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HERITAGE MANAGEMENT PLAN – TAHMOOR SOUTH DOMAIN – LONGWALLS SOUTH 1A – SOUTH 7A

Tahmoor Coal Pty Ltd

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Document Control

Applicant:	Tahmoor Coal Pty Ltd
Mine:	Tahmoor Coal Mine
Development Approval:	SSD 8445
Mining Leases:	CCL716 and CCL747
Document Title:	Tahmoor South Domain Longwalls South 1A – South 7A Heritage Management Plan
Document Number:	TAH-HSEC-00364
Publication Date:	August 2025
Document Status:	Draft (Version 7)
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1 Introduction

1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing underground coal mine located approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW). Tahmoor Mine surface facilities are situated between the towns of Tahmoor and Bargo within the Wollondilly Local Government Area (LGA). The mine has previously extracted longwalls to the north and west of the surface facilities and has been operating continuously since 1979 when coal was first mined using bord and pillar mining methods, followed by longwall mining methods since 1987.

The location of Tahmoor Mine in the regional context is shown in **Figure 1.**

Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Extracted coal is processed on site at the coal handling and preparation plant (CHPP) and coal clearance facilities prior to transportation via rail to Port Kembla and Newcastle for Australian domestic and export customers.

An Environmental Impact Statement (EIS) was exhibited in early 2019 to gain approval for the Tahmoor South Coal Project, which involves use of the existing surface infrastructure and the expansion of underground longwall mining to the south of the existing workings (referred to as the Tahmoor South Domain). Tahmoor Coal subsequently revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020). In April 2021, Tahmoor Coal received Development Application Approval (SSD 8445) for the extraction of up to 4 Mtpa of ROM coal, with a total of up to 33 Mt of ROM coal proposed to be extracted over a 10-year period. In 2024 Tahmoor Coal proposed an application to modify the development consent SSD 8445 to include an additional longwall panel (LW S7A) to the existing approved mine plan (MOD3). This was granted in May 2025.

The Tahmoor South Domain is located south of the Bargo River and east of Remembrance Driveway and the township of Bargo. Longwall mining would be used to extract coal from the Bulli coal seam within the bounds of Consolidated Coal Lease (CCL) 716 and CCL 747. Thirteen longwalls are proposed in this domain which are divided into a series of seven northern (A series) and six southern (B series) longwalls. This management plan applies solely to the A series, being Longwalls South 1A to South 7A (LW S1A–S7A).

Longwalls South 1A to South 3A (extraction completed in December 2024) have been extracted with Longwall South 4A extraction planned to commence in early January.

The location of LW S1A–S7A and associated Extraction Plan Study Area (Study Area) are illustrated in **Figure 2.**

1.2 Purpose

This Heritage Management Plan (HMP) has been prepared to support an Extraction Plan for the secondary extraction of coal from LW S1A–S6A. The HMP was developed and utilised between 2022-2025. An additional longwall panel (LW S7A) was approved in May 2025 and this HMP has been updated to include the findings from the associated assessment for tMOD3.

The purpose of this management plan is to provide a framework for Tahmoor Coal personnel to ensure that compliance is achieved with relevant internal and external regulatory requirements related to Aboriginal and historical heritage monitoring and management within the Extraction Plan Study Area (**Figure 2**). The plan ensures that impacts on the environment and community are minimised and managed within a structured framework.

This plan is to ensure compliance with Development Consent (SDD 8445) (the Consent) Condition C8.

1.3 Scope

The potential impacts applicable to the Study Area that this management plan will address consists of a combination of the predicted 20 millimetre (mm) Total Subsidence Contour and the 35° Angle of Draw Line as shown in **Figure 2**.

The Study Area encompasses nine Aboriginal heritage sites and four historical heritage sites:

- Isolated find: TC14-2-19 (AHIMS 48-2-0275);
- Artefact scatter: Remembrance Drive 2013.1 (AHIMS 52-2-3968);
- Rockshelter with art and stone artefacts: Teatree Hollow 2013.1 (AHIMS 52-2-4471);
- Rockshelter with deposit and stone artefacts: Hornes Creek RS2 (AHIMS 52-2-4975);
- Rockshelter with deposit: Hornes Creek RS3 (AHIMS 52-2-4976);
- Rockshelter with deposit and stone artefact: Hornes Creek RS4 (AHIMS 52-2-4977);
- Rockshelter: Hornes Creek RS5 (AHIMS 52-2-4978);
- Rockshelter with deposit and stone artefact: Hornes Creek RS6 (AHIMS 52-2-4982);
- Rockshelter with deposit: Hornes Creek RS7 (AHIMS 52-2-4981);
- Wirrimbirra Sanctuary (known as the Australian Wildlife Sanctuary) [State Heritage Register (SHR) and Wollondilly local environment plan (WLEP)];
- Bargo Cemetery (WLEP);
- part of the Great Southern Road (non-statutory listed); and
- Tahmoor Colliery (known as the Tahmoor Mine Site) (non-statutory listed).

Relevant environmental features within a 600 metre (m) buffer from extraction that could be susceptible to far-field or valley related movements have also been included for consideration. This includes one locally listed heritage item, Railway Bridge North (also known as Wellers Road Overbridge). Three additional heritage items that are outside the 600 m buffer but could be susceptible to far-field or valley related movements have also been included for consideration: AHIMS #52-2-4980 (Hornes Creek GG1), Picton Weir (WLEP) and Bargo Railway Viaduct (WLEP and SHR).

1.4 Preparation of this Management Plan

This HMP has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of Tahmoor Coal. The HMP in 2022 was prepared by EMM Senior Archaeologist Pamela Chauvel with review and input by EMM Associate Archaeologist Ryan Desic. Pamela and Ryan are suitably qualified archaeologists and heritage consultants who have suitable experience in preparing Aboriginal cultural heritage assessments and heritage management plans throughout NSW.

Pamela Chauvel and Ryan Desic has been endorsed by the Department of Planning, Industry and Environment (DPIE, now the Department of Planning, Housing and Infrastructure (DPHI) as suitability qualified archaeologists to prepare this management plan.

The HMP was updated in 2025 by Dr Alan Williams (Technical Lead, Aboriginal heritage) with the assistance of Amber Morgan (Archeologist). Amber and Alan are suitably qualified archaeologists and heritage consultants who have suitable experience in preparing Aboriginal cultural heritage assessments and heritage management plans throughout NSW.

Dr Alan Williams has been endorsed by the Department of Planning, Housing and Infrastructure (DPHI) as a suitability qualified archaeologist to prepare this management plan.

1.5 Plan and Structure

This management plan:

- Addresses specific requirements set by Development Consent SSD 8445, EIS Commitments, Leases, Licences, and regulatory requirements (refer to Section 2);
- Addresses comments received during stakeholder consultation (refer to Section 0);
- Provides an overview of the existing environment for Aboriginal and historical heritage (refer to Section 3);
- Provides details on the predicted subsidence impacts and environmental consequences to Aboriginal and historical heritage from the extraction of LW S1A-S7A (refer to Section 4);
- Outlines the monitoring program for potential subsidence-related impacts to Aboriginal and historical heritage (refer to Section 5);
- Outlines the management strategies for potential subsidence-related impacts to Aboriginal and historical heritage items (refer to Section 6);
- Outlines the strategies for implementation, reporting, and review of this document (refer to Section 7);
- Provides document information (refer to Section 8); and
- Provides Trigger Action Response Plans (TARPs) to be implemented to manage and protect Aboriginal and historical heritage within the Study Area (refer to Appendix A).

This management plan has been prepared based on the contents of the following technical reports:

- Subsidence Predictions and Impact Assessments Report (MSEC, 2022);
- Tahmoor Coal – Modification 3 – Longwall South 7A (MSEC, 2024);
- Aboriginal Cultural Heritage Assessment: Amended Tahmoor South Project (Niche, 2020);
- Aboriginal Cultural Heritage Assessment: Tahmoor Mine Modification 3 (EMM, 2024);
- Historical Heritage Assessment: Tahmoor South Project (Niche, 2018);
- Overview of the Monitoring of Sandstone Overhangs for the Effects of Mining Subsidence in the Southern Coalfield, (Regal and Reeves, 2017); and
- Southern Coalfields Shelter Monitoring Statistical Analysis (Regal Heritage, 2022).

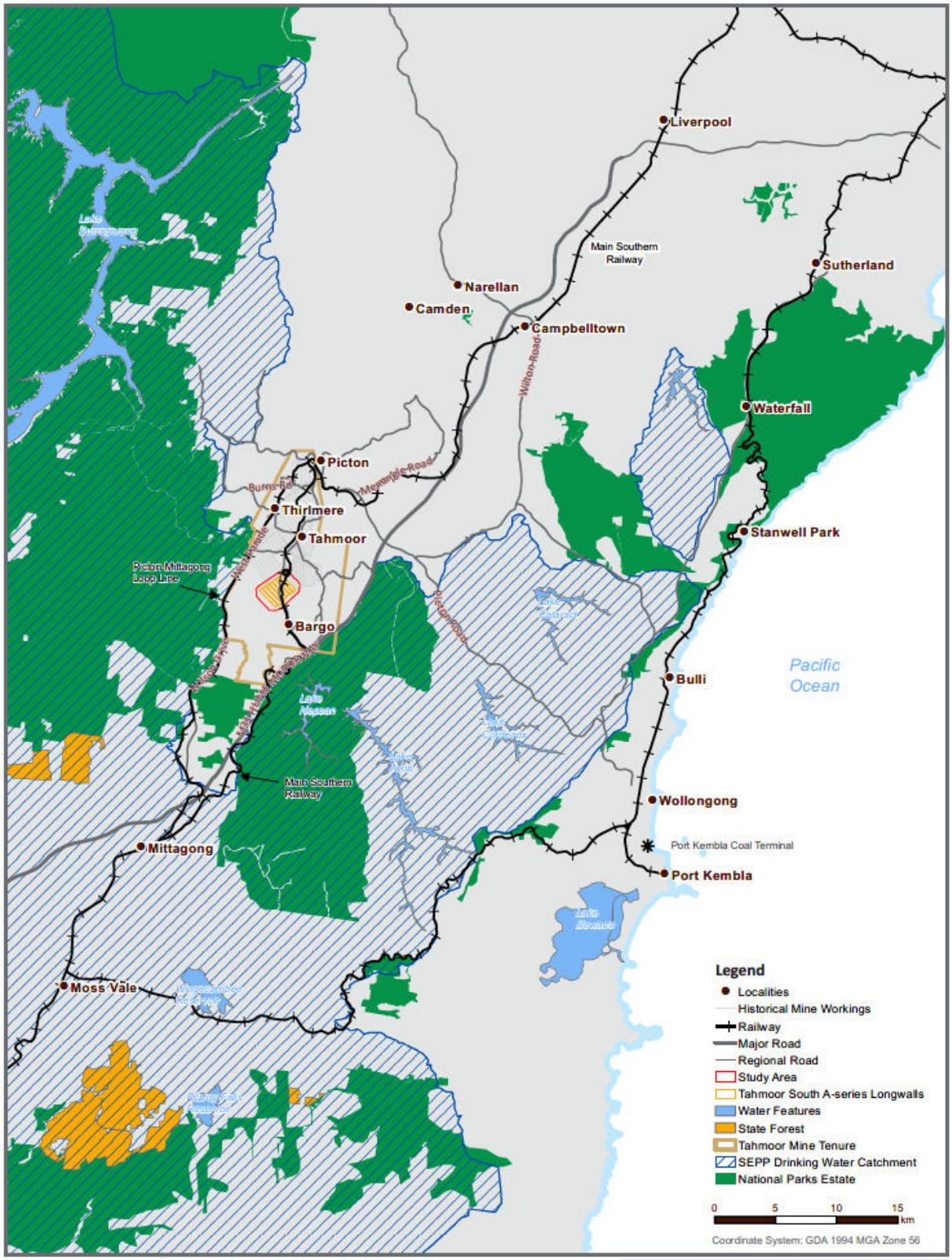
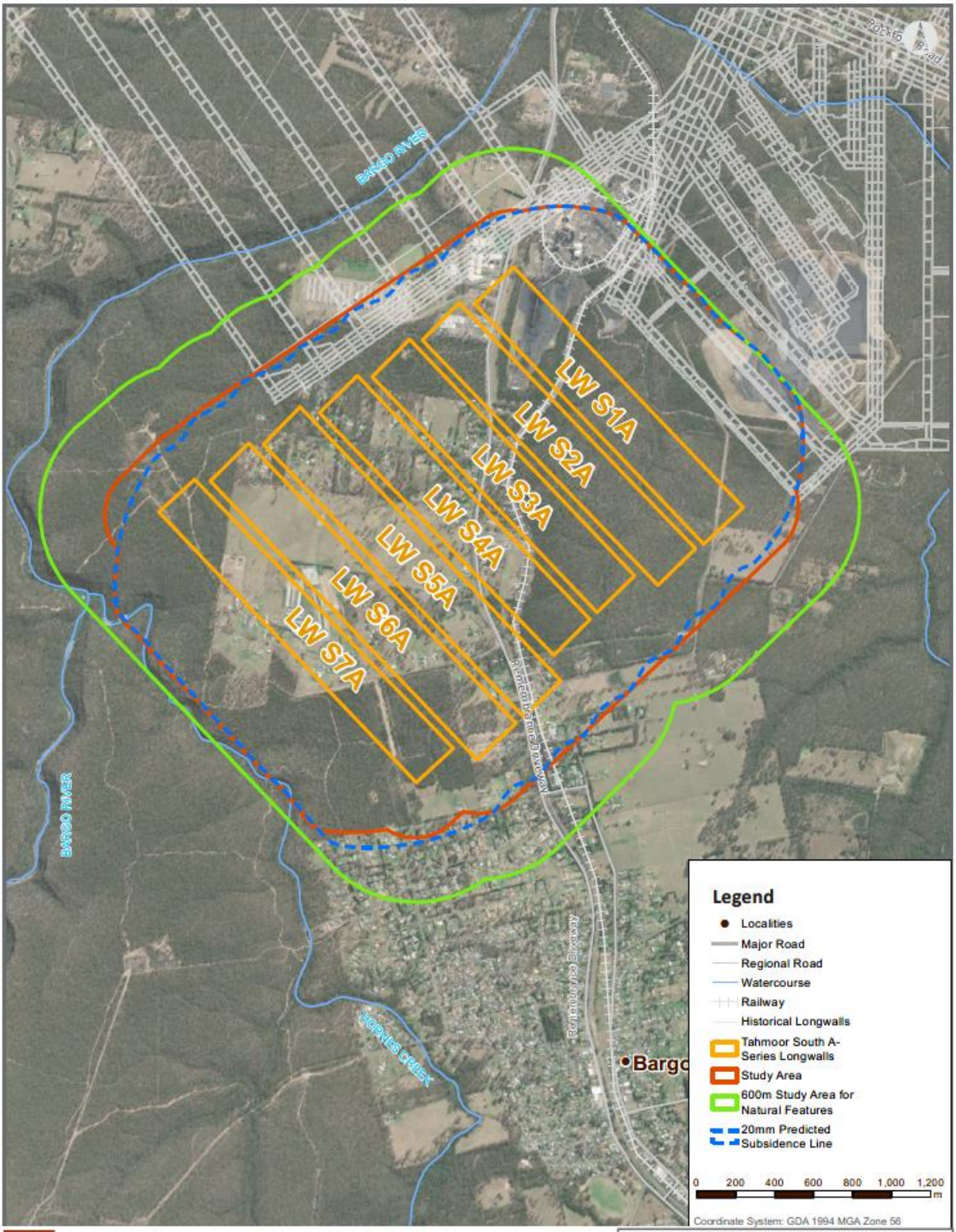


Figure 1 Regional Context



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EXTRACTION PLAN STUDY AREA

Tahmoor South Domain Longwalls S1A to S7A
Extraction Plan

Date: 6/05/2025

Data Sources:
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Aerial Imagery: © Photomapping Services (November 2018)

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Figure 2 Extraction Plan Study Area

2 Regulatory Requirements

2.1 Project Approval

2.1.1 Development Consent Conditions

2.1.1.1 Extraction Plan Requirements

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety, and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database.

LW S1A-S7A will be extracted in the Tahmoor South mining area under Development Consent SSD 8445, as discussed further in Section 3.2.1 of the Extraction Plan Main Document. SSD 8445 provides the conditional planning approval framework for mining activities in the Tahmoor South Domain to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to this management plan from SSD 8445 are detailed in **Table 1.**

SSD 8445 has been modified on three occasions relating to:

- Modification 1 - Extension of time to commission the Tahmoor Coal Water Treatment Plant, approved on 19 July 2022; and
- Modification 2 - Underground brine disposal and transfer of mine water, approved on 13 June 2023.
- Modification 3 - Inclusion of an additional longwall panel (Longwall South 7A (LW S7A)) to the existing approved mine plan, approved on 26 May 2025.

Approval (EPBC 2017/8084) was also granted in 2021 by the then Department of Agriculture, Water and the Environment (DAWE) (now Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW)) for the Tahmoor South Project under sections 130(1) and 133(1) of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act).

It is noted that LW S3A has been shortened by 104 m, as approved by DPHI on 27 March 2024. LW S4A is shortened by 104m as approved by DPHI on 11 November 2024. Modifications to this longwall are discussed in a separate document and further discussion in this document have been omitted. No changes to the proposed monitoring program as presented in this document have resulted from the longwalls shortening.

Table 1 Key Conditions from SSD 8445 regarding Aboriginal and Historical Heritage

Condition Reference	Condition Requirement	Where Addressed
B41	**HERITAGE** The Applicant must ensure that the development does not cause any direct or indirect impact on any identified heritage item, beyond those predicted in the EIS.	**Section 5, Section 6, Appendix A.**
B42	**Protection of Aboriginal Heritage** If any previously unknown Aboriginal object is discovered on the site, or suspected to be on the site: (a) all work in the immediate vicinity of the object or place must cease immediately; (b) a 10 m buffer area around the object or place must be cordoned off; and (c) Heritage NSW must be contacted immediately.	**Section 6.2.3.1**

<table>
<tr><th>Condition Reference</th><th>Condition Requirement</th><th>Where Addressed</th></tr>
<tr><td>B43</td><td>Protection of Aboriginal Heritage
Work in the immediate vicinity may only recommence if:
(a) the potential Aboriginal object is confirmed by Heritage NSW, in consultation with the Registered Aboriginal Parties, not to be an Aboriginal object or Aboriginal place; or
(b) the Planning Secretary is satisfied with the measures to be implemented in respect of the Aboriginal object and makes a written direction in that regard.</td><td>Section 6.2.3.1</td></tr>
<tr><td>B44</td><td>Protection of Aboriginal Heritage
If suspected human remains are discovered on the site, then all work surrounding the area must cease, and the area must be secured. The Applicant must immediately notify NSW Police Force and Heritage NSW, and work must not recommence in the area until authorised by NSW Police Force and Heritage NSW.</td><td>Section 6.2.4</td></tr>
<tr><td>B45</td><td>Protection of Aboriginal Heritage
The Applicant must ensure that all known Aboriginal objects or Aboriginal places on the site and within any offset areas are properly recorded, and those records are kept up to date, in the Aboriginal Heritage Information Management System (AHIMS) Register.</td><td>ACHA (Niche, 2020; EMM, 2024)
Appendix C
Section 6.2.4.2</td></tr>
<tr><td>B46</td><td>Protection of Historic Cultural Heritage
The Applicant must not commence second workings until the Historic Heritage Plan required under condition C8 is approved by the Planning Secretary. The Applicant must implement the Historic Heritage Plan as approved by the Planning Secretary.</td><td>Noted.
Section 7.4</td></tr>
<tr><td>B47</td><td>Visual Amenity and Lighting
The Applicant must:
(a) Take all reasonable steps to minimise the visual and off-site lighting impacts of the development;
(b) take all reasonable steps to shield views of mining operations and associated equipment from users of public roads and privately-owned residences;
(c) ensure no fixed outdoor lights shine directly above the horizontal or above the building line or any illuminated structure;
(d) ensure mobile lighting rigs do not shine directly above the horizontal (except where required for emergency safety purposes);
(e) ensure that all external lighting associated with the development complies with relevant Australian Standards including the latest version of Australian Standard AS4282 (INT) 2019 - Control of Obtrusive Effects of Outdoor Lighting; and
ensure that the visual appearance of any new buildings, structures, facilities or works (including paint colours and specifications) is aimed at blending as far as possible with the surrounding landscape.</td><td>Considered in each individual Construction Environmental Management Plan for surface construction works.
This condition is not relevant to this Heritage Management Plan as the extraction of LW S1A-S7A does not include any of these surface construction works.</td></tr>
<tr><td>C1</td><td>SUBSIDENCE
Performance Measures – Natural and Heritage Features etc.
The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 7.</td><td rowspan="2">Section 5, Section 6, Appendix A.</td></tr>
<tr><td>Excerpt from Table 7</td><td>Table 7: Subsidence impact performance measures - natural and heritage features etc
<table>
<tr><th>Feature</th><th>Performance Measures</th></tr>
<tr><td colspan="2">Heritage</td></tr>
</table></td></tr>
</table>

Condition Reference	Condition Requirement	Where Addressed
	<table><tr><td>Aboriginal cultural heritage sites listed in Appendix 4</td><td>- No greater subsidence impacts or loss of heritage values than predicted in the EIS</td></tr><tr><td>Historic heritage sites listed in Appendix 4</td><td>- No greater subsidence impacts or loss of heritage values than predicted in the EIS</td></tr></table> *Notes for Table 7 (C1):* *Notes:* • *These performance measures apply to all mining taking place after the date of this consent.* • *The Applicant is required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent (see condition CB).*	
C2	**Performance Measures – Natural and Heritage Features etc.** Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Planning Secretary will be the final arbiter.	**Section 5,** Subsidence Management Plans for built features
C8	**Extraction Plan** The Applicant must prepare an Extraction Plan for all second workings on the site of the development to the satisfaction of the Planning Secretary. Each Extraction Plan must:	Noted. This management plan is part of the LW S1A-S7A Extraction Plan Application.
C8(e)	provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed mining covered by the Extraction Plan, incorporating any relevant information obtained since this consent;	**Section 4**
C8(f)	describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 7 and Table 8, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition B56;	**Section 5.1, Section 5.2, Section 6**
C8(g)(vi)	Heritage Management Plan which is consistent with the requirements of conditions B42 to B47:	This management plan. Conditions B42 to B46 considered in **Section 6.2 and 7.4.** Condition B47 is not relevant to this Heritage Management Plan as the extraction of LW S1A-S7A does not include any of these surface construction works.
	• has been prepared in consultation with Heritage NSW, Council and relevant stakeholders for both Aboriginal heritage and non-Aboriginal heritage items;	**Section 2.4**
	• includes a pre-mining assessment of the condition and structure of local and State significant heritage items within the subsidence area;	**Section 3**
	• describes the measures to be implemented to: - protect, monitor and manage potential environmental consequences of the proposed second workings on identified Aboriginal objects and Aboriginal places and	**Section 2.4, Section 5, Section 6.2, Section 6.3, Section 6.4, Appendix A**

Condition Reference	Condition Requirement	Where Addressed
	local and State significant heritage items, in accordance with the commitments made in the EIS; - manage the discovery of suspected human remains and any new Aboriginal objects or Aboriginal places, including provisions for burials, over the life of the development; - ensure compliance with the requirements under conditions B41 to B46 inclusive and the subsidence impact performance measures in Table 7; and - facilitate ongoing consultation and involvement of Registered Aboriginal Parties in the conservation and management of Aboriginal cultural heritage sites within the subsidence area;	
C8(g)(viii)	Trigger Action Response Plans addressing all features in Table 7 and Table 8, which contain:	**Section 6.3, Appendix A**
	• appropriate triggers to warn of increased risk of exceedance of any performance measure;	
	• specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded;	
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measures in Table 7 and/or Table 8, or where any such exceedance appears likely; and	**Section 6.5**
C8(g)(ix)	Contingency Plan that expressly provides for:	**Section 6.4, Appendix A**
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 7 and/or Table 8, or where any such exceedance appears likely;	**Section 6.5**
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures;	**Section 6.2, Section 6.5**
C8(i)	include a program to collect sufficient baseline data for future Extraction Plans.	**Section 5.3**
E4	**Adaptive Management** The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and performance measures in this consent. Any exceedance of these criteria or performance measures constitutes a breach of this consent and may be subject to offset or other provisions as specified in this consent and/or penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria or performance measures has occurred, the Applicant must, at the earliest opportunity: (a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur; (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; (c) within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures or other course of action; and (d) implement reasonable remediation measures as directed by the Planning Secretary.	**Section 6.5**

2.1.1.2 Management Plan Requirements

Condition E5 of the Consent outlines the general requirements for all management plans. **Table 2** outlines the requirements under this condition and identifies where these requirements have been addressed.

