriginal heritage matters within the Construction Environmental Management Plan (CEMP):

Condition E6 states that:

> As well as the general requirements of an EMP as outlined in condition E5, the following shall be addressed[…]:

(b) Aboriginal Heritage

> (i) actions to manage identified Aboriginal objects directly and indirectly impacted by construction, developed in consultation with registered Aboriginal stakeholders prior to any archaeological or salvage works commencing, including but not limited to:
>
> - management measures and strategies for protection, monitoring, salvage, archival recording and/or conservation of sites and items that will be directly or indirectly impacted during construction;
> - procedures for dealing with previously unidentified Aboriginal objects (excluding human remains) including cessation of works, assessment of significance and determination of appropriate management measures, involvement of a suitably qualified archaeologist and consultation with the Department and registered

Aboriginal stakeholders, actions required to enable construction to recommence and notification to the OEH, in accordance with section 89A of the *National Parks and Wildlife Act 1974*, and the department;;

- procedures for dealing with human remains, including cessation of works in the vicinity of the remains and notification of relevant stakeholders, including NSW Police, the department and the OEH;
- training and induction processes for construction personnel on site identification, protection and conservation of Aboriginal cultural heritage;.
- procedures for ongoing stakeholder consultation and involvement for the duration of the project; and
- procedures for monitoring and reporting effectiveness of management measures, including reporting of non-compliance.

Condition E10 states that:

> Prior to the commencement of pre-construction and/or construction activities that will impact the Aboriginal archaeological sites identified in Table 6-22 of the document listed under condition B2(b), the Proponent shall undertake an archaeological salvage program using a methodology prepared in consultation with the registered Aboriginal stakeholders, and to the satisfaction of the Director-General. This work shall be undertaken by an appropriately qualified archaeological heritage consultant.
>
> Within two years of completing the salvage, unless otherwise agreed by the Director General, the Proponent shall submit a report containing the findings of the salvage, including artefact analysis, and the identification of a final repository for any Aboriginal objects, prepared in consultation with the Aboriginal stakeholders and to the satisfaction of the Director-General.

Tables 25 and 26 in the Biosis 2012 report, as referred to in Condition 32, contain (respectively) site-specific recommendations for previously identified archaeological sites/PADs along the alignment, and; recommendations for areas of high, moderate and low archaeological sensitivity as identified in a series of Figures contained within the report. Table 6-22 of the EA, as referred to in Condition E10, contains the same seven previously identified sites/PADs as listed in Table 25 of Biosis 2012. None of these sites/PADs are located within the study area for the current assessment.

Portions of the current WD3 Part 3A study area are outside of the existing Project boundary and were not assessed as part of the Biosis sensitivity mapping (Biosis 2012:Figures 45-52). A review of the existing Biosis Aboriginal cultural heritage assessment determined that areas considered more likely to display archaeological potential were associated with major creeklines, raised flat landforms and ridges and hills where previous disturbance levels were low. This was based on the archaeological predictive model developed for the wider area, informed by the results of previous archaeological and cultural heritage assessments and the presence of recorded Aboriginal sites. The site occupation model for the area indicates that elevated landforms in proximity to watercourses often contain a higher density and wider variety of cultural material due to Aboriginal landscape use of the adjoining resource-rich economic zones. Identification of the [redacted] Archaeological Area of Sensitivity was based on, and is consistent with, the existing predictive model utilised by Biosis for the Project.

The approved recommendation for areas of high archaeological sensitivity, as listed in Biosis Table 26, is:

> "If the areas of high archaeological sensitivity identified in Figure 45 to 52 can not be avoided by the proposed alignments, additional subsurface testing will be required to determine the nature and extent of known sites, and the location of additional sub-surface deposits within the area." (Biosis 2012: 206).

Subsequent changes to the project and the division of works between Part 3A/REF sections have avoided potential impacts to WD2 AS01 and CRS PAD 2. Avoidance of these potential Aboriginal heritage impacts complies with Condition C32 of the Project Approval. It was identified that impacts to CR PAD 3 and [redacted] Area of Archaeological Sensitivity would be unavoidable and that further archaeological investigation would therefore be required in accordance with Condition C36(a).

The current consistency assessment report addresses the requirement for test excavation within [redacted] Area of Archaeological Sensitivity. Testing within CR PAD 3 was undertaken as part of the WD3 REF assessment (reported separately, KNC 2023b). No artefacts were recovered at CR PAD 3 and it was determined the area is not an Aboriginal archaeological site or area of high sensitivity. Additional test excavation for the WD3 Part 3A works was therefore not required under Condition C36(a).

The test program was undertaken in accordance with the existing Project Approval and test excavation methodology for the Project as per the Biosis report, and the Heritage NSW *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a), in compliance with Condition C36(a).

The current consistency assessment and test excavation report meets the requirements of Condition C36(a) regarding the need to undertake an Aboriginal archaeological investigation program and is consistent with existing recommendations for areas of high archaeological sensitivity as identified in Table 26 of the Biosis report. The report meets the content and formatting requirements of Condition C36(b).

9.2 Consistency of proposed impact with existing WDURA Project Approval

The current assessment has allowed for an evaluation of whether potential impacts to Aboriginal heritage within the study area are consistent with the existing approved impacts for the project.

Test excavation identified five Aboriginal archaeological sites within the test excavation area: low significance sites [redacted]. The low significance sites comprise isolated finds and a low density artefact site, all with low research value and typical of the region and local area. The low-moderate significance site is a low to moderate density artefact site with moderate research potential and a better level of archaeological integrity than the low significance sites.