Table 2 Management Plan Requirements

Condition Reference	Condition Requirement	Where Addressed
E5	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	Noted.
(a)	a summary of relevant background or baseline data;	**Section 3**
(b)	details of:	NA
(b)(i)	the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Sections 2.1, 2.2 and 2.3**
(b)(ii)	any relevant limits or performance measures and criteria; and	**Section 5.1**
(b)(iii)	the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Section 5.1, Section 6.3, Appendix A**
(c)	any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	**Section 2.1.2**
(d)	a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 6.2**
(e)	a program to monitor and report on the:	NA
(e)(i)	impacts and environmental performance of the development; and	**Section 5**
(e)(ii)	effectiveness of the management measures set out pursuant to condition E5(d);	**Section 6.2.8**
(f)	a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 6.4, Appendix A**
(g)	a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 6.4, Section 6.5.1**
(h)	a protocol for managing and reporting any:	NA
(h)(i)	incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	**Section 7**
(h)(ii)	complaint; or	**Section 7**
(h)(iii)	failure to comply with other statutory requirements;	**Section 7**
(i)	public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	**Section 7**
(j)	a protocol for periodic review of the plan.	**Section 7**

2.1.2 EIS Commitments

Condition A2(g) of the Consent states that the development may only be carried out generally in accordance with the EIS. The relevant EIS documents include:

- Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019;
- Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020;
- Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020; and

- Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.

EIS commitments relevant to this management plan are outlined in **Table 3**. EIS commitments are for non-Aboriginal heritage only. There were no Aboriginal heritage commitments as a result of the EIS and amendment reports. In addition, these EIS commitments do not include commitments that are covered by the SSD 8445 Conditions of Consent.

Table 3 EIS Commitments

EIS Reference	Commitment	Where Addressed
HH-3	**Non-Aboriginal Heritage** Potential impact: Impacts to items of non-Aboriginal Cultural Heritage Significance as a result of longwall mining and mining-induced subsidence. Management and mitigation measures: Develop a site-specific Heritage Property Subsidence Management Plan for Wirrimbirra Sanctuary prior to commencement of mining, including a detailed site inspection. The outcomes of the assessment would be provided in an additional Statement of Heritage Impact in consultation with the National Trust and NSW Heritage Council, or its delegate.	Currently being developed by Tahmoor Coal in consultation with the National Trust and informed by the SoHI (EMM, 2020)

2.1.3 Extraction Plan Guideline

This management plan has been updated in accordance with the NSW Department of Planning and Environment (DPE) *Extraction Plan Guideline* (DPE, 2022), as detailed in **Table 4.**

Table 4 Extraction Plan Guideline Requirements for Key Sub-Plans

Extraction Plan Guideline Content Requirements for Key Sub-Plans	Where Addressed
A short overview of relevant landscape features, heritage sites, environmental values, built features or other values to be managed under the sub-plan.	**Section 3**
Setting out the consent's performance measures directly relevant to the features or values to be managed under the sub-plan.	**Section 2.1.1, Section 5.1**
Setting out clear objectives to ensure the delivery of the performance measures and all other relevant statutory requirements.	**Section 2, Section 5.1, Section 6**
Setting out performance indicators to ensure compliance with the performance measures and statutory requirements.	**Section 5.1, Appendix A**
A description of the relevant features or values to be managed under the sub-plan and their significance.	**Section 3**
A description of all currently predicted subsidence impacts and environmental consequences relevant to the features and values to be managed under the sub-plan.	**Section 4**
A description of all measures planned to remediate these impacts and/or consequences, including any measures proposed to ensure that impacts and/or consequences comply with performance measures and/or the mining company's commitment.s	**Section 6, Appendix A**
A description of the baseline monitoring network and baseline monitoring results, including pre-subsidence photographic surveys of key landscape features and key heritage sites that may be subject to significant subsidence impacts (such as significant watercourses, swamps and Aboriginal heritage sites).	**Section 5, Appendix C** and **Appendix D**
A description of the proposed environmental monitoring of subsidence impacts and environmental consequences.	**Section 5.2**
A description of proposed monitoring of remediation measures.	**Section 6.2, Section 6.4, Appendix A**

A description of adaptive management.	**Section 6.5**
Listing responsibilities for implementation of the plan.	**Section 7**
An attached Trigger, Action, Response Plan	**Appendix A**

2.2 Relevant Legislation and Policies

The relevant acts and regulations protecting and managing Aboriginal and historical heritage in New South Wales are detailed in the subsections below.

This HMP has been prepared in accordance with the principles of the Australia ICOMOS Burra Charter, 2013 (*Burra Charter*). The *Burra Charter* provides guidance for the conservation and management of places of cultural significance and sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians.

Items of heritage significance in NSW are protected by a series of acts whose purpose it is to ensure that change is appropriately managed to ensure that significance is not lost. In NSW, the NSW *Heritage Act 1977* (Heritage Act), *National Parks and Wildlife Act 1974* (NPW Act) and the *Environmental Planning and Assessment Act 1979* (EP&A Act) are the primary statutory controls protecting Aboriginal and historical heritage and archaeology within NSW. Listing on statutory registers provides legal protection for heritage items.

The relevant Acts and regulations protecting and managing Aboriginal and historical heritage in New South Wales are discussed in the sections below.

2.2.1 National Parks and Wildlife Act 1974

The NPW Act provides protection for Aboriginal objects and places across NSW:

- An Aboriginal object is defined as "*Any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains".*
- An Aboriginal place is defined as "*Any place declared to be an Aboriginal place under section 84 of the Act"*. This is a very specific piece of legislation that provides process and management of Aboriginal sites of cultural, but not necessarily scientific, values. They are commonly, but not always associated with intangible values.
- Any place declared to be an Aboriginal place by the Minister for the Environment, under Section 84 of the Act.

While elements of this Act do not apply to SSD (such as the requirement of Aboriginal heritage impact permits (AHIPs) the potential impact on Aboriginal objects still requires consideration as a part of the assessment needs of such projects.

2.2.1.1 Obligation to Avoid Harm

All employees, contractors, sub-contractors and visitors to the project have an obligation to avoid harming Aboriginal heritage unless engaged in an Aboriginal heritage management activity described in this plan.

The NPW Act defines "harm" to an object or place as any act or omission that:

- destroys, defaces or damages the object or place; or
- in relation to an object-moves the object from the land on which it had been situated; or
- is specified by the regulations; or
- causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c), but does not include any act or omission that:
- desecrates the object or place; or
- is trivial or negligible; or
- is excluded from this definition by the regulations.

2.2.1.2 Obligation to Protect and Implement Management Measures

Site personnel, contractors and subcontractors responsible for land management or construction have an obligation to protect Aboriginal heritage within their area or work responsibility. This extends to both cultural materials identified as part of earlier phases of the project, and any additional cultural materials identified during the construction. Protection means active recognition of known Aboriginal heritage and active measure to avoid and/or suitably mitigate Aboriginal heritage.

This may include fencing, erosion control and modification of work plans to avoid impacts to Aboriginal heritage, as well as facilitating a process where work personnel are aware of the nearby heritage. Site personnel, contractors and subcontractors also have the responsibility to ensure that appropriate management measures have been employed prior to, or in association with, their activities which impact Aboriginal sites.

2.2.1.3 Statutory Reporting Requirements

Notifications to Heritage NSW are required in relation to discovery, impact and care of Aboriginal objects under the NPW Act. This will be the responsibility of the project manager, environmental representative and/or equivalent.

2.2.1.4 Discovery of Aboriginal Objects

Under Section 89A of the NPW Act, it is a requirement that Heritage NSW is notified of the existence of Aboriginal objects as soon as practicable after they are first identified. This is done through the completion of the Heritage NSW Aboriginal Site Card which is submitted to the Registrar of AHIMS for inclusion on the Aboriginal site database. Information regarding AHIMS and site recording forms can be downloaded from Heritage NSW's website:

http://www.environment.nsw.gov.au/licences/DECCAHIMSSiteRecordingForm.htm

2.2.1.5 Reporting Impact to Aboriginal Sites

An Aboriginal Site Impact Recording Form must be completed following impacts to AHIMS sites that are:

- A result of test excavation carried out in accordance with the Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW (DECCW, 2010);
- Authorised by an AHIP issued by Heritage NSW;
- Undertaken for the purpose of complying with Secretary's environmental assessment requirements issued by DPE for:
    - state significant development (SSD);
    - state significant infrastructure (SSI); or
    - a major project; or
    - authorised by a SSD/SSI approval under the EP&A Act.

Completed forms must be submitted to the AHIMS Registrar at ahims@environment.nsw.gov.au

Aboriginal Site Impact Recording Forms can be downloaded at:

https://www.environment.nsw.gov.au/resources/cultureheritage/aboriginal-site-impact-recording-form-120558.pdf

2.2.2 Environmental Planning and Assessment Act 1979

2.2.2.1 Aboriginal Heritage

The proposed development has been assessed as an SSD project under Part 4, Division 4.7, of the EP&A Act, and is subject to project-specific environmental assessment and reporting requirements. These requirements (SEARs) stipulate that Aboriginal heritage impact assessment is required (in accordance with standard Heritage NSW procedures and guidelines) to assess whether the project has the potential to impact on Aboriginal objects, sites, or places of Aboriginal heritage significance.

2.2.2.2 Historical Heritage

The EP&A Act establishes the framework for cultural heritage values to be formally assessed in the planning and development consent process in NSW. The EP&A Act requires that environmental impacts are considered before land development, including impacts on cultural heritage items and places as well as archaeological sites and deposits. The EP&A Act requires that local governments prepare planning instruments, such as Local Environment Plans (LEPs) and Development Control Plans (DCPs) to provide guidance on the level of environmental assessment. This includes identification of heritage items, as listed on the heritage schedules of an LEP.

The Study Area is within the Wollondilly Shire Local Government Area (LGA), and therefore the *Wollondilly Local Environment Plan 2011* (WLEP) is applicable.

2.2.3 Heritage Act 1977

The Heritage Act is the statutory framework for the identification and conservation of heritage in NSW.

Relics are defined by the Heritage Act are "*any artefact, object or material evidence which relates to the settlement of that area that comprises New South Wales, not being Aboriginal settlement, and is of State or local significance.*" Relics are protected under Section 139 of the Heritage Act. Where there exists the potential for relics, the land in which it is found cannot be disturbed or excavated without an excavation permit under s140 of the Heritage Act.

The State Heritage Register (SHR) is a list of places and objects of particular importance to the people of NSW. When a place is listed on the SHR or is affected by an interim heritage order, approval under Section 60 of the Heritage Act, is required for any major work. The purpose of this requirement is to ensure that change to significant places is managed appropriately and does not detract from the heritage significance of the place.

State government agencies have responsibilities under Section 170 of the Heritage Act that requires them to identify, conserve and manage heritage assets owned, occupied or managed by that agency. Each agency is required to maintain a S170 register of all heritage assets and assess the significance of each asset.

Section 118 of the Heritage Act allows for a minimum standard of maintenance and repair, provided conditions in the section are met.

2.3 Other Leases and Licences

All development consents, leases, licences, and other relevant approvals are stored in the Cority Compliance Management database, which is administered by both site and Liberty GFG Corporate (owners of Tahmoor Coal). A summary of the relevant mining leases is provided in **Table 5.** A summary of other approvals and licences is provided in **Table 6.**

Table 5 Mining Lease

Lease	Title	Granted	Expires
CCL 716	Original Tahmoor Leases	15/06/1990 (Instrument of Renewal 16/8/2023)	13/03/2042
CCL 747	Bargo Mining Lease	23/05/1990 (Instrument of Renewal 16/05/2025)	06/11/20246
ML 1308	Small Western Lease to west of CCL 716	2/03/1993 (Instrument of Renewal 24/6/2014)	2/03/2035
ML 1376	Tahmoor North Lease	28/08/1995	28/08/2043

Lease	Title	Granted	Expires
		(Instrument of Renewal 28/3/2023)	
ML 1539	Tahmoor North Extensions Lease	16/06/2003	16/06/2035
ML 1642	Pit-top and REA surface Mining Lease	27/08/2010 (Instrument of Renewal 17/10/2022)	27/08/2031

Table 6 Environmental Approvals and Licences

Approval Title / Description	Date Granted	Expiry Date
Environmental Protection Licence 1389	01/05/1994, latest variation 28/06/2024	No Expiry
WAL36442	6/12/2013	No Expiry
WAL25777	27/10/2014	No Expiry
SWC871469 (Leased)	11/07/2025	01/07/2026
SWC868868 (Leased)	01/07/2024	30/06/2025*
WAL43631	08/03/2021	No Expiry
WAL43655	09/03/2021	No Expiry
WAL43656	1/8/2022	No Expiry
WAL43657	09/03/2021	No Expiry
WAL43659	09/03/2021	No Expiry
WAL45204	07/08/2024	No Expiry
XSTR200005 Dangerous Goods Licence	02/02/2017	02/02/2027
5061521 Radiation Management Licence	29/10/2025	29/10/2026

*Lease in process of renewal for FY2026

2.4 Stakeholder Consultation

2.4.1 Consultation to Date

The following stakeholders were consulted during the preparation of the 2022 management plan:

- DPE (Resource Assessments);
- Heritage NSW;
- DPE Environment, Energy and Science (EES) Group;
- Wollondilly Shire Council; and
- Registered Aboriginal parties (RAPs).

The feedback (relevant to Aboriginal and historical heritage) that was provided by these stakeholders is summarised in **Table 7** below and **Section 2.4.2**. This consultation table does not include consultation completed during the Extraction Plan review stage post submission to DPE.

A summary of all consultation undertaken for this extraction plan is provided in Section 2.1.3 of the Extraction Plan Main Document, and a copy of the incoming correspondence is also provided in Appendix C of the Extraction Plan Main Document. It is noted that during consultation with the DPE EES Group, no comments were made regarding heritage items.

Table 7 Consultation to Date

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation
DPIE (Resources Assessments)	A meeting was held between representatives of DPIE (Jessie Evans and Gabrielle Allan) and Tahmoor Coal via teleconference on 20 December 2021. This meeting was an opportunity to outline the proposed LW S1A-S6A Extraction Plan, the key features in the Study Area to be monitored and managed, and stakeholder consultation currently in progress.	Noted.
	DPIE asked how the proposed impact to the Aboriginal heritage item (AHIMS Site #52-2-4471, rockshelter) compares to the performance measures.	Tahmoor Coal advised that this would be addressed in the Heritage Management Plan as part of the Extraction Plan. Tahmoor Coal noted that there may be indirect harm and a partial loss of value for the item.
	A meeting was held between representatives of DPIE (Jessie Evans and Gabrielle Allan) and Tahmoor Coal via teleconference on 10 February 2022. This meeting was an opportunity to discuss further the involvement of the Independent Advisory Panel for Underground Mining (IAPUM) for the assessment of the proposed LW S1A-S6A Extraction Plan.	Noted.
	How will Wirrimbirra / Australian Wildlife Sanctuary be covered?	Tahmoor Coal responded that a separate management plan will be prepared, and submitted prior to start of Longwall South 1A. Tahmoor Coal also noted that there is a good relationship with Wirrimbirra / National Trust and a Land Access Agreement is in place.
Heritage NSW	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 22 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. A response was received on 13 March 2022 stating there are no specific comments on the proposed extraction.	Noted.
Wollondilly Shire Council	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 22 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. A response from Council's Waste and Environmental Services Team was received on 14 February 2022. This response did not include any comments relating to Aboriginal or historical heritage.	Noted.
Heritage NSW	Pamela Chauvel (EMM) contacted Rose O'Sullivan (Principal Assessments Officer) on 21 April 2022 to discuss the rationale for undertaking the proposed test excavation in rockshelter Teatree Hollow 2013.1, as presented to RAPs in the draft HMP (i.e. undertaken under an approved SSD, 10% chance of	A follow up email was sent to the heritage mailbox and Rose O'Sullivan on 28 April 2022 providing a copy of the methodology letter that was sent to RAPs.

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation
	impacts from underground mining, the opportunity gather a sample of archaeological information prior to any potential impacts impacts). Following on from non-invasive recording (photogrammetry, measured drawings, etc), EMM proposed draft additional investigations to the RAPs. Feedback has been that the RAPs who have commented on the HMP are supportive of test excavation that is targeted and minimal, but that ochre sampling was less supported and excluded from the HMP.	Rose responded on 5 May 2022 in support of the methodology but acknowledged that Heritage NSW will undertake more detailed review once the HMP is referred to them from DPE. Excavations were carried out with the RAPs in late 2022.
Heritage NSW	Alan Williams (EMM) distributed final report of the works undertaken at the Teatree Hollow rockshelter on 8 May 2023.	Noted

2.4.2 Aboriginal Consultation

This project has an established list of RAPs that require ongoing consultation during the pre-mining, mining and post-mining phases of the project. A list of the 43 stakeholders and their contacts is provided in **Table 8.**

The RAPs require consultation during the finalisation of, and any updates to, the HMP, as part of any cultural inductions and cultural monitoring, and in the event of any unexpected impacts occurring. Timing for notification of each of these activities is provided in **Table 9.**

Table 10 provides a list of dates that are important to the Aboriginal community, and during which works requiring their participation should be delayed/cancelled to avoid any potential conflict.

As a requirement of the assessment process, bothACHAs (Niche Environment and Heritage Pty Ltd, 2020 and EMM consulting Pty Ltd , 2024) undertook Aboriginal consultation in accordance with Heritage NSW's *Aboriginal Cultural Heritage Consultation Requirements for Proponents*. This process required the identification and notification of the local Aboriginal community to identify individuals and/or organisations that had an interest in the project. Niche's 2020 ACHA identified 29 individuals and/or organisations, while EMM's 2024 ACHA identified 19. Several of these registrations overlap between the two ACHAs. In total, 43 RAPs individuals and/or organisations registered an interest in the project (**Table 8**). RAPs were provided opportunities to review Aboriginal heritage documentation, including the ACHAs, and participating in the on-site activities. Cubbitch Barta Native Title Claimants Aboriginal Corporation (Cubbitch Barta) and Tharawal Local Aboriginal Land Council (TLALC) are currently the preferred contractors engaged by Tahmoor Coal to undertake on-site cultural heritage management fieldwork due to their longstanding relationship with Tahmoor Coal. As such, preference is given to these groups for ongoing site fieldwork requirements and opportunities.

Consultation was undertaken with RAPs (**Table 8**) who have been involved in the consultation process since the preparation of the ACHA (Niche, 2020). Documentation of the consultation process and its outcomes is included in **Appendix B**.

Consultation with RAPs for the preparation of this HMP has included the following key stages:

- Notification of Tahmoor Coal's intent to prepare a HMP, including the provision of background information and the HMP scope and indicative timing (17 January 2022);
- Provision of draft HMP for RAP review and feedback (1 April 2022); and
- Provision of further draft HMP information with further details of a test excavation methodology for the rockshelter with art and stone artefacts: Teatree Hollow 2013.1 (AHIMS 52-2-4471) (19 April 2022).