In accordance with Condition C32, Sydney Water has sought to minimise impacts to the identified sites and realignment of the proposed impact corridor has avoided any impact to low-moderate significance site [redacted]. The realigned corridor also avoids impacts to nearby sites [redacted], CRS PAD 2, WD2 AS01 and WD3 PAD 08.

Condition C36(b)(i) states that consideration of measures to avoid or minimise disturbance to Aboriginal objects are required where objects of moderate to high significance are found to be present. The test excavation and current assessment did not identify any objects or sites of moderate to high significance. The identified sites do not represent a moderate or high value archaeological resource. More intact or better examples exist elsewhere along the [redacted] catchment. Low-moderate significance site [redacted] and other nearby sites of higher archaeological and cultural value will not be impacted by the proposed work. The sites within the impact corridor have been assessed as displaying low significance and avoidance or impact-minimisation is not recommended on archaeological grounds.

Condition C36(b)(ii) refers to recommendations for further investigation where avoidance is not possible. The current assessment fulfils this requirement. The findings of the test excavation conform with the site predictive model and existing understanding of Aboriginal landscape use in the area. The impacted sites are of low significance and no further archaeological work is recommended in accordance with Condition C36(c).

Condition C36(b)(iii) refers to the requirement for management and mitigation measures to ensure there are no additional impacts due to pre-construction and construction activities. Recommended management measures in accordance with Condition C36(b)(iii) are contained in Section 10 of this report.

Based on the existing recommendations in Biosis 2012, the findings of the current consistency assessment, and the Conditions of Project Approval for Aboriginal heritage as detailed above, the proposed impact of the WD3 Part 3A works is therefore considered to be consistent with the existing Project Approval.

10 Management Recommendations

Archaeological assessment and test excavation have determined that four Aboriginal archaeological sites are located within the WD3 Part 3A study area and proposed impact area ([redacted]). The sites have been assessed as displaying low archaeological significance.

The following recommendations have been developed based on the findings of the current assessment, the existing recommendations in Biosis 2012, and the Conditions of Project Approval.

- Impact as described in Section 9 is considered to be consistent with the existing approved Aboriginal heritage impacts for the Project and consistent with the Project Approval.

- The impacted sites do not represent a moderate or high value archaeological resource. All impacted sites have been assessed as displaying low significance.

- No further archaeological work or salvage is recommended at the impacted sites or within the WD3 Part 3A study area.

- Low-moderate significance site [redacted], identified during the test excavation program, and other nearby Aboriginal archaeological sites and PADs will not be impacted by the proposal. Suitable management measures for these areas (in accordance with Condition C36(b)(iii) of the Project Approval) include:
    - Non-impacted Aboriginal archaeological sites in the vicinity (outside of study area boundary) as identified in Figure 31 should be marked on the CEMP prior to construction activities to ensure these sites and areas of archaeological sensitivity are avoided and not impacted by the proposed works. The sites/areas should be marked as environmentally sensitive “no-go zones”.
    - Where required, temporary fencing may be erected along the border of the approved impact area prior to construction to provide a physical barrier against accidental access or impact.
    - Workers should be inducted as to appropriate Aboriginal heritage protection measures

- Ongoing Aboriginal heritage management measures should be undertaken in accordance with the project CEMP, as described in Condition E6(b) of the Project Approval.

- As no impact is proposed to sites listed in Table 6-22 of the EA and no additional salvage mitigation is proposed for the WD3 Part 3A works, Condition E10 does not apply.

- Long-term management of Aboriginal objects recovered during the test program will be determined in consultation with the Registered Aboriginal Stakeholders, and in accordance with Condition C36 of the Project Approval. It is recommended that the recovered objects undergo reburial within [redacted] near the location of identified site [redacted]. The location of the reburied assemblage would be registered on AHIMS in accordance with the *Code of Practice*.

References

Australian Museum Business Services (AMBS), 2006. Aboriginal Heritage Management Plan: West Dapto Release Area. Consultancy report to Wollongong City Council.

Archaeological & Heritage Management Solutions (AHMS). 2012. Aboriginal Cultural Heritage Assessment: McPhail Lands, Bong Bong Road, West Dapto, Wollongong LGA. Report for Stockland.

Attenbrow, V., 2002. *Sydney's Aboriginal Past: Investigating the Archaeological and Historical Records*. University of New South Wales Press, Sydney.

Biosis Research Pty Ltd, 2010. Fairwater Drive Extension to Cleveland Road: s.87 AHIP Aboriginal Archaeological Excavation Report.

Biosis, 2012. Water and Wastewater Servicing of the West Dapto Urban Release Area and Adjacent Growth Areas: Aboriginal Heritage Assessment and Impact Management. Report prepared for Sydney Water.

Biosis. 2015. Fowlers Road Extension, West Dapto, NSW: Archaeological Report. Report for Cardino on behalf of Wollongong City Council

Biosis. 2020. Cleveland Precinct Planning Proposal – Interim Heritage Report. Report prepared for DFP Planning on behalf of Newquest Property.

Biosis. 2023. Cleveland Road North and South Precincts: Aboriginal Cultural Heritage Assessment. Final Report. Prepared for Newquest Property Pty Ltd.

Department of Environment, Climate Change and Water NSW (DECCW) (now Heritage NSW), 2010a. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales: Part 6 National Parks and Wildlife Act 1974*. Department of Environment, Climate Change and Water NSW, Sydney

DECCW, 2010b. *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. Department of Environment, Climate Change and Water NSW, Sydney.

Hazelton, P.A. and Tille P.J. 1990. *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet.* Department of Conservation and Land Management (incorporating Soil Conservation Service of NSW), Sydney.

Hazelton, P. A. 1992. *Soil Landscapes of the Kiama 1:100,000 Sheet.* Department of Conservation and Land Management, Sydney.

GML Heritage (GML). 2015. *Dapto Land Review*. Report for Stockland

Kelleher Nightingale Consulting Pty Ltd (KNC), 2023a. West Dapto Package 3 Water and Wastewater Servicing. Aboriginal Heritage Consistency and Due Diligence Assessment. Report for Sydney Water.

Kelleher Nightingale Consulting Pty Ltd (KNC), 2023b. West Dapto Package 3 Water and Wastewater Servicing. Aboriginal Cultural Heritage Assessment Report. Report for Sydney Water.

McDonald, W.G., 1976. *Nineteenth-Century Dapto.* Illawarra Historical Society, Wollongong.

NSW Government Spatial Services, 2023. Spatial Collaboration Portal – Historical Imagery Viewer. Available online at https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery. Aerial photo references: 1961, WOLLONGONG 9029, Images #1063_03_018, #1063_01_081 and #1063_02_037.

NSW National Park and Wildlife Service (NPWS), 2002. Native Vegetation of the Illawarra Escarpment and Coastal Plain. Central Conservation Programs and Planning Division. NSW National Parks and Wildlife Service.

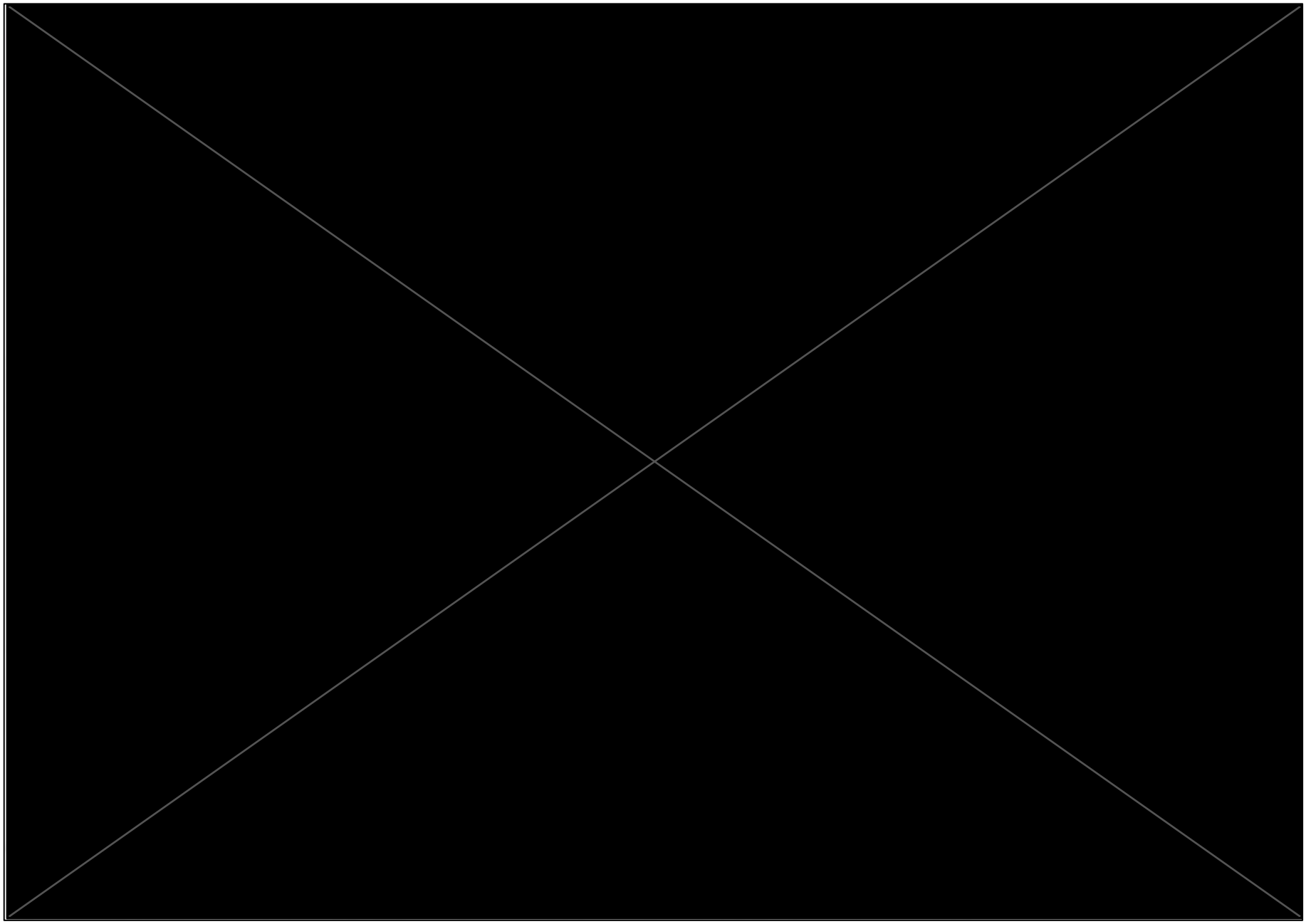
Trigg, S. and Campbell, L.M., 2016. *Moss Vale 1:100 0000 Geology Sheet 8928. Explanatory Notes*. Geological Survey of New South Wales