This information has been retracted
- For more information contact Tahmoor Coal

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MEMBER OF GFG ALLIANCE

Project stage	Activity	Type and preferred method of communication	Comment period to be provided
		Cubbitch Barta and TLALC to be invited to participate.	
	Finalisation of HMP	Provision of final report via e-mail and/or post prior to its implementation (with the exception of archival recording which has been completed during the preparation of the HMP).	4 weeks
	Archaeological excavations and dating methods	Select RAP representatives will be engaged for test excavation of Teatree Hollow 2013.1 (#52-2-4471), noting that Cubbitch Barta and TLALC are the preferred RAP contractors with Tahmoor Coal. Initial notification via phone/e-mail to advise of the schedule of the proposed program, followed by further excavation details, timing, personnel required, and relevant engagement and subcontract documentation, etc, via e-mail/post.	2 weeks
During mining	Monitoring of rockshelter: Teatree Hollow 2013.1 (#52-2-4471)	Monitoring of the rockshelter by a qualified archaeologist and RAP representative(s) will be undertaken at the end of each longwall panel. Cubbitch Barta and TLALC to be invited to participate. All RAPs to be informed via email of the results of monitoring Monitoring reports are included in Appendix G (note: this has been partially completed following the completion of longwalls S1A-S3A in July 2023, April 2024, December 2024).	Ongoing, with a minimum of one week's notice when required
	Monitoring of rockshelters Hornes Creek RS2-RS7	Monitoring of the rockshelter by a qualified archaeologist and RAP representative(s) will be undertaken at the end of LW S7A. Cubbitch Barta and TLALC to be invited to participate. All RAPs to be informed via email of the results of monitoring	2 weeks
	Hornes Creek GG1	Monitoring of the site by a qualified archaeologist and RAP representative(s) will be undertaken at the end of LW S7A. Cubbitch Barta and TLALC to be invited to participate. All RAPs to be informed via email of the results of monitoring	2 weeks
	Any impacts observed during ongoing monitoring inspections	Initial notification via e-mail followed by provision of documentation for review as required. Where significant or major impacts have occurred suitable face-to-face meetings and/or on-site observation should be provided.	Within 7 days of impact
	Unexpected finds	Contact all RAPs via e-mail or phone to advise of any unexpected finds and proposed management. This may include invitation to undertake on-site observations.	Within 2 days of find
Post-mining	Monitoring of rockshelter: Teatree Hollow 2013.1 (#52-2-4471)	Monitoring of the rockshelter by a qualified archaeologist and RAP representative(s) will be undertaken at the end of each longwall panel. Cubbitch Barta and TLALC to be invited to participate. All RAPs to be informed via email of the results of monitoring.	2 weeks
	Monitoring of rockshelters Hornes Creek RS2-RS7	Monitoring of the rockshelter by a qualified archaeologist and RAP representative(s) will be undertaken at the end of LW S7A. Cubbitch Barta and TLALC to be invited to participate. All RAPs to be informed via email of the results of monitoring	2 weeks

Project stage	Activity	Type and preferred method of communication	Comment period to be provided
	Hornes Creek GG1	Monitoring of the site by a qualified archaeologist and RAP representative(s) will be undertaken at the end of LW S7A. Cubbitch Barta and TLALC to be invited to participate. All RAPs to be informed via email of the results of monitoring	2 weeks
	Remediation (if required)	Initial notification via e-mail followed by provision of documentation for review as required. Where significant or major impacts have occurred suitable face-to-face meetings and/or on-site observation should be provided.	≥2 weeks

Table 10 Culturally Sensitive Dates to Avoid for Aboriginal Heritage Inputs/Participation

Dates	Activity	Description
26 January	Invasion Day	Also known as Australia Day, the public holiday and surrounding days, are increasingly seen as a time of trauma for Aboriginal people, and any work activities will be re-scheduled to avoid this date.
27 May – 3 June	National Reconciliation Week, includes Sorry Day	A week during which Australians are encouraged to learn about shared histories, cultures, and achievements, and to explore how one can contribute to achieving reconciliation in Australia. Aboriginal people are often committed to activities during this week and will often be unavailable.
First Sunday – Second Sunday July	NAIDOC week	A week during which Australians are encouraged to celebrate Aboriginal history, cultural and achievements. Aboriginal people are often committed to activities during this week and will often be unavailable.
-	Sorry business	Sorry business is when a member of the Aboriginal community has passed away, and includes the funeral, mourning period and other related associated activities. The timing for these are unknown and are variable, but when advised that there is Sorry business, the project activity should be postponed.

3 Existing Environment

3.1 Summary of Aboriginal Heritage

An ACHA was initially prepared as part of the EIS for the Tahmoor South Coal Project in 2018. Tahmoor Coal subsequently revised the proposed mine design and submitted two amended development applications, with an updated ACHA, in 2020. The ACHA assessed the subsidence study area of all twelve longwalls proposed for the Tahmoor South Coal Project (A and B series) and was undertaken in accordance with Heritage NSW guidelines. This included consultation with the Aboriginal community, desktop review of the regional archaeological record, and on-site investigations to identify and assess the cultural heritage within the project area. Field investigations involved survey of the subsidence area by Niche in 2018 and of the electricity transmission line alignment by EMM in 2020 (addendum report in the ACHA), and test excavation undertaken in 2020 by EMM (addendum report in the ACHA). In 2024 EMM prepared an ACHA for Modification 3 approval, which is the inclusion of longwall 7A.

In summary, the following Aboriginal heritage assessments were completed as part of the EIS:

- Aboriginal Cultural Heritage Assessment: Tahmoor South (Niche, 2018);
- Aboriginal Cultural Heritage Assessment: Amended Tahmoor South Project (Niche, 2020);
- Tahmoor South Project: Addendum to the Aboriginal Cultural Heritage Assessment (EMM, 2020); and
- Aboriginal Cultural Heritage Assessment: Tahmoor Mine Modification 3 (EMM, 2024).

Aboriginal heritage assessments and surveys undertaken in the local area have generally been situated on the rolling hills or smaller drainage lines. The most common type of Aboriginal heritage site located during these previous assessments has been open sites containing stone artefacts, most commonly on flats, lower slopes and hill crests. As the area has been largely cleared for pasture, scarred trees are rare. Where sandstone is exposed in incised and eroded drainage features, axe grinding grooves and shelter sites may be present. The ACHA identified Dogtrap Creek (approximately 2 km to the south of the Study Area) as a significant archaeological complex with a high number of rockshelter sites in the sandstone geology beside Dogtrap Creek. These art sites contain a distinctive and representative assemblage of anthropomorphic motifs (Niche, 2020; p.38).

3.2 Aboriginal Sites within the Study Area

There are nine registered Aboriginal sites recorded in the Study Area. comprising two artefact sites with 1–2 artefacts, six rockshelters with deposit, artefacts or both and a rockshelter with art and artefacts – Teatree Hollow 2013.1 (#52-2-4471). A grinding groove site, Hornes Creek GG1 (AHIMS #52-2-4980), was recorded within 10m of the study area and has been included due to the significance of the site. It should be noted that the site is located outside the 20mm subsidence zone, hence the likelihood of subsidence impact is considered low. As an example, Teatree Hollow 2013.1 that was mined beneath and subject to regular monitoring (section 5.2.1) revealed no impacts. Notably, majority of these sites are further away than Teatree Hollow 2013.1.

Table 11 and **Figure 3** provide an overview of the registered Aboriginal sites within the Study Area. Further information about the registered Aboriginal heritage sites can be found in the ACHA reports (Niche, 2020; EMM 2024).

The three sites that were assessed by Niche were assessed as having low archaeological significance because they are considered to align with the following criteria:

> The site or object contains only a single or limited number of features and has no potential to meaningfully inform our understanding of the past beyond what it contributes through its current recording (ie. No or low research potential). The site or object is a representative but unexceptional example of the most common class

> of sites objects in the region. Many more similar examples can confidently be predicted to occur within the Subject Area or region (Niche, 2020; p.64-5).

The six sites EMM assessed were assessed as either low moderate or high archaeological significance because they are considered to align with the following criteria:

> When considering the scientific significance, many of the sites can be considered to have moderate (local) value with the ability to provide information on the past activities of the area (research potential). These primarily include the rockshelters with artefacts and/or PAD. All of these can be subject to further investigations, such as archaeological excavation, and which can provide data on the timing, behaviour and environments within which people visited and used the locale. Larger rockshelters, particularly those that contain observed cultural material, are assessed as having higher scientific significance compared with those that are smaller and/or contain no observed cultural material. Of these, Hornes Creek RS2 (#52-2-4975) and Hornes Creek RS6 (#52-2-4982) are considered to have the highest research potential containing artefacts and extensive PAD that could be further investigated (EMM, 2024; p.68-9).

Rockshelter Teatree Hollow 2013.1 has a number of ochre and charcoal art panels and confirmed deposit (20 artefacts were identified in 2013). Therefore the (research) and cultural significance of this site could be considered higher than the small open stone artefact sites nearby that were attributed with the same significance level (as per the significance criteria). Feedback from RAPs as part of the consultation process for this HMP has been that they consider this site to be of higher cultural significance rather than the low significance rating attributed to it in the ACHA (Niche, 2020) (refer **Section 2.4.2**).

Table 11 Aboriginal Heritage Sites within the Study Area (Niche, 2020)

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (Niche, 2020)*	Management as stipulated in the ACHA (Niche, 2020)
48-2-0275	TC14-2-19	Isolated find	Single silcrete flake on an existing transmission line.	Hillslope	350 m east of LW S1A	Low	No management required.
52-2-3968	Remembrance Drive 2013.1	Open camp site	Two red silcrete artefacts with located on a small knoll with potential archaeological deposit (PAD).	Crest	10 m west of LW S3A	Low	No management required.
52-2-4471	Teatree Hollow 2013.1	Rockshelter with art and deposit	Sandstone shelter formed by cavernous weathering and blockfall, beside Teatree Hollow Creek. Artefacts of quartz, chert and silcrete. Three art panels: • 3 hand stencils, 1 foot stencil and 4 indeterminate red stencils; • Indeterminate charcoal line; and • Infill charcoal fish and 3 indeterminate charcoal infill lines.	Lower scarp	Above LW S2A	Low	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

– *The significance of these sites adopts those outlined in the existing Aboriginal cultural heritage assessment that documents them. It is acknowledged that these rankings primarily apply scientific significance to the classification, and may contrast from views of specific Aboriginal individuals or parties. It is acknowledged that feedback from one of the registered Aboriginal parties believes that these sites may be of higher cultural significance than presented here (see Section 2.4.2).

Table 12 Aboriginal Heritage Sites within or nearby the Study Area (EMM, 2024)

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (EMM, 2024)*	Management as stipulated in the ACHA (EMM, 2024)
52-2-4975	Hornes Creek RS2	Rockshelter with deposit and artefacts	High, shallow rockshelter with deposit and artefacts. Overhang extends for approximately 80 m along the upper scarp. Artefacts were identified under the dripline within a 1 m^2 area. Artefacts included a mudstone flake, a quartz flake piece and a silcrete flake.	Upper scarp	~300 m south west of LW S7A	High	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (EMM, 2024)*	Management as stipulated in the ACHA (EMM, 2024)
52-2-4976	Hornes Creek RS3	Rockshelter with deposit	Cavernous, open shelter facing west on the upper scarp. Rockshelter has a rock platform base overlaid with 10-20 cm depth of sandy PAD and a large area of PAD below the drip line.	Upper scarp	~350 m south west of LW S7A	Low	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (EMM, 2024)*	Management as stipulated in the ACHA (EMM, 2024)
52-2-4977	Hornes Creek RS4	Rockshelter with deposit and artefact	• Large, west facing rockshelter with good amenity and area of PAD (6 x 4 m). Charcoal graffiti and disturbance from recent campfires in the shelter. Indeterminate charcoal markings, partly covered in lichen may represent earlier artworks. One silcrete debitage flake.	Upper scarp	~350 m south west of LW S7A	Moderate	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (EMM, 2024)*	Management as stipulated in the ACHA (EMM, 2024)
52-2-4978	Hornes Creek RS5	Rockshelter	Low shelter (1.7 m high) with charcoal graffiti and some indeterminate charcoal markings. No PAD.	Upper scarp	~300 m south west of LW S7A	Low	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (EMM, 2024)*	Management as stipulated in the ACHA (EMM, 2024)
52-2-4982	Hornes Creek RS6	Rockshelter with deposit and artefact	Large rockshelter formed by cavernous weathering, facing north above Hornes Creek. A small micro-debitage mudstone flake was found within the dripline. The shelter contains an area of PAD approximately 6 x 3 m.	Upper scarp	~400 m south west of LW S7A	High	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

AHIMS site number	Site name	Site type	Description	Landform	Distance from the longwalls	Significance (EMM, 2024)*	Management as stipulated in the ACHA (EMM, 2024)
52-2-4981	Hornes Creek RS7	Rockshelter with deposit	Small rockshelter with PAD (approximately 1 x 3 m) beside Hornes Creek.	Footslope	~350 m south west of LW S7A	Low	Subsidence monitoring program to monitor all Aboriginal sandstone shelter sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.
52-2-4980	Hornes Creek GG1	Grinding grooves	Narrow grinding grooves, possibly from spear sharpening, located on a sandstone platform in Hornes Creek. The grooves (n=7) are oriented north – south. The deepest groove is approximately 5 mm deep, 130 mm long and 15 mm wide.	Creek (4th order)	~400 m south west	Moderate	Subsidence monitoring program to monitor all Aboriginal sandstone sites located within the 35° angle of draw of the project. The program should include (but not be limited to): • appropriate detailed baseline and archival site recordings, including high resolution digital photographs; • a schedule for undertaking subsidence monitoring; • an impact Trigger Action Response Plan (TARP) specific to the site.

– *The significance of these sites adopts those outlined in the existing Aboriginal cultural heritage assessment that documents them. It is acknowledged that these rankings primarily apply scientific significance to the classification, and may contrast from views of specific Aboriginal individuals or parties. It is acknowledged that feedback from one of the registered Aboriginal parties believes that these sites may be of high cultural significance than presented here (see Section 2.4.2).

3.3 Historical Heritage Items

3.3.1 Registered Historical Heritage Sites within the Study Area

An Historical Heritage Assessment (HHA) was initially prepared as part of the EIS for the Tahmoor South Coal Project in 2018 (Niche Environment and Heritage Pty Ltd, 2012). Tahmoor Coal subsequently revised the proposed mine design and submitted two amended development applications, with an updated assessment of historical heritage impacts, in 2020. Section 6.1 sets out the changes that were made to the mine design and have generally reduced the impacts on historical heritage items. The HHA (Niche, 2018) assessed the disturbance footprint of all twelve longwalls proposed for the Tahmoor South Coal (A and B series) and was undertaken in accordance with Heritage NSW guidelines. This included desktop review and on-site investigations (field survey) to identify and assess the cultural heritage within the project area. As part of this process, a review of the following databases was undertaken in September 2017 and reviewed for this report:

- Commonwealth Heritage List (CHL);
- National Heritage List (NHL);
- State Heritage Register (SHR);
- Wollondilly Local Environment Plan (WLEP 2011), schedule 5;
- Sydney Trains on behalf of Transport Asset Holding Authority (TAHE) s170 register;
- Australian Rail Track Corporation (ARTC) s170 register;
- Country Regional Network (CRN) managed by John Holland Rail (JHR) S170 Register; and
- Non-statutory National Trust register.

Within the Study Area there are no items listed on the CHL or NHL. One heritage item, Wirrimbirra Sanctuary (now known as the Australian Wildlife Sanctuary) is of State heritage significance and is listed on the SHR for its historical heritage values, research potential, rarity and associative values. Wirrimbirra Sanctuary is also listed on the National Trust register and the WLEP (2011). A site-specific management plan for the Sanctuary is being developed as a stand-alone document. The *Australian Wildlife Sanctuary Management Plan* includes a Statement of Heritage Impact (EMM, 2020) that was prepared in consultation with the National Trust and NSW Heritage Council.

Including Wirrimbirra Sanctuary, there are two registered items of local heritage significance (WLEP 2011) within the Study Area and three additional item of local heritage significance that are outside the Study Area but may be subject to far field movement (Picton Weir, Bargo Railway Bridge North (known as the Wellers Road Overbridge) and Bargo Railway Viaduct). Bargo Railway Bridge North is also listed on the CRN S170 Register.

A summary of registered heritage items is provided in **Table 13.**

3.3.2 Unregistered Historical Heritage Sites within the Study Area

Two unregistered heritage sites were identified by Niche (2020): the Great Southern Road in Bargo (c.1820) and Tahmoor Colliery (c.1972) (also known as the Tahmoor Mine Site). Approximately 550 m of the Great Southern Road at its northern end are located within the Study Area. The road has had many subsequent upgrades and parts of the original road are no longer in use. Tahmoor Colliery was identified in the *Macarthur Heritage Study* (1986) as item #509 but is not listed on any of the heritage registers.

A description of these unregistered heritage items is included in **Table 13.**

Table 13 Registered and Unregistered Historical Heritage Sites in the Study Area and Surrounds (EMM, 2021b; EMM, 2021d)

SHR	WLEP	S170 Register	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
Registered historical heritage sites within the Study Area							
01508	139		Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)	31105 Remembrance Driveway, Bargo (Lot 1/DP789005; Lot 132/DP130897; Lots 18, 19. 33, 203/ DP 751250)	The sanctuary comprises an area of approximately 95 hectares containing remnant Bargo Brush, and established gardens with over 1,800 native plants that provide a resource base for the study of native flora. A dingo sanctuary is located on the property. A number of buildings were destroyed during the 2019 bushfires. Within the Administration Area there are two rangers' cottages; a visitors' centre; a nursery structure, shade house, glass house, workshop, enclosures and sheds. Archaeological evidence of pre-sanctuary settlement within the grounds includes a hut site, stone well and sandstone retaining walls.	Above LW S1A – S4A	Wirrimbirra has State significance for its role in the development of the conservation movement in NSW; its association with key persons who pioneered the conservation debate; as a natural area with a rich and diverse flora and fauna, including rare and endangered species; as a recreation and social area; as a historic site containing relics and cultural items, as well as being associated with the pioneering expeditions to the Southern Highlands; as an area containing extensive plantings of native plants including rare and endangered species, and as an area which encouraged investigations into the growing and propagation of native plants (SHI).
	I18		Bargo Cemetery	15 Great Southern Rd, Bargo (Lot 7013/DP 93010)	Small cemetery surrounded by a plantation of mature trees. The earliest marked grave is 1935. The cemetery is still in use with lots allocated to 'Church of England' and 'Roman Catholic' and three unused lots. There is a residential house on the site of 'Mission Hall' church site.	Above LW S4A – S5A	The Bargo Cemetery has local significance for its associations with the growth of Bargo in the twentieth century following the construction of the railway SHI). It has social and cultural significance for the local community.
	I40	John Holland Rail (JHR)	Bargo Railway Bridge North	Wellers Rd, Bargo	Brick construction road bridge over the Main Southern Railway (c.1919). Dentil course capping and stone construction to base and arch. The original Aeroplane Jelly	360 m south-east of LW S6A	The Bargo Rail Bridge has local significance through its association with the construction of the southern rail line. It is a typical example of

SHR	WLEP	S170 Register	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
			(Wellers Road Overbridge)		advertisement that graced the arch has been painted over but is still in situ and could possibly be recovered.		rail bridges constructed in the 1890-1920 period built to an established model by the NSW Government Railways. It has further significance through its association with the deviation from the original Picton – Mittagong route.
	I41		Picton Weir	Bargo River, Bargo	Constructed on the Bargo River in 1899 for the Picton water supply by the Department of Public Works. The weir is no longer used as part of the water supply infrastructure and has been replaced by the Nepean Dam.	800 m south-west of LW S6A	Picton Weir has local significance as evidence of the attempts by State and Local governments to provide reliable potable water sources to towns and regional areas in the late nineteenth century. It is an excellent example of late nineteenth century civil engineering and is an important component of the historic cultural landscape of Bargo. It is a good early example of early water technology, for controlling water flows on the Bargo River (SHI).
01024	I33		Bargo Railway Viaduct	Main Southern railway. Chainage 96.265 kms	Constructed in 1919, Bargo Railway Viaduct is a large brick arch viaduct consisting of five 15.2 m (50 feet) spans over the Bargo River. The bridge is part of the major duplication of the Main South Railway and supports dual railway tracks	1.5 km north of LW S1A	Bargo Railway Viaduct has significance because it is part of the major duplication of the Main South Railway, the use of brick construction compliments the natural environment, the duplication work contributed significantly to the continued development of South Western New South Wales, commercially through freight trains and socially through faster, better

SHR	WLEP	S170 Register	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
							passenger trains and in the 'era of brick arch construction', 1910-23, there were around 90 railway sites where brick arches singly and in multiples, for clear spans from 6.1 m (20 feet) to 13.1 m (43 feet) were built. But this viaduct has a set of larger brick arches at 15.2 m (50 feet) clear spans. The bridge retains its original fabric and structure (SHI).
Unregistered heritage items within the Study Area							
			Tahmoor Colliery (Tahmoor Mine Site)	Remembrance Drive, Bargo	Established in 1972, the buildings and infrastructure were constructed between 1975 – 1983. The site consists of an underground mine and Coal Handling and Preparation Plant, a series of conveyor belts and stockpile silos as well as an administration block, workshops and sheds.		Tahmoor Colliery has local significance for its role in illustrating the course and pattern of industrial development in Tahmoor.
			Great Southern Road (partial)	Great Southern Rd, Bargo	Partially within the Study Area. Built c.1820s, many parts of the Great Southern Road in Bargo are still in use. The road has had many upgrades with concrete kerbing and guttering in some places. Parts of the original road are no longer in use where new sections of the road were resumed to improve the route.		The Great Southern Road has local significance as an early road alignment and illustrates the course and pattern of development in the local area.

4 Predicted Subsidence Impacts and Environmental Consequences

4.1 Aboriginal Heritage Items

Mine Subsidence Engineering Consultants (MSEC) has prepared a subsidence impact assessment for the Aboriginal heritage sites within and outside of the Study Area (MSEC, 2022; MSEC, 2024). The likelihood of damage occurring at the Aboriginal heritage sites was assessed on criteria which considers theoretical cracking limits caused by strains and tilts. A detailed discussion of the likely impacts to Aboriginal items in the Study Area as a result of subsidence is provided in Section 13 of the ACHAs (Niche, 2020; EMM 2024).

An overview of the predicted subsidence impacts on Aboriginal site types is provided in **Sections 0 – 4.1.2** and summarised in **Table 14**.

If potential or confirmed subsidence impacts are observed during monitoring Tahmoor Coal will implement the TARP (**Appendix A**). In the event of any subsidence impact, appropriate management, remediation and mitigation measures will be undertaken in accordance with this HMP.

Table 14 Aboriginal Heritage Sites within LW S1A–S6A Extraction Plan Study Area and Predicted Likelihood of Impact

AHIMS	Site name	Site type	Significance (Niche, 2020)	Location in relation to the longwalls	Predicted probability of impact (MSEC, 2022)
48-2-0275	TC14-2-19	Isolated find	Low	350 m east of LW S1A	Very unlikely
52-2-3968	Remembrance Drive 2013.1	Open camp site	Low	10 m west of LW S3A	Very unlikely
52-2-4471	Teatree Hollow 2013.1	Rockshelter with art and deposit	Low	Above LW S2A	Unlikely

Table 15 Aboriginal Heritage Sites within LW S7A Extraction Plan Study Area and Predicted Likelihood of Impact

AHIMS	Site name	Site type	Significance (EMM 2024)	Location in relation to the longwalls	Predicted probability of impact (MSEC, 2024)
52-2-4975	Hornes Creek RS2	Rockshelter with deposit and artefacts	High	~300 m south west of LW S7A	Unlikely
52-2-4976	Hornes Creek RS3	Rockshelter with deposit	Low	~350 m south west of LW S7A	Unlikely
52-2-4977	Hornes Creek RS4	Rockshelter with deposit and artefact	Moderate	~350 m south west of LW S7A	Unlikely
52-2-4978	Hornes Creek RS5	Rockshelter	Low	~300 m south west of LW S7A	Unlikely
42-2-4982	Hornes Creek RS 6	Rockshelter with deposit and artefact	High	~400 m south west of LW S7A	Unlikely

AHIMS	Site name	Site type	Significance (EMM 2024)	Location in relation to the longwalls	Predicted probability of impact (MSEC, 2024)
52-2-4981	Hornes Creek RS7	Rockshelter with deposit	Low	~350 m south west of LW S7A	Unlikely
52-2-4980	Hornes Creek GG1	Grinding grooves	Moderate	~350 m south west of LW S7A	Unlikely

4.1.1 Artefact Sites – Isolated Finds and Artefact Scatters

Subsidence movements are not expected to have observable effects on artefact scatters and isolated finds in open terrain as in the case of deeper longwall mines, any stresses and strains exerted by the ground movement will generally be within the tolerance limits of the soil profile (therefore showing little impact to no impact on the surface). It is noted, however, that isolated cracking of soils at the surface may occur (MSEC, 2022 p.140). If this cracking is coincident with a surface Aboriginal heritage site or object, then it could be argued that the site is harmed. In addition, if remediation of the surface was required after mining, these works could potentially impact the sites. This is considered a low risk and extremely unlikely to occur.