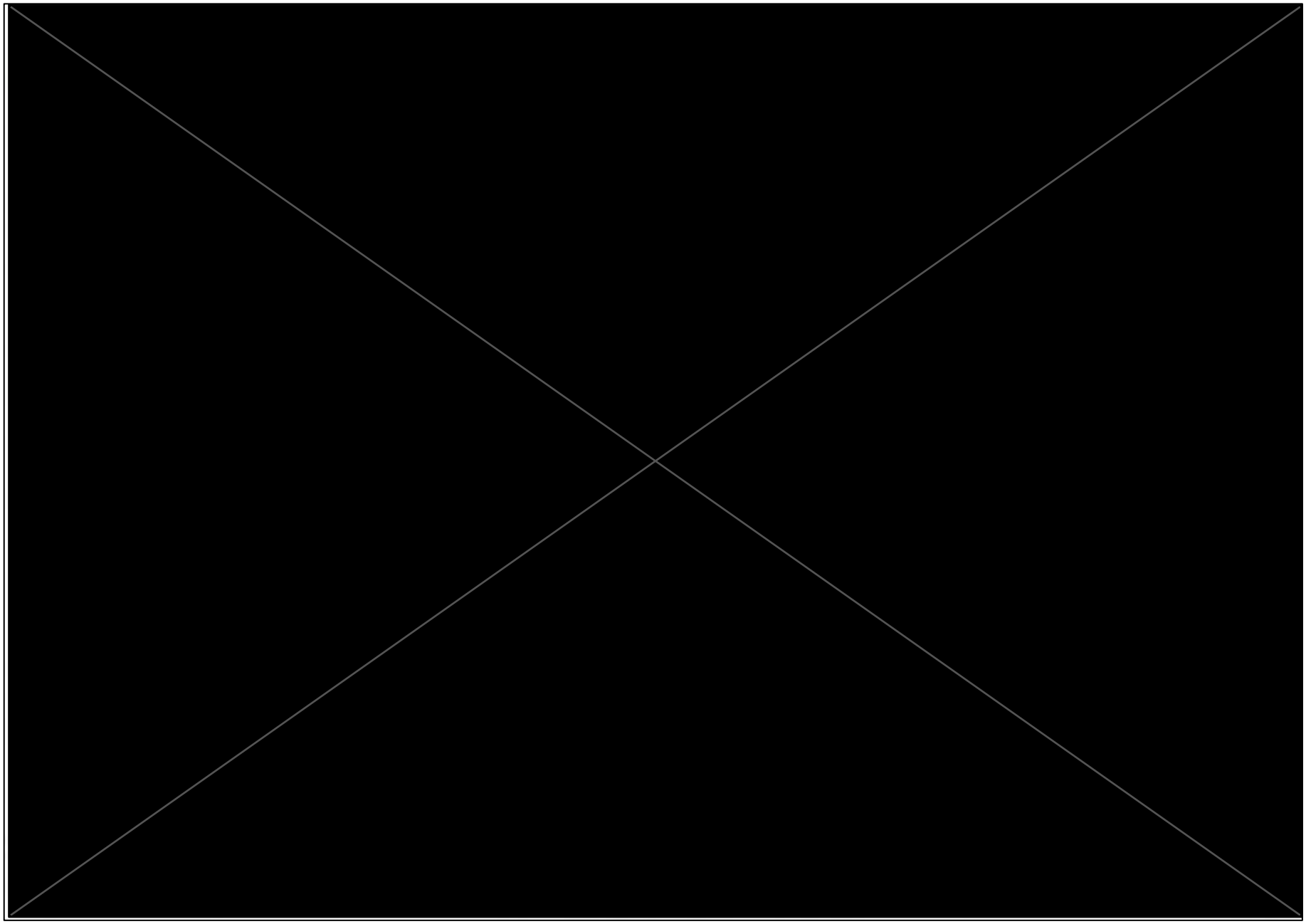
Troedson A.L., 2016. *Wollongong 1:100 000 and 1:25 000, Coastal Quaternary Geology Map Series*. Geological Survey of New South Wales, Maitland.