Other possible impacts may be from changes to surface or sub-surface drainage, which may alter local erosion and potentially expose, slump or bury sites. Such cases, especially in respect of isolated objects, would be very difficult to predict. Overall, the artefact sites can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. It is unlikely, however, that the artefacts themselves would be impacted by surface cracking (MSEC, 2022; p.140).

The performance measures in the Conditions of Consent require "no greater subsidence impacts or loss of heritage values than predicted in the EIS". Predicted impacts on the artefact sites in the EIS (MSEC, 2020) for both A and B series longwalls are included in **Table 16**, along with the predictions specific to the A series of longwalls (MSEC, 2022; MSEC, 2024).

In summary, subsidence movements are not expected to have observable effects on the two registered artefact sites within the Study Area which are recorded as having one and two artefacts respectively, as they are located in open terrain with a very gently sloping gradient. The predicted likelihood of impact on artefact sites is considered extremely unlikely and subsidence movements are unlikely to constitute 'harm' as defined by the NPW Act.

Table 16 Predicted Impacts on Artefact Sites After All Longwalls

	Total subsidence (mm)	Maximum tilt (mm/m)	Maximum hogging (1/km)	Maximum sagging (1/km)
MSEC 2020 (EIS) A and B series longwalls	1050	6	0.09	0.03
MSEC 2022 A series longwalls	550	5	0.05	0.02
MSEC 2024 Longwall S7A	20	<0.5	<0.01	<0.01

4.1.2 Rockshelter Sites

There are seven registered rockshelter sites within the Study Area.

Teatree Hollow 2013.1 (AHIMS 52-2-4471) is situated within the valley of a tributary stream to Teatree Hollow and may therefore experience valley related movements. However, the valley is not deeply incised but broad and low which reduces the potential for subsidence related impacts. Hornes Creek RS2- RS7 (AHIMS #52-2-4975, #52-2-4976, #52-2-4977, #52-2-4978, #52-2-4982, #52-2-4981) are located on steep sandstone scarps overlooking Hornes Creek.

However, it is difficult to assess the likelihood of instabilities for rockshelters based upon predicted ground movements as the likelihood of the shelters becoming unstable is dependent on several factors which are difficult to fully quantify. These factors include jointing, inclusions, weaknesses within the rockmass, groundwater pressure and seepage flow behind the rockface. Even if these factors could be determined, it would still be difficult to quantify the extent to which these factors may influence the stability of the shelter naturally or when it is exposed to mine subsidence movements (MSEC, 2022, p.140).

Monitoring of the effects of subsidence induced ground movements to Aboriginal heritage sites (such as rockshelters and grinding groove platforms) has been conducted since the 1990s (see Sefton, 2000; Biosis Research, 2009; Regal and Reeves, 2017; Regal Heritage, 2022; Niche, 2019). Previous experience shows that approximately 1 in 10 rock-based sites that have been subjected to subsidence induced ground movements show demonstrable changes that can be attributed to subsidence. These changes take the form of block fall, exfoliation, cracking, opening and/or closing of existing faults and fissures (Biosis Research, 2009).

The performance measures in the Conditions of Consent require “no greater subsidence impacts or loss of heritage values than predicted in the EIS”. Predicted impacts on the rockshelters in the EIS (MSEC, 2020) for both A and B series longwalls are included in **Table 17**, along with the predictions specific to the A series of longwalls (MSEC, 2022).

MSEC (2022) has predicted that during extraction of the A series longwalls, Teatree Hollow 2013.1 could experience upsidence of up to 300 mm and total closure up to 350 mm. MSEC (2024) has predicted that the newly identified rockshelters Hornes Creek RS2-RS7 could experience subsidence of up to 50 mm. MSEC’s assessments (2022; 2024) are based on studies of longwall mining in the Southern Coalfields beneath 52 rockshelters, whereby approximately 10% of the rockshelters have been affected by fracturing of the strata or shear movements along bedding planes and none of the rockshelters collapsed. This previous data indicates that the likelihood of substantial physical impacts to the rockshelter is “relatively low” and “very low” (MSEC, 2022 p.140; MSEC, 2024 p.122) which is taken to mean unlikely to occur.

From the summary of impacts above discussed in the EIS, Tahmoor Coal has interpreted this to mean that there is a 10% probability of impacts occurring to the rockshelters in the Tahmoor South Domain (Study Areas for both A and B series longwalls), as discussed in the *Subsidence Ground Movement Predictions and Subsidence Impact Assessments for Natural Features and Surface Infrastructure* (EIS Appendix B, MSEC, 2020).

While this probability is relatively low, if impacts were to occur to this rockshelter the effects could range from minor (such as minor cracking or changes to faults and fissures) to severe (such as damage or loss of art panels or collapse of the sandstone shelter). Such effects could result in partial to total loss of its heritage value.

Table 17 Predicted Impacts on the Rockshelter Sites After All Longwalls

	Total subsidence (mm)	Maximum tilt (mm/m)	Total hogging curvature (1/km)	Total sagging curvature(1/km)
MSEC 2020 (EIS) A and B series longwalls	1350	10	0.10	0.07

	Total subsidence (mm)	Maximum tilt (mm/m)	Total hogging curvature (1/km)	Total sagging curvature(1/km)
MSEC 2022 A series longwalls	900	4.5	0.06	0.03
MSEC 2024 Longwall S7A	50	<0.5	<0.01	<0.01

4.1.3 Grinding Groove Site

There is one grinding groove site nearby the study area. Hornes Creek GG1 is located 10 m from the 20 mm subsidence zone on a rockbar within the valley and could experience valley related movements (MSEC, 2024)

However, it is difficult to assess the likelihood of instabilities for rockshelters based upon predicted ground movements as the likelihood of the shelters becoming unstable is dependent on several factors which are difficult to fully quantify. These factors include jointing, inclusions, weaknesses within the rockmass, groundwater pressure and seepage flow behind the rockface. Even if these factors could be determined, it would still be difficult to quantify the extent to which these factors may influence the stability of the shelter naturally or when it is exposed to mine subsidence movements (MSEC, 2022, p.140).

Monitoring of the effects of subsidence induced ground movements to Aboriginal heritage sites (such as rockshelters and grinding groove platforms) has been conducted since the 1990s (see Sefton, 2000; Biosis Research, 2009; Regal and Reeves, 2017; Regal Heritage, 2022; Niche, 2019). Previous experience shows that approximately 1 in 10 rock-based sites that have been subjected to subsidence induced ground movements show demonstrable changes that can be attributed to subsidence. These changes take the form of block fall, exfoliation, cracking, opening and/or closing of existing faults and fissures (Biosis Research, 2009).

MSEC (2024) has predicted that during extraction of longwall S7A, Hornes Creek GG1 could experience upsidence of up to 45 mm and total closure up to 65 mm. MSEC's assessment (2024) was based on the offset distance of the grinding site relative to LW S7A, the low likelyhood of fracturing occurring and in the unlikely event that it occurs, the fracture are expected to be minor and isolated. Overall the likelihood of substantial physical impacts to the grinding groove site is "extremely low" (MSEC, 2024 p.122).

Table 18 Predicted Impacts on the Grinding groove Sites After All Longwalls

	Total subsidence (mm)	Maximum tilt (mm/m)	Total hogging curvature (1/km)	Total sagging curvature(1/km)
MSEC 2024 Longwall S7A	20	<0.5	<0.01	<0.01

4.2 Historical Heritage Items

Subsidence predictions for the existing and proposed longwalls and impact assessments for the heritage items within the Study Area, prepared by MSEC (2022), have informed the impact assessment and management measures outlined in this report. The likelihood of damage occurring at the sites was assessed on criteria that consider theoretical cracking limits caused by strains and tilts. A detailed discussion of the likely impacts to historical heritage items in the Study Area as a result of subsidence is provided in Section 6 and 7 of the HHA (Niche, 2018).

Table 19 summarises the predicted probability of impact for each of the heritage sites and **Sections 4.2.1 – 4.2.7** provide an overview of the predicted subsidence impacts to each historical heritage site within the Study Area.

If potential or confirmed subsidence impacts are observed during monitoring, Tahmoor Coal will implement the TARP (**Appendix A**). In the event of subsidence impact, appropriate management, remediation and mitigation measures will be undertaken in accordance with relevant approvals as specified in **Section 6**.

Table 19 Historical Heritage Sites within LW S1A–S6A Extraction Plan Study Area and Predicted Likelihood of Impact

Site name	Site type	Significance	Location in relation to the longwalls	Probability of Impact Rating
Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)	Complex/group and landscape	State	Above LW SA1 – SA4	*Possible*
Bargo Cemetery	Complex/group	Local	Above LW SA4 – SA5	*Extremely unlikely*
Bargo Railway Bridge North (Wellers Road Overbridge)	Built structure	Local	370 m south-east of LW S6A	*Extremely unlikely*
Picton Weir	Built structure	Local	605 m west of LW S7A	*Unlikely*
Great Southern Road	Road	Local	Partially above LW S5A	*Possible*
Tahmoor Colliery (Tahmoor Mine Site)	Complex/group	Local	Partially above LW S1A	*Possible*

4.2.1 Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)

Mining will occur directly beneath Wirrimbirra Sanctuary during extraction of LW S1A–S4A. The built structures on the property are situated above LW S3A and S4A. These structures are predominantly timber-framed structures with metal-clad timber-framed roofs, on reinforced concrete slabs. As this style of structure is generally small in size and of light-weight construction, they are relatively flexible compared to masonry buildings.

Therefore, if impacts occur, they will most likely consist of non-structural cracking of walls, concrete floors or ceilings. However, there remains a small probability (less than 2%) that a structure may experience severe impacts as result of substantial non-conventional movements. Overall, experience of excavating directly beneath similar structures in the Southern Coalfield indicates that the incidence of impact on these types of structures is very low (MSEC, 2022). Therefore, as the heritage significance of Wirrimbirra Sanctuary is primarily associated with its role in the conservation movement, its association with key conservationists and as a natural recreation and social area (refer to **Table 12** and **Appendix D**), minor impacts to the fabric of buildings on the property, if rectified, are unlikely to affect the heritage values of the site.

The performance measures in the Conditions of Consent require "no greater subsidence impacts or loss of heritage values than predicted in the EIS". Predicted impacts on the Wirrimbirra Sanctuary/Australian Wildlife Sanctuary structures in the EIS (MSEC, 2020) for both A and B series longwalls are included in **Table 20**, along with the predictions specific to the A series of longwalls (MSEC, 2022).

Table 20 Predicted impacts on the Wirrimbirra Sanctuary Structures after All Longwalls

	Total subsidence (mm)		Maximum final tilt (mm/m)		Total hogging curvature (1/km)		Total sagging curvature (1/km)	
	MSEC 2020 (EIS)	MSEC 2022	MSEC 2020 (EIS)	MSEC 2022	MSEC 2020 (EIS)	MSEC 2022	MSEC 2020 (EIS)	MSEC 2022

	Total subsidence (mm)		Maximum final tilt (mm/m)		Total hogging curvature (1/km)		Total sagging curvature (1/km)	
Cabin 4 & 5 & shelter*	1200	-	3.5	-	0.05	-	0.04	-
Cabin 3*	1250	-	3.5	-	0.05	-	0.04	-
Laboratory*	1300	-	3.5	-	0.06	-	0.15	-
Schoolhouse/hall*	1300	-	3.5	-	0.06	-	0.19	-
Nursery structure	1000	*900*	3.0	*3.5*	0.05	*0.08*	0.03	*0.02*
Visitor centre	1000	*900*	3.0	*4.5*	0.06	*0.08*	0.03	*0.03*
Cottage 1	950	*950*	2.0	*5.5*	0.07	*0.08*	0.03	*0.02*
Shade house	900	*900*	2.0	*4.5*	0.07	*0.08*	0.03	*0.02*

1. * Destroyed by fire

4.2.2 Bargo Cemetery

Bargo Cemetery is located above LW S4A – S5A. It encompasses an area of 2.26 hectares with isolated grave sites of concrete and stone, typically placed on the natural ground surface with minimum foundations. Due to their small sizes, the sites are expected to accommodate conventional subsidence movements (MSEC, 2022).

However, in the unlikely event that substantial non-conventional movements develop at the cemetery, it may result in cracking of the ground surface or displacement of gravestones relative to the graves. As non-conventional movements are localised in nature, should substantial non-conventional movements develop at the cemetery, it is extremely unlikely that they will affect every grave site. If minor impacts to the grave monuments were to occur, it is unlikely that once rectified, these will affect the heritage values of the site.

The performance measures in the Conditions of Consent require "no greater subsidence impacts or loss of heritage values than predicted in the EIS". Predicted impacts on Bargo Cemetery in the EIS (MSEC, 2020) for both A and B series longwalls are included in **Table 21**, along with the predictions specific to the A series of longwalls including LW S7A (MSEC, 2022 and MSEC, 2024).

Table 21 Predicted Impacts on Bargo Cemetery after All Longwalls

	Total subsidence (mm)	Maximum tilt (mm/m)	Total hogging curvature (1/km)	Total sagging curvature (1/km)
MSEC 2020 (EIS) A and B series longwalls	1600	10.5	0.18	0.28
MSEC 2024 A series longwalls	975	8.3	0.09	0.23

4.2.3 Bargo Railway Bridge North (Wellers Road Overbridge)

Bargo Railway Bridge North is a railway overbridge on Wellers Road, approximately 370 m from the commencement end of LW S6A and 540 m from the commencement end of LW S7A. The bridge is predicted to experience less than 20mm of conventional subsidence, with negligeable tilt, curvature and strain due to the extraction of longwalls S1A to S7A (MSEC,2024).

While the masonry bridge with concrete arch is outside the study area, it is somewhat inflexible and may experience far field horizontal movements, although mining-induced ground movements are predicted to develop gradually at the bridge. The risk is considered low and will reduce further as the longwall moves away from the bridge. Bargo Railway Bridge North is a well-used road bridge and will be carefully

monitored to ensure public safety. It is therefore assumed that if impacts were to occur, they would be detected early and measures put in place to ensure that the structure remains sound. Minor impacts to the built fabric, if rectified, are unlikely to affect the heritage values of the site.

The performance measures in the Conditions of Consent require "no greater subsidence impacts or loss of heritage values than predicted in the EIS". Predicted impacts on the Bargo Railway Bridge North in the EIS (MSEC, 2020) for both A and B series longwalls are included in **Table 22**, along with the predictions specific to the A series of longwalls including LW S7A (MSEC, 2022 and MSEC, 2024).

Table 22 Predicted impacts on the Bargo Railway Bridge North after All Longwalls

	Total subsidence (mm)	Maximum tilt (mm/m)	Total hogging curvature (1/km)	Total sagging curvature (1/km)
MSEC 2020 (EIS) A and B series longwalls	675	2.5	0.05	0.04
MSEC 2024 A series longwalls	20	Negligible	Negligible	Negligible

4.2.4 Picton Weir

Picton Weir is situated on the Bargo River, 605m west of LW S7A.. **Table 23** summarises the predicted value of total vertical subsidence, upsidence and closure at Picton Weir. The weir is located outside the predicted limit of subsidence and is therefore, predicted to experience negligible conventional subsidence movements (MSEC, 2024). Predictions of non-conventional valley closure and upsidence movements indicates that Bargo River is predicted to experience less than 20mm of incremental valley closure and upsidence at the Picton Weir due to the extraction of LW S7A (MSEC, 2024)

Tahmoor Coal has developed management measures (outlined in Picton Weir Management Plan) to ensure the weir remains safe and serviceable throughout the mining period and that potential impacts on the Picton Weir do not result in environmental consequences on the Bargo River due to the extraction of the A series Longwalls. Impacts to the built fabric of the weir, if they were to occur, are likely to be minor and, if rectified, unlikely to affect the heritage values of the site.

Table 23 Predicted total vertical subsidence, upsidence and closure at Picton weir

	Predicted Total subsidence (mm)	Predicted total upsidence (mm)	Predicted total closure (mm)
MSEC 2024 After LW S7A	<20	20	<20

4.2.5 Bargo Railway Viaduct

Bargo Railway Viaduct is situated on the Main Southern Railway over Bargo River, approximately 1.7 km north of LW S1A and well outside the predicted 20 mm total subsidence contour. While the Viaduct may experience far-field horizontal movements during the extraction of the proposed longwalls, it is not expected to experience impacts. The Bargo Railway Viaduct is part of the Main Southern Railway and will be carefully monitored to ensure public safety. If impacts were to occur, they would be detected early, and measures put in place to ensure that the structure remains sound. Minor impacts to the built fabric, if rectified, are unlikely to affect the heritage values of the site.

4.2.6 Great Southern Road

The Great Southern Road runs along the eastern side of the Main Southern Railway. Little evidence of original fabric remains as the road now has a bitumen seal and has been repeatedly upgraded. The section of the Great Southern Road within the study area does not have kerbs and is situated on flat to very gently inclined topography.

The road is partially located over LW S5A and could experience conventional subsidence movement (i.e. away from valleys and steep slopes). However, surface cracking is uncommon when mining is occurring 400 m below the ground surface, as is the case within the Study Area. Therefore, cracking is not anticipated to occur. Where surface cracking has been observed in the Southern Coalfields as the result of conventional subsidence movements, it has generally been relatively isolated and of a minor nature. As much of the original surface of the road has been altered, the primary historical significance of the Great Southern Road is its historical alignment. Therefore, minor surface cracking, if rectified, is unlikely to affect the heritage value of this item.

4.2.7 Tahmoor Colliery (Tahmoor Mine Site)

Mining will not occur directly beneath the majority of the Tahmoor Mine facilities. However, mining will occur beneath a small number of structures, which are located within the longwalls boundary. These include:

- A coal conveyor;
- Plant associated with the coal conveyor;
- The southern coal stockpile area;
- Small sheds;
- Dams or reservoirs; and
- Unsealed access roads.

The coal conveyor and associated plant and equipment is predicted to subside approximately 1,000 mm.

The end of the conveyor is predicted to subside relative to the northern end by approximately 600 mm (MSEC, 2022). Impacts are anticipated to be low and easily managed with careful monitoring. The Tahmoor Mine Site is a working site and minor impacts are unlikely to affect its heritage values.

5 Subsidence Monitoring Program

5.1 Performance Measures and Indicators

Performance measures for Aboriginal and historical heritage are provided in Table 7 of Condition C1 of SSD 8445 and are summarised in **Table 23.**

Table 23 Subsidence Performance Measures and Performance Indicators for Aboriginal and Historical Heritage

Site name	Site type	Subsidence Performance Measures	Probability of subsidence impact	Subsidence Performance Indicators
Aboriginal cultural heritage sites				
TC14-2-19	Isolated find	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 0)	Very unlikely	No performance indicators are currently established as impacts are predicted to be negligible.
Remembrance Drive 2013.1	Open camp site	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2)	Very unlikely	No performance indicators are currently established as impacts are predicted to be negligible.
Teatree Hollow 2013.1	Rockshelter with art and deposit	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2 for discussion about this definition)	Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and - these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling of the art work panels or, elsewhere in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Teatree Hollow 2013.1. Such impacts would not exceed the 10% threshold of impacts to the 19 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).

Site name	Site type	Subsidence Performance Measures	Probability of subsidence impact	Subsidence Performance Indicators
Hornes Creek RS2	Rockshelter with deposit and artefacts	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2)	Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and - these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Hornes Creek RS2. Such impacts would not exceed the 10% threshold of impacts to the 25 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Hornes Creek RS3	Rockshelter with deposit	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2)	Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and - these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Hornes Creek RS3. Such impacts would not exceed the 10% threshold of impacts to the 25 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Hornes Creek RS4	Rockshelter with deposit and artefact	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2)	Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and

Site name	Site type	Subsidence Performance Measures	Probability of subsidence impact	Subsidence Performance Indicators
				- these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Hornes Creek RS4. Such impacts would not exceed the 10% threshold of impacts to the 25 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Hornes Creek RS5	Rockshelter		Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and - these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Hornes Creek RS5. Such impacts would not exceed the 10% threshold of impacts to the 25 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Hornes Creek RS 6	Rockshelter with deposit and artefact	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2)	Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and - these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Hornes Creek RS6. Such impacts would not exceed the 10% threshold of

Site name	Site type	Subsidence Performance Measures	Probability of subsidence impact	Subsidence Performance Indicators
				impacts to the 25 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Hornes Creek RS7	Rockshelter with deposit	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.1.2)	Unlikely	This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: - subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and - these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Hornes Creek RS7. Such impacts would not exceed the 10% threshold of impacts to the 25 total rockshelters in the longwalls A and B Study Area. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Hornes Creek GG1	Grinding grooves	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.1)	Unlikely	This performance indicator will be considered to be triggered if cracks or movement in excess of natural environmental change occur as a result of Tahmoor South Domain (including A and B series longwalls). Impacts include: - subsidence monitoring identifies obvious perceptible change, e.g. cracking, spaces, gaps of movement of joints and rock associated with the grinding grooves; and - these subsidence impacts result in impacts to the heritage values of the site. This performance measure cannot be exceeded during the extraction of the A series longwalls. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).
Historical heritage sites				
Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)	Complex / group and landscape	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.1)	*Possible*	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).

Site name	Site type	Subsidence Performance Measures	Probability of subsidence impact	Subsidence Performance Indicators
Bargo Cemetery	Complex / group	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.2)	Extremely unlikely	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).
Bargo Railway Bridge North (Wellers Road Overbridge)	Built structure	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.3)	*Extremely unlikely*	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).
Picton Weir	Built structure	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.4)	Extremely unlikely	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).
Tahmoor Colliery (Tahmoor Mine Site)	Complex / group	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.7)	*Possible*	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).
Great Southern Road (partial)	Road	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.6)	*Possible*	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).
Bargo Railway Viaduct	Built structure	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see Section 4.2.5)	Extremely unlikely	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).

With regard to the subsidence performance measure for the rockshelter sites, the EIS (and amendment documents) and 2024 ACHA predicted that conventional and valley related movements at the site as a result of longwall mining, are similar to the typical movements in the Southern Coalfield where longwall mining has previously been carried out (MSEC, 2020; **Appendix B**). Of the 52 rockshelters that have been mined beneath, approximately 10% have been affected by fracturing of the strata or shear movements along bedding planes. None of these shelters have collapsed (Sefton, 2000). The EIS (and amendment documents) concluded that experience from the Southern Coalfield indicates that substantial physical

impacts on rockshelters within the Subsidence Study Area is “relatively low”, which is taken to mean unlikely to occur.

Accordingly, Tahmoor consider the subsidence performance indicator is considered to have been exceeded if the number of rockshelters in the Tahmoor South Domain that experience fracturing due to longwall mining exceeds 10% (or one in 10). There are nineteen rockshelters in the combined longwalls A and B Study Area. **Section 4.1.2** also discusses the definitions around the predictions presented in the EIS.

Based on the predicted subsidence impacts (MSEC, 2022; MSEC 2024) it is considered that the performance measures for Aboriginal and historical heritage within the Study Area (refer Table 23) will be achieved during and after mining of LW S1A–S7A (Niche, 2018; Niche, 2020; EMM, 2024). While it is considered unlikely that the rockshelter sites could be impacted, it is nevertheless possible that it could be impacted to some degree by subsidence, with consequences ranging from partial to total loss of heritage value. Accordingly, monitoring will be implemented prior to mining, and in the event that performance measures have been exceeded or if exceedance seems likely during mining.

These measures will include:

- Pre-mining: baseline archival recording of the site (**Section 5.2**);
- During and post-mining:
    - Structural geotechnical review of Teatree Hollow 2013.1 and Hornes Creek RS2-RS7 inclusive with the objective to understand the structural characteristics of the rockshelter and any features that could respond adversely to mining-induced subsidence effects. This should include any bedding plane exposures and the potential for mining-induced instability on inclined bedding plane and/or joint or fracture lines. This will be undertaken prior to secondary workings with the aim to provide better resolution on any potentially detectable subsidence effects, thus enabling better implementation of the TARP.
    - A monitoring program will be implemented to confirm if impacts remain within predictions and identify management or mitigation measures as required (**Section 5.2**). To establish compliance with the performance measures, a TARP has been developed (**Appendix A**) outlining adaptive management where monitoring indicates that performance measures have been exceeded or if exceedance seems likely.

5.2 Monitoring Program

A subsidence monitoring program for Aboriginal and historical heritage will be implemented to monitor the impacts and consequences of subsidence effects during the extraction of LW S1A-S7A. The details of this monitoring program are provided in **Table 24**, and the locations of monitoring sites are illustrated in **Figure 3** and **Figure 4.**

The aim of the monitoring program is to identify where there is a risk of impact to Aboriginal and historical heritage as a result of extraction activities. The monitoring program provides for the opportunity to record the condition of the site during the following three phases:

- Prior to Mining – baseline survey of the condition of the site before the commencement of mining including archival recording (Appendix E);
- During Mining – monitoring of the condition of the site during active subsidence to establish whether there has been any change to the site or if changes have occurred from the effects of subsidence; and
- Post Mining – monitoring of the condition of the site after mining to identify whether there has been any change to the site in the period since mining, and to determine if the ground surface conditions have stabilised.

Management measures are outlined in **Table 25**.

If an impact is identified to have occurred or is likely to occur, the relevant TARP (refer to **Appendix A**) will then be referred to for the identification of appropriate mitigation strategies.

Details of planned monitoring works and investigations that are in addition to the proposed monitoring program are provided in the following subsections.

In addition, a site-specific / infrastructure management plan will also be prepared for the Australian Wildlife Sanctuary, Bargo Cemetery, Main Southern Railway (which will include the Bargo Railway Bridge North / Wellers Road Overbridge), Picton Wier, Wollondilly Shire Council road infrastructure (which will include the Great Southern Road), and the Tahmoor Mine Site. These management plans will be prepared in consultation with the relevant landowner / infrastructure owner and implemented prior to potential subsidence impacts to each of these features.

5.2.1 Teatree Hollow 2013.1 rockshelter monitoring program

Monitoring of Teatree Hollow 2013.1 has been undertaken following the completion of LW S1A – S3A. Inspections are yet to be undertaken for the remaining LW S4A as per monitoring program.

Three site inspections have been undertaken to date. An EMM archaeologist and a representative of Cubbitch Barta Native Title Claimants Aboriginal Corporation were in attendance. Tharawal LALC was also invited to participate, but did not reply despite repeated attempts in the weeks prior to the site inspections. The inspections occurred on 10 July 2023 (end of LW S1A), 12 April 2024 (end of LW S2A) and, 03 December 2024 (end of LW S3A).

Overall, the rockshelter appeared in a similar condition to when previously visited by these personnel as part of archaeological excavations in November 2022. The site inspections did not identify any observable impacts such as cracks, exfoliation, or collapse, as a result of subsidence or other activities. Further, the floor of the rockshelter showed no evidence of recent rockfall or other moved material that may suggest collapse or movement has occurred.

5.3 Future Extraction Plans

To assist in the preparation of future Extraction Plans, Aboriginal and historical heritage monitoring as outlined in **Table 24** would provide sufficient baseline data. Monitoring data collected during the mining of LW S1A-S7A would be used in the review of observed subsidence impacts to inform future Extraction Plans for the Tahmoor South Domain. The program will adapt to mine design and/or include improvements to overall design of the monitoring program.

Table 24 Monitoring Program for Aboriginal and Historical Heritage

Feature	Monitoring Component	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Aboriginal cultural heritage sites				
Remembrance Drive 2013.1	None required	None required	None required	None required
Teatree Hollow 2013.1	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (complete, refer to **Appendix E**). Structural geotechnical review prior to secondary workings.	Fortnightly visual inspection of the rockshelter (monitoring overall rockshelter stability) during periods of active subsidence for LW S1A, S2A, S3A and S4A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S1A, S2A, S3A and S4A.	Visual inspection by archaeologist with RAPs at the completion of LW S1A, S2A, S3A and S4A.
TC14-2-19	None required	None required	None required	None required
Hornes Creek RS2	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed). Structural geotechnical review prior to secondary workings.	Monthly visual inspection of the rockshelter by a geotechnical engineer (PSM) (monitoring overall rockshelter stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	Visual inspection by archaeologist with RAPs at the completion of LW S7A.

Feature	Monitoring Component	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Hornes Creek RS3	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed). Structural geotechnical review prior to secondary workings.	Monthly visual inspection of the rockshelter by a geotechnical engineer (PSM) (monitoring overall rockshelter stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	Visual inspection by archaeologist with RAPs at the completion of LW S7A.
Hornes Creek RS4	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed). Structural geotechnical review prior to secondary workings.	Monthly visual inspection of the rockshelter by a geotechnical engineer (PSM) (monitoring overall rockshelter stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	Visual inspection by archaeologist with RAPs at the completion of LW S7A.
Hornes Creek RS5	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed). Structural geotechnical review prior to secondary workings.	Monthly visual inspection of the rockshelter by a geotechnical engineer (PSM) (monitoring overall rockshelter stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to	Visual inspection by archaeologist with RAPs at the completion of LW S7A.

Feature	Monitoring Component	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
			Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	
Hornes Creek RS 6	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed). Structural geotechnical review prior to secondary workings.	Monthly visual inspection of the rockshelter by a geotechnical engineer (PSM) (monitoring overall rockshelter stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	Visual inspection by archaeologist with RAPs at the completion of LW S7A.
Hornes Creek RS7	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed). Structural geotechnical review prior to secondary workings.	Monthly visual inspection of the rockshelter by a geotechnical engineer (PSM) (monitoring overall rockshelter stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	Visual inspection by archaeologist with RAPs at the completion of LW S7A.
Hornes Creek GG1	Visual inspections Baseline recording Archival photogrammetry	Visual inspection by archaeologist with RAPs. Baseline recording, sampling and photogrammetry (to be completed).	Monthly visual inspection of the grinding grooves by a geotechnical engineer (PSM) during periods of active subsidence for LW S7A.	Visual inspection by archaeologist with RAPs at the completion of LW S7A.

Feature	Monitoring Component	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
			Monitoring of GNSS units / survey lines in proximity to the grinding grooves (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A.	
Historical heritage items				
Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)	SoHI Visual inspections Structural assessment Survey control points	Visual assessment by a heritage consultant as part of SoHI (completed). Pre-mining condition and structural assessment as per the Australian Wildlife Sanctuary Management Plan. Install monitoring system as per the Subsidence Monitoring Plan.	Regular monitoring as per the Australian Wildlife Sanctuary Management Plan.	Visual inspection by a heritage consultant at the completion of LW S5A. Inspections and assessments as per the Australian Wildlife Sanctuary Management Plan.
Bargo Cemetery	Visual inspections Baseline recording Photography Survey control points	Baseline recording and visual assessment by heritage consultant (completed, see Appendix D). Pre-mining assessments as per the Bargo Cemetery Management Plan. Install monitoring system as per the Subsidence Monitoring Plan.	Regular monitoring as per the Bargo Cemetery Management Plan.	Visual inspection by a heritage consultant at the completion of Longwalls LW S7A. Inspections and assessments as per the Bargo Cemetery Management Plan.
Bargo Railway Bridge North (Wellers Road Overbridge)	Visual inspections Structural assessment Survey control points	Visual assessment by a heritage consultant. Pre-mining condition and structural assessment as per the Main Southern Railway Management Plan. Install monitoring system as per the Subsidence Monitoring Plan.	Regular monitoring as per the Main Southern Railway Management Plan.	Visual inspection by a heritage consultant at the completion of Longwalls LW S7A. Inspections and assessments as per the Main Southern Railway Management Plan.

Feature	Monitoring Component	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Picton Weir	Visual inspections Structural assessment Survey control points	Pre-mining condition and structural assessment as per the Picton Weir Management Plan. Install monitoring system as per the Subsidence Monitoring Plan.	Regular monitoring as per the Picton Weir Management Plan.	Inspections and assessments as per the Picton Weir Management Plan.
Bargo Railway Viaduct	Visual inspections Structural assessment Survey control points	Visual assessment by a heritage consultant. Pre-mining condition and structural assessment as per the Main Southern Railway Management Plan. Install monitoring system as per the Subsidence Monitoring Plan.	Regular monitoring as per the Main Southern Railway Management Plan.	Visual inspection by a heritage consultant at the completion of Longwalls LW S7A. Inspections and assessments as per the Main Southern Railway Management Plan.
Tahmoor Colliery (Tahmoor Mine Site)	Visual inspections Structural assessment Survey control points	Pre-mining condition and structural assessment as per the Tahmoor Mine Site Management Plan. Install monitoring system as per the Subsidence Monitoring Plan.	Regular monitoring as per the Tahmoor Mine Site Management Plan.	Inspections and assessments as per the Tahmoor Mine Site Management Plan.
Great Southern Road (partial)	Visual inspections Survey control points	Pre-mining condition as per the Wollondilly Shire Council Management Plan.	Regular monitoring as per the Wollondilly Shire Council Management Plan.	Inspections and assessments as per the Wollondilly Shire Council Management Plan.

Table 25 Description of Monitoring Program Measures

Management measure	Description
Baseline recording (historical heritage sites)	Baseline recording will be carried out prior to the commencement of mining to assist with ongoing monitoring and assessment of impacts, allowing a determination regarding whether impacts have occurred due to mining. A final assessment and recording will be completed at the completion of subsidence. The results of the baseline recording will be used for comparisons to determine impact from mining. To this end, the baseline recording will: • Assess the structure's pre-mining condition; • Undertake an archival recording to provide a record of the site's condition in the unlikely event that irrevocable damage occurs; and • Provide a set of baseline records for the monitoring program.
Photography	Photographs will be taken with the appropriate scale and will include: • The wider context of the site, showing the landscape and setting at long range and medium scales; • Details of the structure's features; and • Close up photographs of pre-existing cracks and damage, and their location noted on the plan drawings.
Photogrammetry	Photogrammetry of the rockshelter site will be carried out prior to the commencement of mining in order to: • Assist with ongoing monitoring and assessment of whether impacts from mining have occurred; • Mitigate the risk of potential impact through more detailed archival recording; and • Archival record is provided in Appendix E.
Rockshelter recording	Rockshelter recording will consist of the following: • Scale drawing of rockshelter and art panels; • Archival photographs with photography scale; • Recording of surface artefacts and other features; and • Estimate of potential archaeological deposit (PAD) depth and size. The results of the baseline recording will be used for comparisons to determine impact from mining. To this end, the baseline recording will: • Assess the rockshelter's pre-mining condition; • Undertake an archival recording to provide a record of the site's condition in the unlikely event that irrevocable damage occurs; and • Provide a set of baseline records for the monitoring program.
Grinding groove recording	Grinding groove recording will consist of the following: • Scale drawing of grooves; • Archival photographs with photography scale. The results of the baseline recording will be used for comparisons to determine impact from mining. To this end, the baseline recording will: • Assess the grinding groove pre-mining condition; • Undertake an archival recording to provide a record of the site's condition in the unlikely event that irrevocable damage occurs; and • Provide a set of baseline records for the monitoring program.
Survey control points	A surveyor will be appointed by Tahmoor Coal to record survey control points on heritage items where needed. The number, type and location of the survey points will provide sufficient points of reference to later monitor the extent and effects of subsidence.

Visual inspection	Visual inspections will be conducted to relevant items as set out in Table 24. Visual inspection will include additional general photography at each inspection, and comparison of the observed conditions with photos from previous inspections.

This information has been retracted
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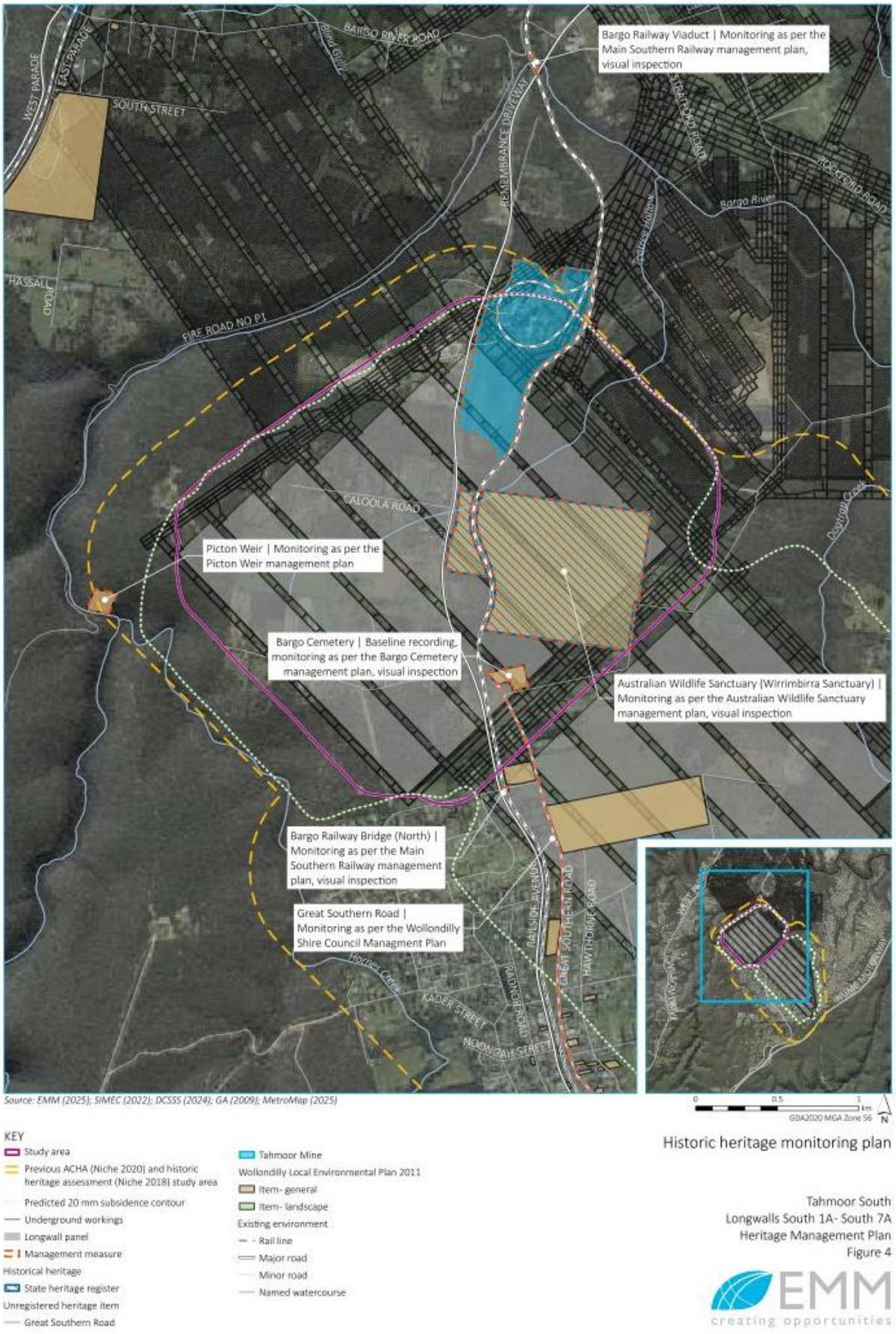

Figure 4 Historical Heritage Monitoring Plan

6 Subsidence Management Strategies

6.1 Mine Design Considerations

The Tahmoor South Domain mine plan has undergone a series of amendments since the issue of the first EIS for the Tahmoor South Project in 2014. These mine plan revisions are summarised below:

- EIS Submission (2014): Original EIS submission, which was placed on hold and subsequently withdrawn in late 2015;
- EIS Submission (January 2019): Updated EIS submission based on revised Secretary's Environmental Assessment Requirements (SEARs) issued in June 2018;
- Project Amendment Report (February 2020): The mine design was modified to reduce potential environmental impacts of the Project through the reduction in the extent of longwall mining. This was achieved by the following modifications:
- Removal of LW 109, which was located directly beneath Dog Trap Creek. This would result in elimination of direct impacts to Aboriginal heritage items;
- Configuration of the longwall layout to comprise two series of shorter longwall panels;
- Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m; and
- Reduction in the height of extraction within the longwall panels from up to 2.85 m to up to 2.6 m.
- Second Amendment Report (August 2020): The mine design was again modified to further reduce potential environmental impacts. This included the removal of two longwalls in the southern part of the mine near the township of Bargo (LW 107B and LW108B), which would result in a reduction in magnitude of subsidence impacts.
- LW S3A has been shortened by 104 m, as approved by DPHI on 27 March 2024. LW S4A is shortened by 104m as approved by DPHI on 11 November 2024.
- Modification 3: modification of development consent SSD 8445 to include an additional longwall panel (LW S7A) to the existing approved mine plan

The numerous modifications of the Tahmoor South Domain mine plan have resulted in a reduction of the magnitude and extent of subsidence impacts, as well as avoidance of significant impact to sensitive surface features, including Aboriginal heritage items.

The current mine plan proposes to complete underground mining with access to the Tahmoor South Domain provided from the existing pit top facilities. This mine design consideration minimises surface impacts from mining through the avoidance of establishing new surface facilities.

6.2 Mitigation Measures and Corrective Management Actions

6.2.1 Management Measures for Aboriginal Sites

6.2.1.1 Artefact Sites

Impacts to the open artefact sites are considered extremely unlikely and no management measures are required.

6.2.1.2 Rockshelter Sites

6.2.1.2.1 (Hornes Creek RS2-RS7)

If subsidence related impacts to the rockshelter were to occur, impacts could range from cracking or exfoliation that is similar to natural weathering or, at worst, the collapse of the shelters. Management of the rockshelters considers this range of possibilities.

Baseline recording will be undertaken prior to the commencement of mining (scale drawings, archival photographs and photogrammetry to create a 3D model, see **5** in **Section 5.2).**

Visual inspection of the rockshelters (from a safe distance) will be undertaken during extraction of the longwall S7A, and if impacts involving cracking or exfoliation occur, project RAPs will be notified and consulted regarding appropriate remediation, and in accordance with the TARP.

6.2.1.2.2 (Teatree Hollow 2013.1)

If subsidence related impacts to the rockshelter were to occur, impacts could range from cracking or exfoliation that is similar to natural weathering, through to damage to the art panels from cracking or spalling or, at worst, the collapse of the shelter. Management of the rockshelter considers this range of possibilities.

Tahmoor Coal considered the implementation of physical mitigation measures that could be employed at Teatree Hollow rockshelter prior to the influence of mine subsidence. Options included propping of the rockshelter, installing strapping or mesh, installing rock bolts and drilling/cutting of stress-relieving slots on either side of the rockshelter. These options, excluding the stress-relieving slots, would be located within the rockshelter structure and would cause permanent impact to the rockshelter site.

When the impacts of the discussed mitigation measures are weighed against the likelihood of impacts at the site (in the order of 10%), it was decided on the relative merits against implementing these options.

Instead, Tahmoor Coal decided to implement the following:

- Archaeological test excavation will be implemented to mitigate the potential subsidence impacts for the rockshelter site. This will be mitigation in the event of irreparable damage, as suitable archaeological data and samples will be collected and analysed. In addition to the targeted archaeological excavation within the shelter, will be completed in order to characterise the nature and extent of cultural deposit and gather chronological information, if feasible, through OSL or radiocarbon dating. Further details are outlined in the Archaeological Research Design (ARD) (**Appendix F**). Test excavation, dependant on RAP availability, will be completed prior to 1 December 2022 so that the rockshelter can be safely accessed without the risk of subsidence hazards.
- Photogrammetry and detailed site record (completed by EMM and a Cubbitch Barta Native Title Claimant representative). This recording, undertaken as part of baseline recording prior to the commencement of mining (scale drawings, archival photographs and photogrammetry to create a 3D model, see **Table 24** in **Section 5.2)** is included as **Appendix E**).

Data derived from the investigations could contribute to knowledge of Aboriginal occupation in the local region. It will also ensure that information is preserved and available to the Aboriginal community in the event that partial or total loss of heritage values through subsidence impacts does occur, ultimately providing a positive social and cultural output even in the event the site is lost.

A methodology, developed in consultation with RAPs, is included **in Appendix C**. The approach has strong support from the local Aboriginal community, who want to obtain further information from the rockshelter as well as spend time on Country exploring their culture. In addition to the proposed excavations, analysis of the rock art was also proposed to the RAPs during consultation. Due to the potentially unnecessary destructive requirements of this analysis, it was not progressed in this investigative phase of works. Details of RAP inputs and feedback is included in **Appendix B**.