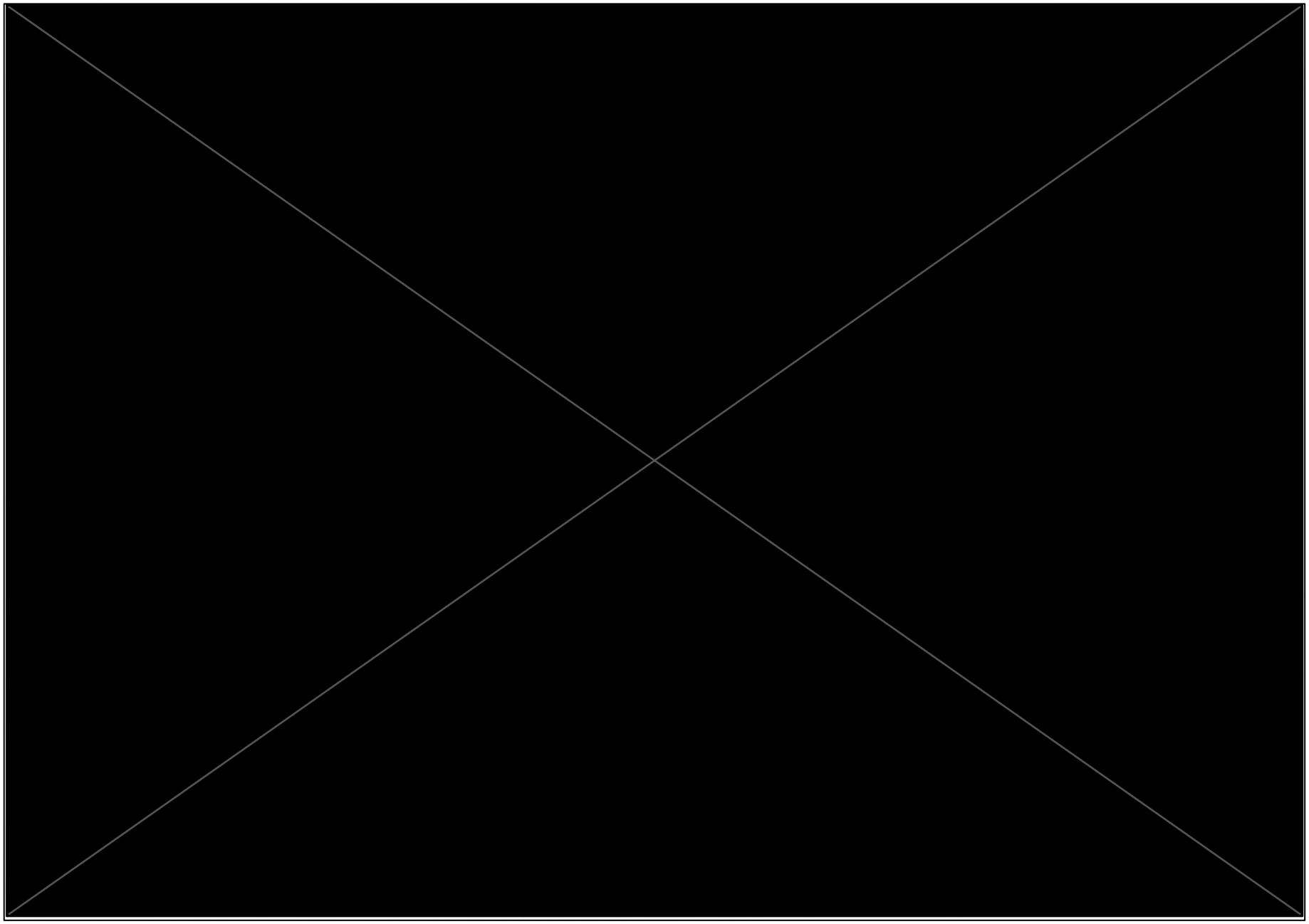
White, E. 2018. *Time Matters on Shallow Open Sites: An Example from Western Sydney, Australia*. Faculty of Arts and Social Sciences, University of Sydney. Doctor of Philosophy.

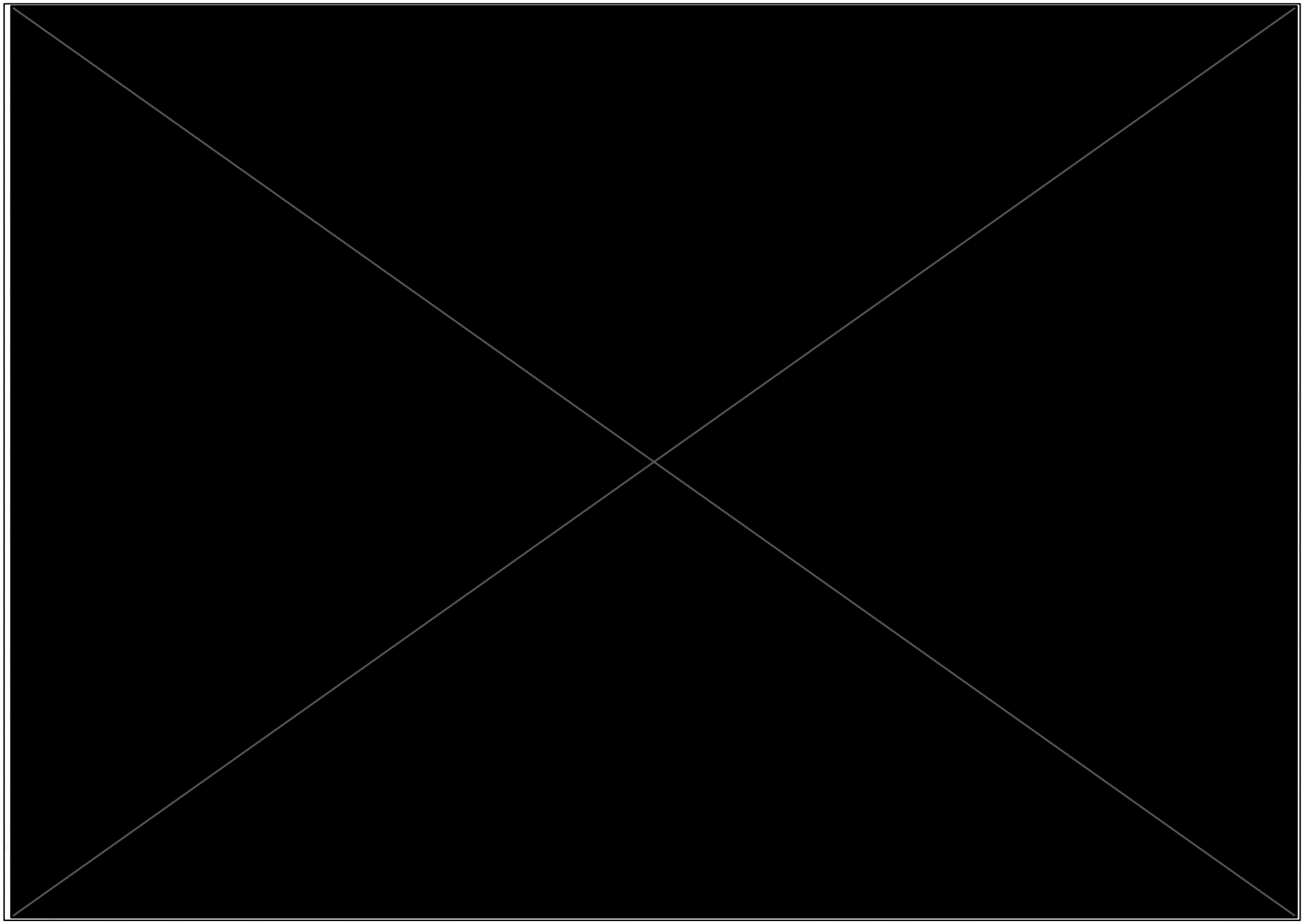
Wollongong City Council. 1976. Lake Illawarra: An Environmental Assessment Project. Wollongong City Council and University of Wollongong.