Heritage NSW are also supportive, and sought further information on the research aims and methodologies of the excavations (Archaeological Research Design) which has been provided (**Appendix F**).

These activities were undertaken in November 2022, with the full report in Appendix G. Regular monitoring of the creek line and visual inspection of the rockshelter (from a safe distance) was undertaken during extraction of the longwalls LW S1A, LW S2A and LW S3A. No impacts were identified, project RAPs were notified and consulted regarding excavation and subsequent monitoring (see Section 6.2.5, Appendix G). Monitoring of the rockshelter will continue during the mining of LW S4A as per monitoring program in accordance with the TARP.

6.2.1.3 Grinding Groove Sites

Hornes Creek GG1 is 10m outside the Study Area however there is a higher level of subsidence, upsidence and closure that is predicted to occur from the addition of Longwall S7A. While there is some movement that is predicted to occur, the overall likelihood of this movement causing an impact on the newly recorded Aboriginal sites is considered low (MSEC 2024).

Baseline recording will be undertaken prior to the commencement of mining (scale drawings, archival photographs and photogrammetry to create a 3D model, see **5** in **Section 5.2.**

Visual inspection of the Grinding Grooves (from a safe distance) will be undertaken during and following extraction of the longwall S7A, and if impacts involving cracking or exfoliation occur, project RAPs will be notified and consulted regarding appropriate remediation, and in accordance with the TARP.

6.2.2 Management Measures for Historical Heritage Sites

6.2.2.1 Wirrimbirra (Australian Wildlife Sanctuary)

Management of Wirrimbirra Sanctuary is outlined in the *Australian Wildlife Sanctuary Management Plan* (in development). In summary, the site will be managed by the following measures:

- Pre-mining visual assessment by a heritage consultant (completed);
- Pre-mining condition and hazard identification inspection of each structure by a structural engineer;
- Installation of reinforcement (if required) as a risk minimisation measure;
- Installation of a monitoring system;
- Regular visual inspections of the building structures;
- Regular visual inspection of the well;
- An end of panel inspection by a heritage consultant at the completion of LW S5A; and
- Implementation of planned responses if triggered by monitoring and inspection.

6.2.2.2 Bargo Cemetery

Management of the Bargo Cemetery is outlined in the *Bargo Cemetery Management Plan* (in development). In summary, the site will be managed by the following measures:

- Baseline condition recording and photography by a heritage consultant (completed);
- Installation of a monitoring system;
- Regular visual inspections;
- An end of panel inspection for LW S5A; and

- Implementation of planned responses if triggered by monitoring and inspection.

6.2.2.3 Bargo Railway Bridge North (Wellers Road Overbridge)

Bargo Railway Bridge North is outside the Study Area and mining-induced ground movements are predicted to develop gradually at the bridge. Installing monitoring devices so that the development of ground movements and impacts can be detected early will allow time to implement intervention measures to stabilise the bridge.

Management of Bargo Railway Bridge North is outlined in the *Main Southern Railway Management Plan* (in development). In summary, the site will be managed by the following measures:

- Re-assessment of the pre-mining condition of the bridge prior to mining;
- Consideration of risk minimisation measures prior to mining and implementation if required;
- Pre-mining visual assessment by a heritage consultant;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and bridge movements;
- Regular review and assessment of the monitoring data;
- Regular visual inspections of the bridge;
- An end of panel inspection for LW S7A; and
- Implementation of planned responses if triggered by monitoring and inspections.

6.2.2.4 Picton Weir

Management of Picton Weir is outlined in the *Picton Weir Management Plan* (in development). In summary, the site will be managed by the following measures:

- Assessment by structural, geotechnical and subsidence engineers;
- Consideration of risk minimisation or strengthening measures prior to mining;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements;
- Regular visual inspections; and
- Implement planned responses if triggered by monitoring and inspections.

6.2.2.5 Bargo Railway Viaduct

Bargo Railway Viaduct is outside the Study Area and is approximately 1.7 km to the north of LW S1A. While the Bargo Railway Viaduct may experience small far field horizontal movements during the extraction of the proposed longwalls, it is not expected to experience impacts. Monitoring devices are being installed so that the development of ground movements and potential impacts can be detected early, which will allow time to implement intervention measures to stabilise the bridge, if required.

Management of Bargo Railway Viaduct is outlined in the *Main Southern Railway Management Plan* (in development). In summary, the site will be managed by the following measures:

- Re-assessment of the pre-mining condition of the bridge prior to mining;
- Consideration of risk minimisation measures prior to mining and implementation if required;
- Pre-mining visual assessment by a heritage consultant;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and bridge movements;
- Regular review and assessment of the monitoring data;
- Regular visual inspections of the bridge;
- An end of panel inspection for LW S7A; and
- Implementation of planned responses if triggered by monitoring and inspections.

6.2.2.6 Tahmoor Colliery (Tahmoor Mine Site)

Management of Tahmoor Colliery is outlined in the *Tahmoor Mine Management Plan* (in development). In summary, the site will be managed by the following measures:

- Risk minimisation or strengthening measures prior to mining, particularly in relation to the coal conveyor and dams;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements;
- Regular visual inspections of the surface facilities; and
- Implement planned responses if triggered by monitoring and inspections.

6.2.2.7 Great Southern Road

Management of the Great Southern Road is outlined in the *Wollondilly Shire Council Management Plan* (in development). In summary, the road will be managed by the following measures:

- Pre-mining condition and visual inspection by a structural engineer;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements;
- Regular visual inspections of the road; and
- Implement planned responses if triggered by monitoring and inspections.

6.2.3 Aboriginal Heritage Awareness Training

All known Aboriginal Sites in the Tahmoor South Domain that were identified during the EIS stage have been recorded in the AHIMS register. Awareness of existing and potential Aboriginal heritage sites to site personnel is included in the annual Environmental Awareness Training presentation.

6.2.4 Unexpected Finds Procedures

6.2.4.1 Discovery of Aboriginal Objects

In the event that any previously unknown Aboriginal object is discovered on site, or suspected to be on the site, all work in the immediate vicinity of the object or place must cease immediately and a 10 m buffer area around the object or place established by cordoning off the area.

The object or place should be inspected by a qualified archaeologist and RAP representative(s).

Heritage NSW must be notified of the existence of Aboriginal objects as soon as practicable after they are first identified.

Work in the immediate vicinity may only recommence if:

- The potential Aboriginal object is confirmed by Heritage NSW, in consultation with the Registered Aboriginal Parties, not to be an Aboriginal object or Aboriginal place; or
- The Planning Secretary is satisfied with the measures to be implemented in respect of the Aboriginal object and makes a written direction in that regard.

6.2.4.2 Reporting Impact to Aboriginal Sites

An Aboriginal Site Impact Recording Form must be completed following impacts to AHIMS sites that are:

- A result of test excavation carried out in accordance with the Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW and that proposed for Teatree Hollow 2013.1;
- Authorised by an AHIP issued by Heritage NSW;
- Undertaken for the purpose of complying with Secretary's environmental assessment requirements issued by DPIE for:
- State Significant Development;
- State Significant Infrastructure; or
- A major project; or
- Authorised by a State Significant Development/State Significant Infrastructure/former Part 3A consent/approval under the *NSW Environmental Planning and Assessment Act 1999*.

Completed forms must be submitted to the AHIMS Registrar at www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm

Aboriginal Site Impact Recording Forms can be downloaded from the Heritage NSW website located at https://www.environment.nsw.gov.au/resources/cultureheritage/aboriginal-site-recording-form-180307.pdf

6.2.4.3 Discovery of Historical Heritage

Additional historical heritage assessments are not recommended at this point as impacts are not anticipated to historical heritage items in the vicinity. Due to the nature of the extraction activities, it is unlikely relics will be uncovered; however, if they are, the following steps will be taken:

- No further harm to the object;
- Immediately cease all work at the particular location;
- Secure the area so as to avoid further harm to the relic; and
- Contact an archaeologist for further information and advice.

6.2.4.4 Discovery of Human Skeletal Remains

In the event that known or suspected human skeletal remains are encountered within the Study Area, the following procedure must be followed:

- The immediate vicinity will be secured to protect the find and the find will be immediately reported to the work supervisor who will immediately advise the site supervisor or other nominated senior staff member;
- The environmental manager or other nominated senior staff member will notify the police and the state coroner on the same day of the find (as required for all human remains discoveries);
- The environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material;
- If it is determined that the skeletal material is ancestral Aboriginal remains, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains;
- The site will be recorded in accordance with the NPW Act and Heritage NSW guidelines;
- If the remains are historical and not of Aboriginal origin, Heritage NSW will be notified for further instruction; and
- Works will not recommence until written approval is received.

6.2.5 Management Measure Effectiveness

The proposed baseline data collection captures the heritage significance of the sites as they exist. Together with the pre-mining condition and structural assessments, this allows for effective monitoring during the mining phase and early detection of impacts. Early detection is integral to avoidance of further impacts and is therefore an effective measure.

6.2.6 Remediation Measures for Aboriginal Heritage Sites

6.2.6.1 Artefact Sites

If subsidence induced cracking of the ground surface occurs in the vicinity of registered artefact sites, a site inspection should be undertaken by a qualified archaeologist and RAP representative prior to remediation of the ground surface in order to ensure that Aboriginal objects (if present) are not harmed.

6.2.6.2 Rockshelter Sites

With regard to the rockshelter sites, if an impact to Aboriginal heritage occurs, the type of remediation that is undertaken will be dependent on:

- The nature of the damage and its location within the site (e.g. rockshelter roof or wall; proximity to art);
- The impact on the heritage values of the site (e.g. loss of art works); and
- Cultural advice from the local Aboriginal community to the proposed remediation measures (e.g. sealants used on cracks or introducing supports or scaffolding into rockshelters).

The remediation set out in **Table 26** have been formulated in the context of the predicted range of potential subsidence impacts at the rockshelter sites.

Table 26 Remediation Measures for Teatree Hollow 2013.1 and Hornes Creek RS2-RS7

Type of impact	Remediation options
Cracking or spalling within the rockshelter comparable to existing naturally occurring examples but not impacting the art panels (Teatree Hollow 2013.1 only)	Depending on the extent and proximity of these impacts to the art panel features, the option for no remediation should be explored first. Explore options with RAPs and remediation consultant to patch crack void with suitable materials (e.g. cement and/or coloured sand render).
Cracking or spalling within the rockshelter across the art panels (Teatree Hollow 2013.1 only)	The option for no remediation should be explored first. Explore options with RAPs and remediation consultant to patch crack void with suitable materials and or stabilise the surrounding area to prevent further loss from spalling.
Rockfall	If shelter is deemed stable, no further action is needed.
Shelter collapse	The option for no remediation should be explored first. Depending on the extent of collapse and the safety/stability of the shelter, explore options with RAPs for propping up the shelter based on geotechnical and engineering advice.

6.2.6.3 Grinding Groove Sites

With regard to the Grinding Groove sites, if an impact to Aboriginal heritage occurs, the type of remediation that is undertaken will be dependent on:

- The nature of the damage and its location within the site (e.g. hairline or larger crack, in close proximity to grooves or on the broader sandstone exposure, etc)
- The impact on the heritage values of the site (e.g. loss of groove features); and
- Cultural advice from the local Aboriginal community to the proposed remediation measures (e.g. sealants used on cracks).

6.2.7 Remediation Measures for Historical Heritage Sites

If an impact to a historical heritage item occurs, the type of remediation that is undertaken will be dependent on (EMM, 2021b):

- The nature of the damage;
- The scale of the damage;
- The impact on the historical heritage significance of the site; and
- Expert advice regarding practical and historically sympathetic remediation measures.

Therefore, remediation measures, if needed, will be assessed on a case-by-case basis in the light of these considerations in order to ensure that performance measures are met and that negative outcomes to historical heritage values are limited.

If impacts occur, they will most likely consist of non-structural cracking of walls, concrete floors or ceilings and are likely to develop gradually over time. Damage can therefore be repaired in consultation with relevant stakeholders and a heritage consultant (if needed) to ensure that the heritage significance of the structure is maintained.

Remediation measures will follow best practice principles of heritage management. Remediation measures will be visually inconspicuous and preserve the appearance of the heritage item in its setting.

Attachments to the fabric of the structure will be designed to be reversable and to do no harm to the fabric of the heritage item. Remediation works will be developed in consultation with a suitably qualified heritage specialist.

6.2.8 Verification Methods

Ongoing monitoring as specified in **Section 6.2** will provide early warning of potential impacts to heritage significance. In addition, heritage items will be inspected at the completion of each longwall.

The current condition of each heritage item will be verified against their pre-mining condition and structural assessment and other baseline recording.

6.3 Trigger Action Response Plan

A series of TARPs have been developed to address various components of Aboriginal and historical heritage using the performance indicators for implementation during LW S1A-S7A mining, in accordance with Condition C8(g)(viii) of the Consent (refer to **Appendix A**).

The primary actions of the TARP are to:

- Define appropriate trigger levels in order to manage and protect known heritage sites within the Study Area;
- Develop specific actions to respond to high risk of exceedance of performance measure to ensure that the measure is not exceeded; and
- Present a plan in the event a performance measure is exceeded or are likely to be exceeded and describe the management / corrective actions to be implemented (i.e. notifications to relevant agencies, structural assessments, consultation with RAPs, revision in the relevant Corrective Action Management Plan and the Annual Review).

The 'Normal Condition' section of each TARP indicates that the environment is performing within normal levels or natural variability. Deviation from baseline or expected condition triggers an increased level of risk to the environment (Level 1 or higher based on escalating corresponding risk).

6.3.1 Implementation of Monitoring Program and TARP Requirements

Tahmoor Coal's standard approach for all monitoring, reporting, investigation and remediation is to commence all tasks as soon as practicable. The following sections provide more information on this standard approach to be adopted during the LW S1A-S7A pre-mining, mining and post-mining phases:

- All monitoring commitments will be tracked on a weekly basis so that tasks are completed as required, taking into consideration land access and environmental factors. Post-mining monitoring will typically be completed within one month of the completion of the relevant longwall and prior to the influence from the active subsidence zone on the feature from the next longwall.
- Following the receipt of monitoring data and laboratory results, specialist consultants will review the data against the relevant TARPs as soon as practicable. If any TARP trigger has occurred, specialist consultants will notify Tahmoor Coal as soon as practicable. Monitoring results and TARP triggers will also be discussed during the monthly Environmental Response Group meetings, and any relevant information from other disciplines will be shared within the group. It is noted that discussions amongst specialists from different disciplines will not be restricted to ERG meetings, and relevant specialists will be included at any time to discuss results and assist with the completion of required actions and responses, as required.
- In the event of a TARP trigger occurrence, Tahmoor Coal will initiate all requirements (actions and responses) in accordance with the relevant TARP (i.e. investigation, report, negotiation, corrective management actions (CMA) determination, or similar) as soon as practicable and endeavour to commence actions and responses within one month of the exceedance being recorded. This timeframe is noted to be subject to issues outside of Tahmoor Coal's control such as land access constraints, inclement weather, extended timeframes where further monitoring is required, and inability to communicate with a third party / landholder.
- Tahmoor Coal will complete the required actions and responses relating to the TARP trigger as soon as practicable and will endeavour to finalise these requirements, subject to issues outside of Tahmoor Coal's control, as follows:
    - Level 1 and Level 2 TARP trigger actions and responses within three months of the exceedance being recorded;

- Level 3 and Level 4 TARP trigger actions and responses within six months of the exceedance being recorded; and
- Exceeds Performance Measures actions and responses in accordance with the timeframes provided in the relevant TARPs.

6.4 Contingency Plan

In accordance with Conditions C8(g)(ix) and E5(f) of the Consent, in the event that performance measures (in the form of pre-defined triggers) are considered to have been exceeded or are likely to be exceeded, a response will be undertaken in accordance with these TARPs (refer to **Appendix A**). The Contingency Plan is built into the TARP and describes the management / corrective actions that can be implemented where required to remedy the exceedance.

If a Corrective Action Management Plan is required in accordance with the TARP, this plan will be prepared by the Response Group in accordance with Section 3.6.3 of the Extraction Plan Main Document.

The success of remediation measures that have been implemented for any TARP exceedance would be reviewed as part of any Corrective Action Management Plan and the Annual Review.

6.5 Adaptive Management Strategies

6.5.1 Adaptive Management for Aboriginal and Historical Heritage Sites

If extraction of LW S1A-S7A indicates that an environmental consequence has occurred to the heritage significance of Rockshelter Sites and/or grinding grooves (and a Level 2 of TARP HMP1 has been triggered), Tahmoor Coal would review the impacts that occurred to the rockshelter sites and also review the experiences that were observed at other non-heritage rockshelters (and sandstone exposures for grinding grooves) during the mining of LW S1A-S7A. If the review indicates that impacts on Aboriginal sites above the B Series longwalls are likely to be greater than predicted in the EIS, Tahmoor Coal will review the mine design and determine whether some longwall panels should be setback further to avoid directly mining beneath other rockshelter sites.

If extraction of LW S5A indicates that an environmental consequence has occurred at the Picton Weir (and a Level 2 of TARP HMP2 has been triggered), Tahmoor Coal would be required to review the mine design and consider whether to amend the mine plan to minimize impacts to the weir from future longwalls. This could include shortening LW S6A to ensure that the weir is not impacted to the extent that it cannot be repaired in a manner that restores its heritage value.

6.5.2 Continuous Improvement

Tahmoor Coal have adopted the “Plan-Do-Check-Act” model as shown in **Figure 5**. This model will be applied to all aspects of Tahmoor Coal’s environmental management and is utilised to embed the continuous improvement process in all system documents.

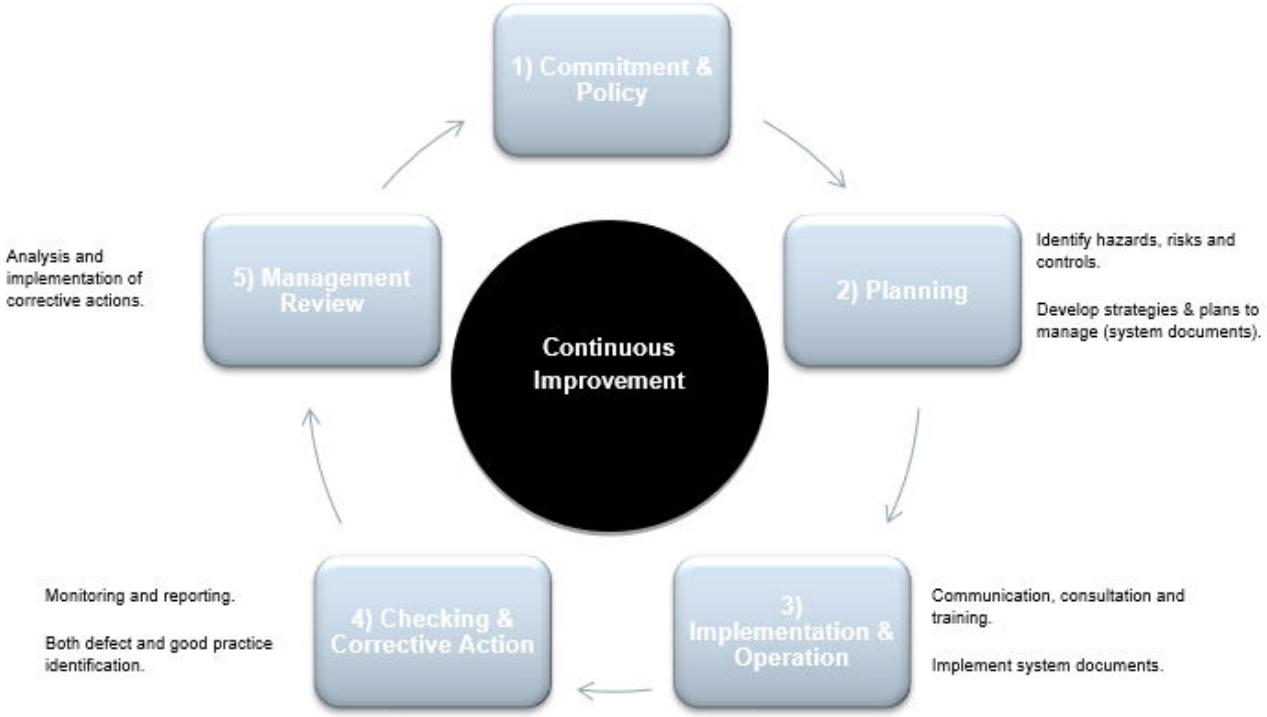

Figure 5 Continuous Improvement Model

7 Implementation and Reporting

7.1 General Requirements

This section of the management plan describes the key elements of implementation and reporting specific to the management of Aboriginal and historical heritage.

A description of requirements and procedures that are applicable to the extraction of LW S1A-S6A in general are provided in the Extraction Plan Main Document. This detail includes:

- Environmental Management System Framework;
- General reporting requirements, including details regarding Annual Review, and Annual Return;
- Incident management and reporting requirements;
- Non-compliance management and reporting requirements;
- Exceedances management and reporting requirements;
- Compliant and dispute management protocol;
- Audit and review requirements for general environmental performance, including internal audits and reviews, and independent environmental audits;
- General roles and responsibilities;
- Employee and contractor training requirements;
- Response groups to facilitate the review of monitoring data;
- Internal and External Stakeholder Communication Procedures;
- Access to information requirements, including Tahmoor Coal website and the Tahmoor Colliery Community Consultative Committee;
- Document control protocol; and
- Risk assessment for built and natural features and corresponding outcomes.

7.2 Reporting Requirements

7.2.1 Performance Measure Exceedance

In accordance with Condition E4 of the Consent, where exceedance of the criteria or performance measures outlined within this document has occurred, Tahmoor Coal will:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures / corrective management actions or other course of action;
- Within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures / corrective management actions or other course of action; and
- Implement reasonable remediation measures / corrective management actions as directed by the Planning Secretary.

7.2.2 Specific Reporting for Aboriginal and Historical Heritage

There are no reporting requirements, except within the above report requirement or response reporting discussed in the TARPs, specific to the management of Aboriginal and historical heritage identified for the extraction of LW S1A-S7A.

7.3 Review and Auditing

7.3.1 Plan Audit

Audits of the *Heritage Management Plan* are to be conducted in consultation with the Plan owner and nominated individuals and shall focus on the content and implementation.

Audits on the content shall consist of a determination of understanding of the *Heritage Management Plan* by the individual's allocated responsibility under this plan.

Audits on the implementation shall consist of reviews of the safe working procedures and risk assessments developed to ensure safe operation of this *Heritage Management Plan*, they may also involve discussions with personnel involved in the management plan to determine understanding and compliance.

Should an audit of this *Heritage Management Plan* determine that a deficiency is evident in the content or implementation, a corrective action must be developed and implemented. Actions will be assigned to a nominated individual and tracked in Cority.

Tahmoor Coal is responsible to verify that the nominated corrective action has been implemented by way of a follow up audit.

Any changes to the *Heritage Management Plan* are to be managed and communicated to all personnel in line with the Change Management Process.

7.3.2 Plan Review

This ***Heritage Management Plan*** will be reviewed:

Event based: in accordance with Condition E7 (a) of the Consent, a review will be required within 3 months of any incident, event or finding that identifies an inadequacy in the ***Heritage Management Plan*** risk assessment or associated documents to continue to effectively manage the identified hazard; a change to the workplace itself or any aspect of the work environment, a change to a system of work, a process or a procedure; or

Time based: in the absence of regular event-based reviews and in accordance with Condition E7 (b-e) of the Consent, this plan will be reviewed within three months of:

- the submission of an Annual Review under Condition E13;
- the submission of an Independent Environmental Audit under Condition E15;
- the approval of any modification of the conditions of this consent (unless the conditions require otherwise); or
- notification of a change in development phase under Condition A19;

If deemed appropriate, relevant stakeholders may be included in the review process. All reviews are to be documented. The process for review of this document will be in according to Tahmoor Coal's *Document and Record Control* (TAH-HSEC-00124).

Following changes (or as otherwise required above), a copy of the amended management plan will be forwarded to the Secretary of the DPIE for approval.

7.4 Roles and Responsibilities

Table 24 describes roles and responsibilities specific to the implementation of Aboriginal and historical heritage identified for the extraction of LW S1A-S7A.

Table 27 Roles and Responsibilities for Heritage Management

Role	Responsibilities
Environment & Community Manager	• Ensure that the HMP is implemented as approved by the Secretary. • Ensure the implementation of this plan is carried out appropriately during longwall mining. • Ensure adequate financial and personnel resources are made available for the implementation of this plan.
Approvals Specialist	• Ensure the Aboriginal heritage management measures required to be undertaken prior to the commencement of longwall mining in the Study Area are conducted in accordance with the measures outlined in this plan. • Engage and coordinate relevant specialist personnel to undertake management measures or additional assessment as specified in this plan. • Ensure relevant reporting, data management and registration is conducted, maintained and updated. • Arrange for a review of this plan in accordance with review cycles and conditions specified in this plan.
Archaeologist (Consultant)	• Primary contact with RAPs. • Maintain records of Aboriginal consultation.

8 Document Information

8.1 Referenced Documents

Reference information, listed in **Table 28** below, is information that is directly related to the development of this document or referenced from within this document.

Table 28 Reference Information

Title
Department of Planning and Environment (DPE) (2022), Extraction Plan Guideline. Biosis Research (2009), Tahmoor Colliery Longwalls 27 to 30: Impacts of Subsidence on Cultural Heritage, report to Xstrata Coal Tahmoor. EMM Consulting: - 2020 Tahmoor South Project: Wirrimbirra Sanctuary Statement of Heritage Impact, unpublished report for Tahmoor Coal Pty Ltd; - 2020 Tahmoor South Project: Addendum to the Aboriginal Cultural Heritage Assessment (Appendix 9, Niche 2020) - 2024 Tahmoor Mine Modification 3 - Aboriginal Cultural Heritage Assessment (Appendix D, EMM 2024) ICOMOS (2013), The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Burra Charter). JRC Planning Services (1986), Macarthur Heritage Study, report to NSW Department of Environment and Planning. Mine Subsidence Engineering Consultants (MSEC) - 2020 Tahmoor South Project – Second Amendment Report for Longwalls 101A to 106B: Subsidence Ground Movement Predictions and Subsidence Impact Assessments for Natural Features and Surface Infrastructure, report for Tahmoor Coal Pty Ltd. - 2022 Tahmoor South Project – Extraction Plan for Longwalls S1A to S6A: Subsidence ground movement predictions and subsidence impact assessments for natural features and surface infrastructure. - 2024 Tahmoor Coal – Modification 3 - Longwall S7A: The effects of the proposed addition of LW S7A on previous subsidence predictions and impact assessments. Niche Environment and Heritage (Niche): - 2018 Historical Heritage Assessment: Tahmoor South Project, unpublished report for Tahmoor Coal Pty Ltd. - 2019 Redbank Creek 4: Aboriginal Cultural Heritage Assessment Report, unpublished report for Tahmoor Coal Pty Ltd. - 2020 Aboriginal Cultural Heritage Assessment: Amended Tahmoor South Project – Regulator Document, unpublished report for Tahmoor Coal Pty Ltd. Regal and Reeves (2017) Overview of the Monitoring of Sandstone Overhangs for the Effects of Mining Subsidence in the Southern Coalfield, Proceedings of the 10th Triennial Conference on Mine Subsidence 2017. Regal Heritage (2022) Southern Coalfields Shelter Monitoring Statistical Analysis (Project Reference Number 1002) report for Tahmoor Coal. Sefton, C. (2000), *Overview of the Monitoring of Sandstone Overhangs for the Effects of Mining Subsidence, Illawarra Coal Measures* report prepared for Illawarra Coal. Simec: - 2019 Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019.

Title
- 2020 Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020. - 2020 Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020. - 2020 Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.

8.2 Related Documents

Related documents, listed in **Table 29** below, are internal documents directly related to or referenced from this document.

Table 29 Related Documents

Number	Title
TAH-HSEC-00124	Document and Record Control
TAH-HSEC-00365	LW S1A-S7A Extraction Plan Main Document
TAH-HSEC-00361	LW S1A-S7A Water Management Plan
TAH-HSEC-00362	LW S1A-S7A Land Management Plan
TAH-HSEC-00364	LW S1A-S7A Heritage Management Plan
TAH-HSEC-00366	LW S1A-S7A Built Features Management Plan
TAH-HSEC-00365	LW S1A-S7A Public Safety Management Plan
TAH-HSEC-00367	LW S1A-S7A Subsidence Monitoring Plan

8.3 Glossary of Terms

Section 8.3 of the Extraction Plan Main Document provides a compiles Glossary of Terms.

8.4 Abbreviations

Abbreviations used in this document are provided below in **Table 30.**

Table 30 Abbreviations

Abbreviation	Definition
ACHA	Aboriginal cultural heritage assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ARTC	Australian Rail Track Corporation
BAIC	Before-After-Control-Impact
CCL	Consolidated coal lease
CHL	Commonwealth Heritage List
CHPP	Coal handling and preparation plant
CoA	Conditions of Approval
Cubbitch Barta	Cubbitch Barta Native Title Claimants Aboriginal Corporation
DCP	Development control plan

Abbreviation	Definition
DEC/DECCW	A former NSW government body, now Heritage NSW
DPE	NSW Department of Planning and Environment (now DPHI)
DPHI	NSW Department of Planning, Housing and Infrastructure
DPIE	NSW Department of Planning, Industry and Environment (now DPHI)
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Ltd
EP&A Act	Environmental Planning and Assessment Act 1979
GTR	Groundwater technical report
HHA	Historical Heritage Assessment
HMP	LW S1A-S6A Heritage Management Plan (this document)
ICAMOS	International Council on Monuments and Sites
Km	Kilometer
LEP	Local Environment Plans
LGA	Local Government Area
LW	Long wall
M	Meter
Mm	Millimetre
MOD	Modification to a project approval
MSEC	Mine Subsidence Engineering Consultants
Mtpa	Million tonnes per annum
NHL	National Heritage List
NPW Act	National Parks and Wildlife Act 1974
NSW	New South Wales
PAD	Potential archaeological deposit
RAP	Registered Aboriginal Party (for the project)
ROM coal	Run-of-mine coal
SSD	State Significant Development
SEARs	Secretary's Environmental Assessment Requirements
SHI	State Heritage Inventory
SHR	State Heritage Register
SSI	State Significant Infrastructure
TAHE	Sydney Trains of behalf of Transport ASSET Holding Authority
Tahmoor Coal	Tahmoor Coal Pty Ltd
TARP	Trigger Action Response Plan
TLALC	Tharawal Local Aboriginal Land Council
WLEP	Wollondilly Local Environment Plan

8.5 Change Information

Full details of the document history are recorded below in **Table 31**.

Table 31 Document History

Version	Date Reviewed	Reviewed By	Change Summary
1.0	May 2022	April Hudson, Charlie Wheatley, Zina Ainsworth, Malcolm Waterfall, Peter Vale	New Document
2.0	September 2022	April Hudson, Charlie Wheatley, Zina Ainsworth	Updated document following consultation with DPE, government agencies and the Independent Advisory Panel for Underground Mining.
3.0	January 2023	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(e) following the commencement of first and second workings (18 October 2022) of the Consent SSD 8445.
4.0	June 2023	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(b) following the submission of an Annual Review (31 March 2023), Condition E7(c) following the submission of an Independent Environmental Audit (2 June 2023) and Condition E7 (d) following the approval of any modification (Modification - 13 June 2023) of the Consent SSD 8445.
5.0	June 2024	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(b) following the submission of an Annual Review (28 March 2024).
6.0	February 2025	Nick Le Baut, Zina Ainsworth	Review following the approval of Amendment 2 (Shortening of LW S4A) to the Tahmoor South LWS1A-S6A Extraction plan (11 November 2024).
7.0	August 2025	Nick Le Baut, Zina Ainsworth	Review in accordance with Condition E7(d) following the approval of Modification 3 (on 26 May 2025) and Condition E7(b) following the submission of an annual review (30 September 2025).

Appendix A – Trigger Action Response Plans

HERITAGE MANAGEMENT PLAN TARP – HMP1 ABORIGINAL CULTURAL HERITAGE SITES

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Performance Measure Feature Aboriginal cultural heritage sites (listed in Appendix 4 of SSD 8445). Aboriginal cultural heritage sites (listed in Appendix D of SSD 8445 Mod 3). **Performance Measure** No greater subsidence impacts or loss of heritage values than predicted in the EIS and/or MOD[1]. **Performance Indicator** **Open camp site (Remembrance Drive 2013.1) and Isolated find (TC14-2-19)** No performance indicators are currently established as impacts are predicted to be negligible[2]. **Rockshelters with art and deposit, art, deposit or artefacts and deposit(Teatree Hollow 2013.1, Hornes Creek RS2, Hornes Creek RS3, Hornes Creek RS4, Hornes Creek RS5, Hornes Creek RS6, Hornes Creek RS7)** This performance measure will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: • subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and • these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking, spalling or collapse of the art work panels that result in damage or loss of the art. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Teatree Hollow 2013.1. Such impacts would not exceed the 10% threshold of impacts to the 19 total rockshelters in the longwalls A and B Study Area. **Grinding groove site** This performance indicator will be considered to be triggered if cracks (>2 cm) or movement in excess of natural environmental change occur as a result of Tahmoor South Domain (including A and B series longwalls). Impacts include: • subsidence monitoring identifies obvious perceptible change, e.g. cracking, spaces, gaps of movement of joints and rock associated with the grinding grooves; and • these subsidence impacts result in impacts to the heritage values of the site. This performance measure cannot be exceeded during the extraction of the A series longwalls. This performance measure and performance indicator have been incorporated into TARP HMP1 (Aboriginal cultural heritage sites).	**Locations** Teatree Hollow 2013.1. Hornes Creek RS2 Hornes Creek RS3 Hornes Creek RS4 Hornes Creek RS5 Hornes Creek RS6 Hornes Creek RS7 Hornes Creek GG1 Location shown in Figure 3 of the Heritage Management Plan. Monitoring of stone artefact sites Remembrance Drive 2013.1 and TC14-2-19 is not required as impacts are not anticipated. **Monitoring Frequency** **Pre-mining** • Visual inspection by archaeologist with RAPs (completed for Teatree Hollow 2013.1, to be completed for Hornes Creek RS2-RS7 inclusive and Hornes Creek GG1). • Baseline recording, sampling and photogrammetry (completed for Teatree Hollow 2013.1, to be completed for Hornes Creek RS2-RS7 inclusive and Hornes Creek GG1). Structural geotechnical review prior to secondary workings Teatree Hollow 2013.1. **During Mining** Teatree Hollow 2013.1 • Fortnightly visual inspection of the rockshelter (monitoring overall rockshelter stability) during periods of active subsidence for LW S1A, S2A, S3A and S4A, to be completed from a safe distance. • Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S1A, S2A, S3A and S4A. Hornes Creek RS2-RS7 inclusive, and Hornes Creek GG1 • Monthly visual inspection of the rockshelters and grinding grooves by a geotechnical engineer (PSM) (monitoring overall rockshelter and grinding groove stability) during periods of active subsidence for LW S7A, to be completed from a safe distance. • Monitoring of GNSS units / survey lines in proximity to the rockshelter and Grinding grooves (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S7A. **Post-mining** Teatree Hollow 2013.1	**Normal Condition**		
		• Aboriginal heritage site monitoring indicates no detectable environmental consequences.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		Aboriginal heritage site monitoring indicates potential detectable environmental consequences, but with negligible impacts to the heritage value of rockshelter sites[3], and Hornes Creek GG1[4].	• *Actions as required for Normal Condition.* • An archaeologist to inspect the site within the area of potential impact and confirm Level 1 trigger is correct and that art panels have not been affected. • Detailed photographic recording of any damage to be documented and marked on the shelter base plan. • Undertake an investigation to assess cause and determine if mining related. • Consider and decide on reasonable and feasible options for remediation as relevant which could form corrective management actions (CMAs) in consultation with an archaeologist and RAPs. Engage specialists where relevant to address impact types (e.g. consult an engineer to discuss management of rockfall or toppling of shelter). • Consider increasing monitoring and review of data frequency if it is determined that the shelter structural stability or art panels are at an increased risk of impact from the Level 1 trigger event, subject to land access. • Review Heritage Management Plan and modify if necessary.	• Report trigger exceedance to DPE and key stakeholders. • Notify RAPs within seven days of the event and co-ordinate a site inspection with at least one RAP representative. • Report trigger exceedance and investigation outcomes in Annual Review. • Provide DPE, RAPs, and Heritage NSW with proposed corrective management actions (CMAs) for consultation (e.g. structural support for shelter or additional measures for art panels in response to level of increased risk of impacts). • Consider the development of a Rehabilitation Management Plan, and/or an update to the Heritage Management Plan in consultation with DPE, Heritage NSW and RAPs and key stakeholders (e.g. if additional mitigation or alternative methods not covered in the Heritage Management Plan are proposed). • Implement CMAs. • Monitor and report on success of CMAs in Annual Review. • Advise DPE and key stakeholders of any required amendments to Heritage Management Plan.
		Level 2		
		Aboriginal heritage site monitoring indicates environmental consequences to rockshelter sites[5] and Hornes Creek GG1[6].	• *Actions as stated in Level 1.* Increase monitoring and review of data frequency for sites where Level 2 has been reached at rockshelter sites and/or and Hornes Creek GG1, subject to land access • Investigate exceedance of subsidence prediction. • Review mine design/predictions against mine criteria.	• *Responses as stated in Level 1.* If it is concluded that heritage items have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. Developed CMAs are to be incorporated into this plan. • Implement Rehabilitation Management Plan, subject to land access.

TARP Objective This TARP defines levels of impacts to Aboriginal cultural heritage values from existing conditions identified at the time of their discovery, to indicators that subsidence impacts have or may occur, to indicators of exceedance of the performance measure and the actions required to be implemented in response to each level of impact or exceedance of the performance measure. **Assessment Criteria** Discussion of performance measure indicators and their definitions is provided in Section 4.1.2 and Section 5.1 of the Heritage Management Plan.	• Visual inspection by archaeologist with RAPs at the completion of LW S1A, S2A, S3A and S4 Hornes Creek RS2-RS7 inclusive, and Hornes Creek GG1 • Visual inspection by archaeologist with RAPs at the completion of LW S7A.			
Notes: [1] EIS predictions for aboriginal cultural heritage sites summarised in Section 4.1 of the Heritage Management Plan. [2] Subsidence movements are not expected to have observable effects on these two sites as they are located in open terrain with a very gently sloping gradient. The predicted likelihood of impact on artefact sites is considered extremely unlikely and subsidence movements are unlikely to constitute 'harm' as defined by the NPW Act. As such, these sites will not be monitored and therefore performance measures cannot be established. [3] Visible perceptible change, such as rockfall, cracking, or toppling within the rockshelter similar to naturally caused examples and which does not impact the art panels. [4] Visible perceptible change, such as cracking, gaps, or broader rock movement similar to naturally caused examples and which does not impact the grooves. [5] Visible perceptible change that results in impacts to the heritage values of the site, such as cracking, spalling or collapse of the art work panels that result in damage or loss of the art. [6] Visible perceptible change that results in impacts to the heritage values of the site, such as cracking and/or gaps intersecting with a groove feature, and/or movement of the rock exposure that result in damage or loss of the art.				

HERITAGE MANAGEMENT PLAN TARP – HMP2 HISTORICAL HERITAGE ITEMS

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Historic heritage sites (listed in Appendix 4 of SSD 8445). **Performance Measure** No greater subsidence impacts or loss of heritage values than predicted in the EIS[1]. **Performance Indicator** This performance measure will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items (Wirrimbirra Sanctuary, Bargo Cemetery, Bargo Railway Bridge North, Picton Weir, Tahmoor Mine Site, Bargo Railway Viaduct, Great Southern Road (partial)). **TARP Objective** This TARP defines levels of impacts to historic heritage sites from existing conditions identified at the time of their recording as part of the project EIS, to indicators that subsidence impacts have or may occur, to indicators of exceedance of the performance measure and the actions required to be implemented in response to each level of impact or exceedance of the performance measure. **Assessment Criteria** The historic heritage values related to each site are based on significance assessment criteria adopted as part of the EIS for the project (Niche 2012). TARP assesses impacts in relation to the historically significant values of each heritage item. The significance of each item is summarised in Table 12 of the Heritage Management Plan.	**Locations** • Wirrimbirra Sanctuary (Australian Wildlife Sanctuary). • Bargo Cemetery. • Bargo Railway Bridge North (Wellers Road Overbridge). • Picton Weir. • Tahmoor Colliery (Tahmoor Mine Site). • Bargo Railway Viaduct. • Great Southern Road (partial). Locations of historical heritage items are shown in Figure 4 of the Heritage Management Plan. **Monitoring Frequency** **Wirrimbirra Sanctuary** Pre-mining: • Visual assessment by a heritage consultant as part of SoHI (completed). • Pre-mining condition and structural assessment as per the Australian Wildlife Sanctuary Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Australian Wildlife Sanctuary Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of LW S5A. • Inspections and assessments as per the Australian Wildlife Sanctuary Management Plan. **Bargo Cemetery** Pre-mining: • Baseline recording and visual assessment by heritage consultant (completed, see Appendix D). • Pre-mining assessments as per the Bargo Cemetery Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Bargo Cemetery Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of Longwalls LW S7A. • Inspections and assessments as per the Bargo Cemetery Management Plan. **Bargo Railway Bridge North** Pre-mining: • Visual assessment by a heritage consultant. • Pre-mining condition and structural assessment as per the Main Southern Railway Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Main Southern Railway Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of Longwalls LW S7A. • Inspections and assessments as per the Main Southern Railway Management Plan. **Picton Weir** Pre-mining: • Pre-mining condition and structural assessment as per the Picton Weir Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Picton Weir Management Plan. Post-mining: Inspections and assessments as per the Picton Weir Management Plan. **Tahmoor Colliery** Pre-mining: • Pre-mining condition and structural assessment as per the Tahmoor Mine Site Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Tahmoor Mine Site Management Plan. Post-mining: Inspections and assessments as per the Tahmoor Mine Site Management Plan. **Great Southern Road (partial)** Pre-mining: Pre-mining condition as per the Wollondilly Shire Council Management Plan. During mining: Regular monitoring as per the Wollondilly Shire Council Management Plan. Post-mining: Inspections and assessments as per the Wollondilly Shire Council Management Plan. **Bargo Railway Viaduct**			
		Normal Condition		
		• Historical heritage site monitoring indicates no detectable environmental consequences.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Historical heritage site monitoring indicates potential detectable environmental consequences, but with negligible impacts to the heritage value of the heritage site(s).	• *Actions as required for Normal Condition.* • Co-ordinate a site inspection with a structural engineer. • Consult with a qualified archaeologist or heritage architect to determine whether impacts to heritage sites have occurred. • Consider increasing monitoring and review of data frequency for sites subject to a Level 1 trigger event, subject to land access. • Detailed photographic recording of any damage to be documented. • Erect warning signs and restrict access to areas where necessary.	• Report trigger exceedance to DPE and Heritage NSW. • Report trigger exceedance and investigation outcomes in Annual Review.
		Level 2		
		• Historical heritage site monitoring indicates environmental consequences to heritage site(s) but to a level that could be repaired in a manner that preserves the heritage value of the site(s).	• *Actions as stated in Level 1.* • Consider and decide on reasonable and feasible options for remediation as relevant which could form corrective management actions (CMAs) that would result in the repair of the item to a level that preserves the heritage value of the site(s). • Increase monitoring and review of data frequency for sites subject to a Level 2 trigger event, subject to land access. • Review Heritage Management Plan and modify if necessary. • Investigate exceedance of subsidence prediction. • Review mine design/predictions against mine criteria (e.g. for Picton Weir – review environmental consequences after extraction of LW S5A and determine if LW S6A should be shortened). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Heritage Management Plan. If it is concluded that heritage items have been damaged by subsidence impacts: • Offer site visit with DPE and Heritage NSW. • Provide DPE and Heritage NSW with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Review. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.
		Exceeds Performance Measure		
		• This performance measure will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historic heritage item.	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Engage heritage specialist to determine if impacts to the heritage values of the site are irreparable even after reasonable remediation attempts have been made under the TARP. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan.	• *Responses as stated in Level 2.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
	Pre-mining: • Visual assessment by a heritage consultant. • Pre-mining condition and structural assessment as per the Main Southern Railway Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Main Southern Railway Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of Longwalls LW S7A. • Inspections and assessments as per the Main Southern Railway Management Plan.			
Notes: [1] EIS predictions for historical heritage sites summarised in Section 4.2 of the Heritage Management Plan.				

Appendix B – Aboriginal Consultation

This information has been retracted
- For more information contact Tahmoor Coal

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Appendix C – Teatree Hollow 2013.1: Test Excavation Methodology

Overview

Teatree Hollow 2013.1 rockshelter (Teatree Hollow) was recorded in 2013 (Niche 2020) as containing a number of ochre and charcoal art panels and confirmed cultural deposit (20 artefacts). It is directly above proposed longwall S2A, and MSEC (2022) has predicted that there is a 10% chance that impacts could occur to the rockshelter during underground mining.

Feedback from RAPs as part of the consultation process for the Tahmoor South Heritage Management Plan (HMP) has been that they consider this site to have cultural significance values that warrant for impacts be avoided or minimised where possible, and for suitable mitigation measures to be implemented prior to mining in the event that impacts do occur to the site.