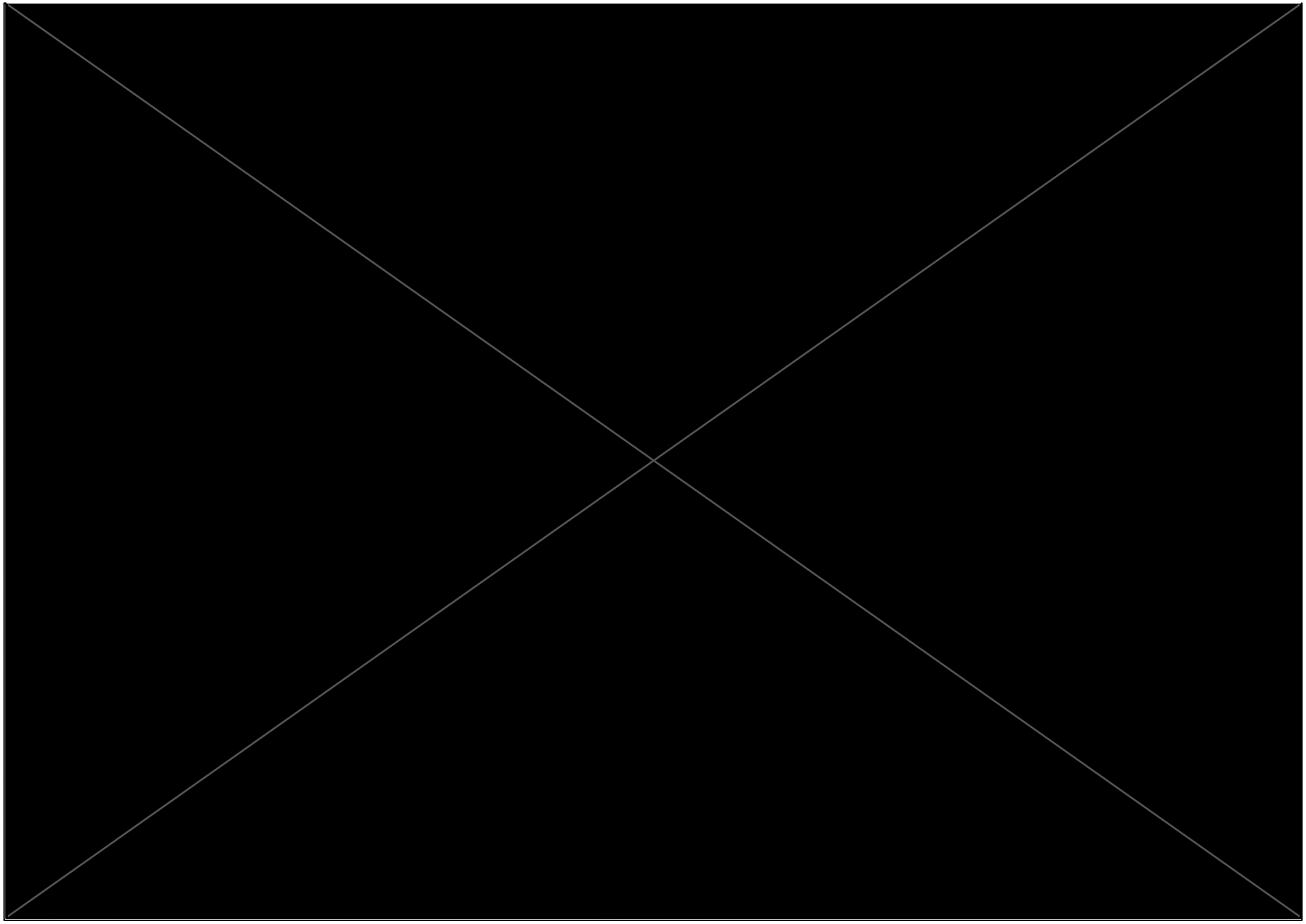
Appendix A AHIMS Search Results

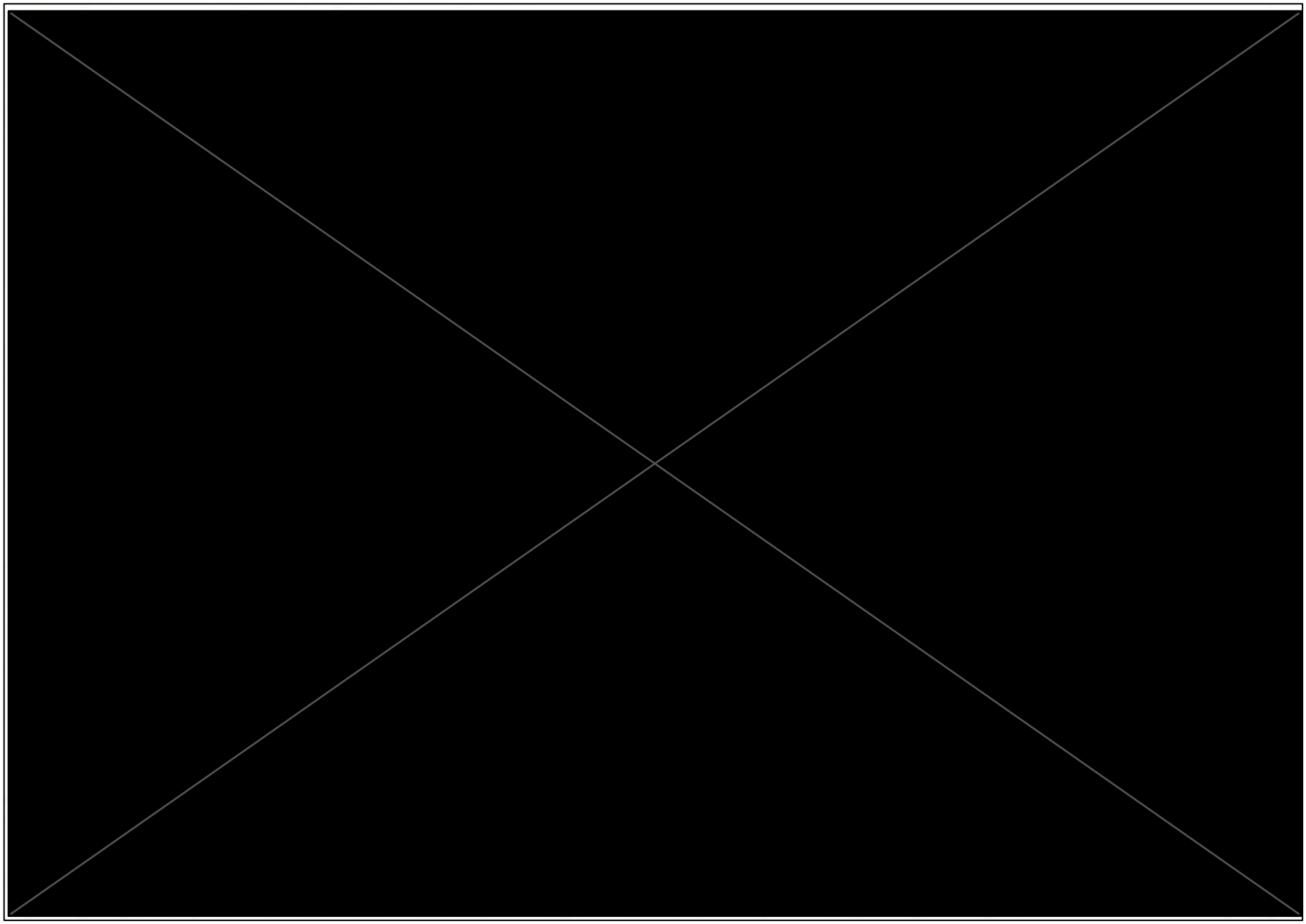


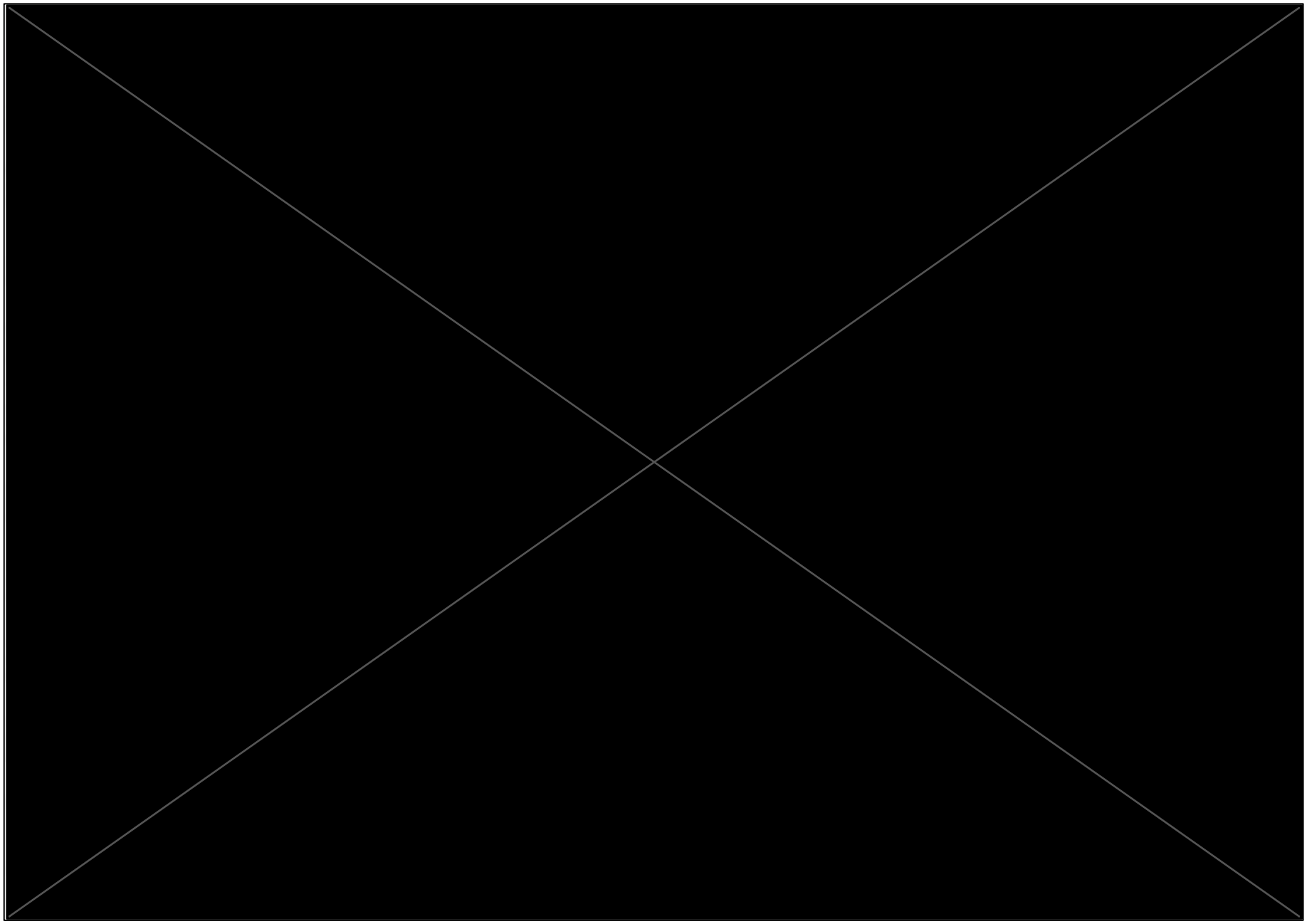


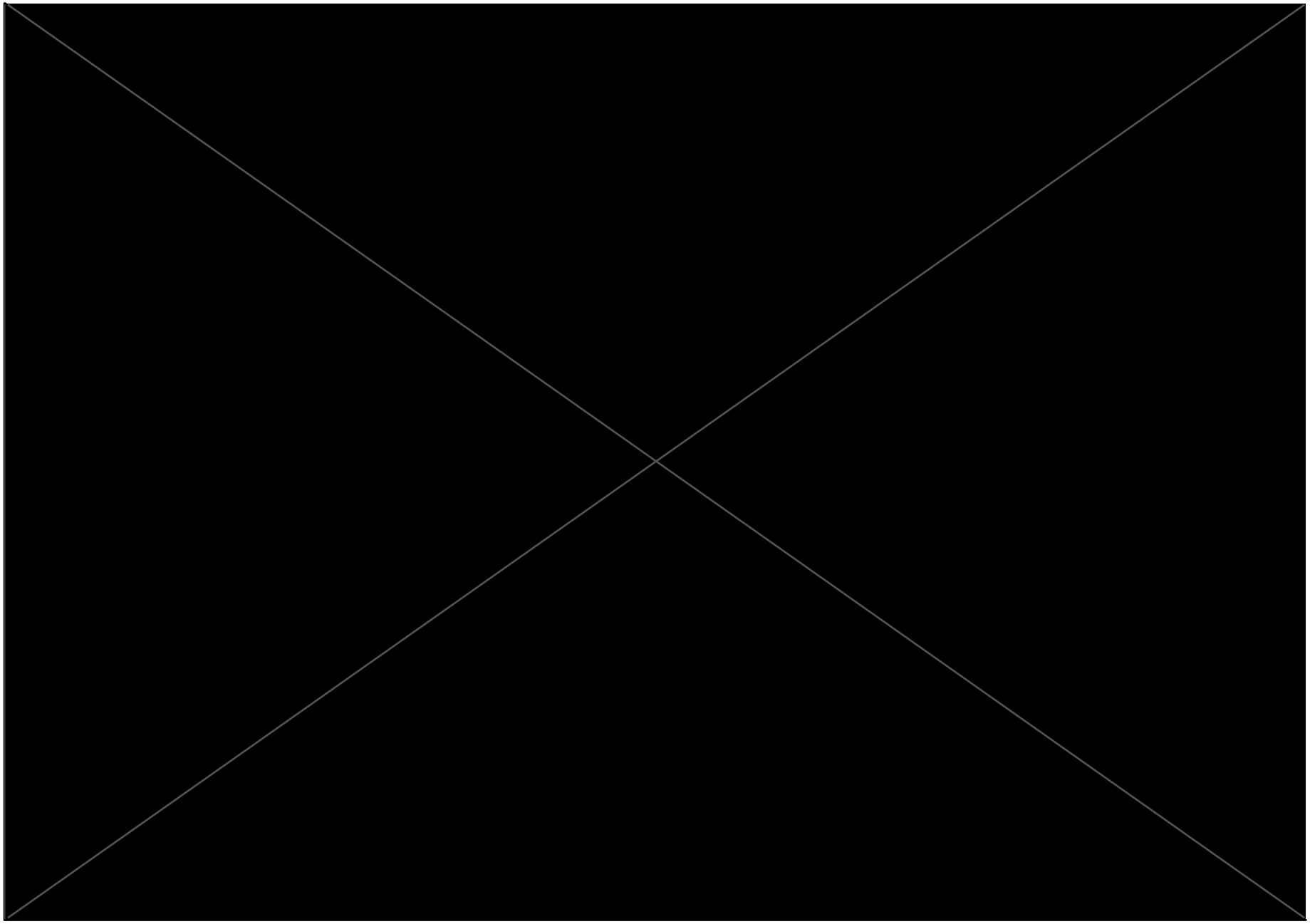












Appendix B Lithics Database