As a proactive response to the 10% chance of rockshelter impacts we propose to undertake detailed recording of the site and to further investigate the shelter through archaeological methods prior to the commencement of mining. This will ensure in the event of irreparable damage, suitable archaeological data and samples are already collected and analysed. In addition to the non-invasive recording that was undertaken as part of baseline recording prior to the commencement of mining (scale drawings, archival photographs and photogrammetry to create a 3D model), we propose targeted archaeological excavation within the shelter.

The proposed archaeological investigations are a rare opportunity to undertake detailed analysis of a rockshelter in the Sydney basin. Data derived from the investigations could contribute to knowledge of Aboriginal occupation, in the local region. It will also ensure that information is preserved and available to the Aboriginal community in the event that impacts do occur and ultimately providing a positive social and cultural output even in the event that damage does occur.

Heritage NSW have been contacted regarding the proposed rockshelter test excavation and are supportive in principal but will be guided by the wishes of the RAPs. Test excavation would precede on the basis of endorsement from Heritage NSW and approval by DPE (now DPHI).

A more detailed archaeological research design is contained in **Appendix F.**

Current condition of Teatree Hollow rockshelter

A site inspection and detailed recording was undertaken by Ryan Desic (EMM Associate Archaeologist) and Kirsty Lee Chalker (Cubbitch Barta Native Title Claimants) on 12 April 2022. Oskar Johansson (EMM GIS Analyst) also attended and is creating a 3D photogrammetry model of the site from photos he took that day. The inspection verified that the rockshelter is in a stable condition although the art panels have faded somewhat since their recording by Niche in 2013. While much of the rockshelter base is rock, there are areas with soil deposit of up to ~40 cm that could be targeted for test excavation and over 20 surface artefacts were identified, mostly within the dripline of the shelter.

Photographs of the site are included as **Plate 1 – Plate 4** and a measured drawing of the rockshelter showing the location of the art panels and artefact concentrations is included as **Figure 6.**

This information has been retracted
- For more information contact Tahmoor Coal

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Appendix D – Bargo Cemetery: site overview and plan

Bargo Cemetery

Bargo Cemetery is a small cemetery that has been in continual use since 1935. The cemetery is surrounded by a plantation of mature trees on Great Southern Road's north end adjacent to Charlies Point Road. Burial plots are separated into 'Roman Catholic' and 'Church of England' denominations while a memorial garden and Columbarium Wall are used to inter ashes. There are three unused lots at the cemetery. There are forty-four known burials in the Roman Catholic section and one hundred and fifty-three in the Church of England section, with some plots containing double and triple burials. A cemetery plan is included as **Figure 7.**

EMM personnel Pamela Chauvel and Anthony Dakhoul conducted baseline recording of Bargo Cemetery on the 15 and 16 of December 2021 using recording sheets and a single lens reflex (DSLR) camera. Results from the baseline assessment revealed that the cemetery is in a relatively good condition, but some individual graves are dilapidated, suffering structural and aesthetic damage. The photographs and recording sheets will be used as a baseline record for monitoring during extraction of LW S1A – S6A.

Many of the burials consist of ground-level ledgers or ledgers on a base enclosed by squared or bevelled kerbs with posts at the corners. The most prominent tombstones are rectangular or capped with a segmental/basket arch or a simple wedged shaped plaque placed within the kerbs of the burial. Some of the burials are decorated ornately tiles while others consist of a simple Latin cross at the top to mark the grave.

Plate 1 Grave ID R-C48. An open book low monument made of granite, gravel and concrete in good condition.

Plate 2 Grave ID A-K7. A mound grave made up of crushed stone marked with a wooden Latin cross.

Plate 3 Grave ID A-A6. Low monument, plain kerb grave with a commemorative plaque made of concrete and metal.

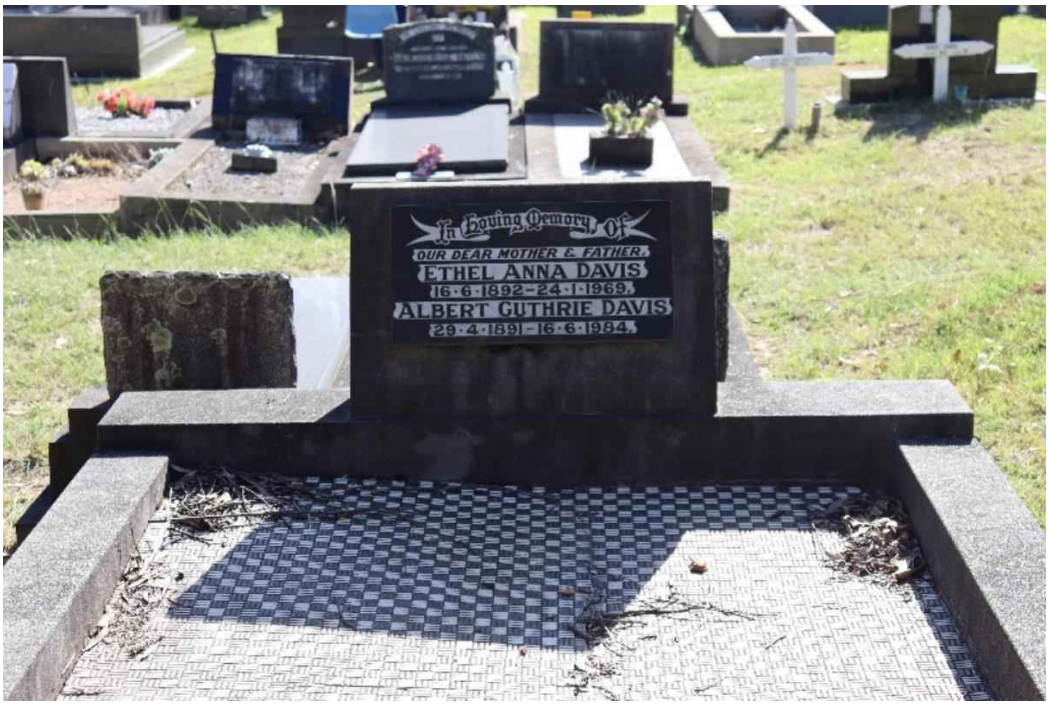

Plate 4 Grave ID A-G17 & A-G18. Low monument plain kerb grave with a tablet headstone made of granite and white and brown ceramic tiles.

Figure 7 Bargo Cemetery Plan

Appendix E – Archival record of rockshelter Teatree Hollow 2013.1

An interactive scale 3D model of rockshelter Teatree Hollow 2013.1 can be found at the following link https://skfb.ly/o9Z6R

Notes for 3D model navigation using computer mouse:

- hold left click down to rotate model;
- hold right click to drag/move the model;
- use mouse scroll wheel to zoom in and out: and
- left click on the annotation numbers visible in the model to see additional information and photos.

Appendix F – Archaeological Research Design – Teatree Hollow Rockshelter

Archaeological Research Design

Teatree Hollow 2013.1 Rockshelter

Prepared for Tahmoor Coal

September 2022

Archaeological Research Design

Teatree Hollow 2013.1 Rockshelter

Tahmoor Coal

E211015 RP#

September 2022

Version	Date	Prepared by	Approved by	Comments
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This report has been prepared in accordance with the brief provided by Tahmoor Coal and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of Tahmoor Coal and no responsibility will be taken for its use by other parties. Tahmoor Coal may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Background and Context

Teatree Hollow 2013.1 rockshelter (Teatree Hollow) is registered on the Aboriginal Heritage Information Management system (AHIMS) as #52-2-4471. It is located beside Teatree Hollow Creek within the Australian Wildlife Sanctuary in Bargo, NSW (Figure 1.1).

Teatree Hollow was recorded in 2013 (Niche 2020) as containing a number of ochre and charcoal art panels and confirmed cultural deposit (20 stone artefacts across the shelter floor). A more recent site inspection and detailed recording was undertaken by Ryan Desic (EMM Associate Archaeologist), Oskar Johansson (EMM GIS Analyst) and Kirsty Lee Chalker (Cubbitch Barta Native Title Claimants) on 12 April 2022. A 3D photogrammetry model of the site was created from the recording (Appendix E in the HMP). The inspection verified that the rockshelter, which has been formed by block fall and cavernous weathering, is in a stable condition although the art panels have faded somewhat since their recording by Niche in 2013. During the site inspection, over 20 surface artefacts were identified, mostly within the dripline of the shelter.

The dimensions of the rockshelter are approximately 14.3m x 3m x 4m. While much of the rockshelter base is rock, there are areas of potential archaeological deposit (PAD) totalling approximately 21 m^2, where soil deposit of up to 30 cm may contain cultural materials (Plate 1.4).

Photographs of the site are included as Plate 1.1 – Plate 1.6 and a measured drawing of the rockshelter, showing the location of the art panels and artefact concentrations, is included as Figure 1.2.

The site is directly above longwall S2A of the approved State Significant Development (SSD) Tahmoor South Project (proponent Tahmoor Coal). Mining Subsidence Engineering Consultants (MSEC) (2022) has predicted that there is a 10% chance that impacts could occur to the rockshelter during underground mining. While of low probability to occur, any subsidence would severely compromise the significance of the site, and as such a program of archaeological works is proposed to capture important information prior to the development activity.

This information has been retracted
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2 Aboriginal consultation

There are 29 Aboriginal parties that have registered for consultation on the Tahmoor South Project. On 19 January 2022, a letter was sent to all project Registered Aboriginal Parties (RAPs) informing them that a Heritage Management Plan (HMP) was being prepared for the project. Responses via phone and email from Kamilaroi Yankunjatjara Working Group (KYWG) and Cubbitch Barta Native Title Claimants (Cubbitch Barta) emphasised that they consider this site to be of higher cultural value rather than the low significance rating attributed to it in the ACHA (Niche 2020). They have urged that impacts be avoided or minimised where possible, and that suitable mitigation measures to be implemented *prior* to mining in the event that impacts do occur to the site.

Consequently, EMM explored the possibility of more detailed archival recording of the rockshelter including pigment sampling of the art and test excavation of the deposit within the rockshelter. Feedback from Cubbitch Barta was that they consider pigment sampling as too destructive, and they therefore did not support it. However, they did support test excavation because it could contribute to greater understanding of their cultural history. KYWG were also supportive of test excavation and would like chronological dating to be done of the cultural deposits.

A draft test excavation methodology for Teatree Hollow rockshelter was sent to all RAPs for review and input on 19 April 2022. Four responses were received, and all were supportive of the methodology. Cubbitch Barta requested that the area of excavation be kept to a minimum and said that they would prefer only one 50 x 50 cm test pit but acknowledged that the provision for additional test pits was suitable to provide the flexibility to achieve the aims of gathering suitable samples for research purposes.

A full record of consultation is included as Appendix A in the Tahmoor South HMP.

3 Research design

3.1 Regional archaeological context

In NSW, the earliest evidence of Aboriginal people are human remains recovered from the lunette in Lake Mungo and dating to approximately 42 ka (Bowler et al. 2003; O'Connell et al. 2018). The presence of red ochre covering the remains representing a society with significant cultural and symbolic complexity (Langley et al. 2011). Near the coastal edge, the earliest populations were found at Cranebrook Terrace, near Penrith. Here a handful of rudimentary stone tools were found in an alluvial unit, some 8 m below the current surface, which were dated to approximately 40-45 ka (Williams et al. 2017). By approximately 35 ka, regional populations appeared to have become established in the Sydney Basin, focussed mainly along major river systems, including the Hawkesbury-Nepean, Parramatta, Georges and Hunter Rivers (Hughes et al. 2014; Williams et al. 2012; 2014). These rivers formed key ecological refuges that hunter-gatherer groups used to survive major climatic events such as the Last Glacial Maximum (21±3 ka) – a cool and arid climatic period.

The terminal Pleistocene and early Holocene (approximately 18–8 ka) was characterized by significant environmental change – the Holocene climatic optimum (Williams et al. 2015a; 2015b). These conditions resulted in increasing population growth, expansion of ranging territories, increasing sedentism (longer patch residence time), the beginnings of low-level food production (eg aquaculture), and ultimately the initiation of social and cultural groupings observed in the late Holocene (Williams et al. 2015b). Evidence of occupation of coastal south-eastern Australia includes Burrill Lake (approximately 25.8 ka) and Bass Point (approximately 20 ka) (Attenbrow 2010 p153).

The late Holocene saw significant population increase, and data suggests that the highest populations during this time were in south-east Australia. Williams et al. (2015b) suggest that this increase was likely a result of intensification of earlier technological advancements, including hafting-technology, plant and seed processing and localised landscape management (using fire). A result of these denser populations was a reduction in movement and the formation of strong classificatory kinship systems, complex cultural and symbolic landscapes, distinctive graphic art systems, land rights in the form of ritual property, and formalized exchange networks (Williams et al. 2015a). For the Sydney Basin, these conditions resulted in a significant increase in the archaeological visibility of past Aboriginal populations, with sites occurring in a much wider range of locations, and generally indicative of a more intensive use of the landscape. In the greater Blue Mountains region, rockshelter use intensified approximately 5-4 ka (Attenbrow 1981; Stockton 1973; Kohen et al. 1981). It is during this time that the Teatree rockshelter is hypothesised as being first used, and which may provide information on this period of societal change.

3.2 Local studies

A considerable level of archaeological investigation has been undertaken locally, often in response to mining lease exploration and development, residential development and infrastructure projects. Notable contributors to the identification and management of Aboriginal sites locally include Caryll Sefton (1994; 1997; 2000), Niche Environment and Heritage (2014a; 2014b; 2018; 2019; 2020), Biosis (2009) and Regal and Reeves (2017). However, despite these works, a comprehensive understanding of the region remains lacking (although see discussions on Dibden's recent [2019] study below).

The oldest date of occupation in the Sydney region is Curracurrang 1 rockshelter 7,450 ±180 BP (see Attenbrow 2010, p18). Excavation and dating of rockshelters regionally give occupation dates of mid to late Holocene (c. 7,000 – 2,000 BP). However, no locally recorded rockshelter has been subject to archaeological test excavation to identify when the Tahmoor region first became used by people in the past.

By the late 1990s, 25 rockshelters had been excavated on the Woronora Plateau, seven coastal, six estuarine and 12 in inland environments (Sefton 1998 p31). However, very few rockshelters have been excavated in recent

years. As an example, Dibden's exceptional (2019) study of occupation of the Woronora Plateau relied entirely on non-invasive rock art observations and existing material. Dibden reviewed the distribution of grinding grooves, engraved groove channels, engraved rock art rockshelters (totalling 810 sites). Dibden's sample of 627 rockshelter sites only included rockshelters that contain observable 'direct evidence' of use. Dibden identified characteristics of rockshelters in the Upper Nepean Catchment:

- of the 627 rockshelters, 509 featured art, 279 featured stone artefacts and 21 featured grinding grooves;
- grinding grooves in shelters have a comparable density distribution with that found in open grinding groove sites;
- rock art counts per shelter vary between 1–206, with a mode of one and median count of four. The majority of shelters contain low rock art counts; and
- rock art shelters are extremely variable in their morphology and dimensions, and the majority have highly uneven rock floors, with limited cultural deposits.

In 2013, Teatree Hollow rockshelter was recorded and assessed by Niche as part of an ACHA for the Tahmoor South Project (Niche 2020). The report included a comparative analysis of local Aboriginal site features to inform rarity and representativeness of sites within the project area and focused on grinding groove sites and a significant cluster of rockshelter art sites (n=17) associated with Dog Trap Creek. The report found that the majority of reliably dated archaeological sites within the region are less than 5,000 years old and previous rockshelter excavations on the nearby Woronora Plateau have returned dates around 2,000 BP (Niche 2020 p34).

The assessment found that Dog Trap Creek was a "significant cultural precinct for Aboriginal people in the past, including the recent past during the first contacts with European people based on interpretation of some of the motifs present" (Niche 2018, p53). The cluster of sites at Dog Trap Creek is located approximately 1.5–3 km to the east/south-east of Teatree Hollow rockshelter. Although the report concluded while these sites had high significance the other rockshelters discussed in the report, including Teatree Hollow were deemed to be of low significance (Niche 2020 p63).

3.3 Subsidence impacts and implications

In response to mining, a focus of previous research has been on identifying, monitoring and managing sandstone-type Aboriginal sites, mainly comprising rockshelters (some including art), grinding grooves and occasionally rock engravings (Sefton 2000, Regal and Reeves 2017). At Whale Cave, a rockshelter with art within the Southern Coalfields, mining subsidence resulted in water seepage, damage to art panels and the partial collapse of the overhang roof. This has been the only *reported* incident of rockshelter collapse within the Southern Coalfields as a result of mining subsidence.

In 2017 Regal and Reeves compiled an overview of the monitoring of sandstone overhangs for the effects of mining subsidence in the Southern Coalfield. Their study built on the earlier work of Carol Sefton (2000) and reviewed the available data from baseline and end of panel monitoring reports for 206 sandstone type Aboriginal cultural heritage sites including 168 rockshelters (with art and/or deposit and/or grinding grooves) as well as grinding groove sites and engravings. Regal and Reeves' study found that of the 206 Aboriginal sites, 32 (15%) had suffered changes as a result of subsidence. Of these 32 sites, two were observed to have experience direct adverse effects to their heritage values as a result of mining, primarily due to cracking or changes to water seepage. They found that 9% of all rockshelters monitored within the Southern Coalfields have experienced impacts that resulted in changes to their structure.

Teatree Hollow 2013.1 (AHIMS 52-2-4471) is situated within the valley of a tributary stream to Teatree Hollow and may therefore experience valley related movements. Monitoring of the effects of subsidence induced ground movements to Aboriginal heritage sites (such as rockshelters and grinding groove platforms) has been conducted

since the 1990s (see Sefton, 2000; Biosis Research, 2009; Regal and Reeves, 2017; Regal Heritage, 2022; Niche, 2019). Previous experience shows that approximately 1 in 10 rock-based sites that have been subjected to subsidence induced ground movements show demonstrable changes that can be attributed to subsidence. These changes take the form of block fall, exfoliation, cracking, opening and/or closing of existing faults and fissures (Biosis Research, 2009). While the probability of impacts to Teatree Hollow rockshelter has been assessed by MSEC as relatively low (MSEC 2022), if impacts were to occur to this rockshelter, the effects could range from minor (such as minor cracking or changes to faults and fissures) to severe (such as damage or loss of art panels or collapse of the sandstone shelter). Such effects could result in partial to total loss of its heritage value. Consequently, while the probability of impacts is low, there remains a small possibility that they could occur. Collating as much monitoring data as possible will therefore not only contribute to knowledge and understanding about historical Aboriginal use of the site and provide an archival record in case impacts do occur; it will also gather data that can potentially contribute to understanding the effects of subsidence on Aboriginal cultural heritage sites in the Southern Coalfields.

3.4 Rationale for test excavation

As a proactive response to the 10% chance of rockshelter impacts, Tahmoor Coal has completed detailed baseline recording (scale drawings, archival photographs and photogrammetry to create a 3D model) and committed to further investigate the shelter through archaeological excavation prior to the commencement of mining. This will ensure in the event of irreparable damage, suitable archaeological data and samples are already collected and analysed to inform the past.

Not only do the investigations ensure cultural information is retained regardless of the proposed development they would also contribute to the broader understanding of the past use of the region; and further inform existing studies such as those outlined above by Dibden. In depth studies such as Dibden's (2019) have primarily focused on rock art and motifs, but less research has been done on cultural deposits and/or chronologies using dating from excavations. Dibden notes that shelters generally have limited areas of cultural deposits or 'do not possess attributes that would have allowed for their use as domestic habitation sites' (Dibden 2019 p.107). In contrast Teatree Hollow rockshelter contains areas of cultural deposits which have the potential to reveal information about Aboriginal cultural use of the local area; and inform these wider concepts and ideas about past activity and occupation.

3.4.1 Aims

The archaeological program has the following aims:

- to characterise the archaeological deposits relating to past Aboriginal occupation of Teatree Hollow rockshelter using excavation and paleo-environmental analyses. This includes a greater understanding of resource exploitation, identification of any change through time in spatial and chronological phases of activity, and site formation processes;
- using the data recovered from the site to further inform existing frameworks and ideas about past Aboriginal occupation and visitation of the Tahmoor region; and to bolster works such as those by Dibden (2019);
- to allow greater cultural association between the site and the Aboriginal stakeholders through Aboriginal community participation and partnership in the archaeological program and options for the interpretation of the results; and
- to preserve information about the rockshelter before the art fades completely and/or the shelter is potentially impacted by subsidence.

3.4.2 Research questions

The following research questions in Table 3.1 have been developed to respond to the aims and objectives of the test excavation, and to address the issues around dating and cultural heritage raised by RAPs.

Table 3.1 Research questions

Research questions	Archaeological methods and analysis to address question
What is the stratigraphic pattern of cultural materials within the rockshelter?	Archaeological excavation conducted in stratigraphic layers (if present) or by 2-5 cm spits.
What is the age, composition, technological attributes, and significance of cultural materials within the rockshelter?	Soil samples taken for OSL dating and stone artefact analysis.
Can the formative processes of the stratigraphic profile provide information on the nature and/or survivability of the archaeological resource within the rockshelter? Are there other key factors in the distribution and extent of the material culture within the rockshelter?	Archaeological excavation in 2-5 cm spits in targeted locations within the shelter.
What are the cultural, social and historic values associated with the cultural materials in the rockshelter? Does the excavation support or require modification of the significance and values previously assigned to Aboriginal sites, places and/or locales within the project area?	Re-evaluation of the significance assessment in the ACHA (Niche 2018) in the light of the evidence obtained through archaeological excavation of the rockshelter and input from RAPs regarding the cultural, social and historic values associated with the rockshelter.
Can intra-site past Aboriginal activities be determined through the results of excavation of the rockshelter?	While no rockshelters in the local area have been excavated, the results of test excavation (including dating) can help inform the wider regional context established by Dibden and others over the last several decades.
How should the cultural materials be conserved and managed in future?	Consultation with RAPs following the collection and analysis of cultural material.

4 Test excavation methods

4.1 Initial excavations – phase 1

The proposed excavation methods are generally as follows:

- up to four test pits (50 cm x 50 cm) will be excavated. It is proposed that these will either be as discrete test pits on a grid across the cultural deposits or combined to form a larger excavation within the site - the eventual layout would be determined to best answer the research questions outlined above, and developed with the registered Aboriginal parties during the program;
- each test pit will be excavated by hand in 2-5 cm spits or, if more appropriate, according to stratigraphic layers encountered;
- manual excavation would continue to either: i) the base of the cultural deposits; ii) to the depth of the underlying geology; or iii) to the maximum depth possible via hand excavation (<150 cm);
- all excavated soils to be sieved using a maximum 3 mm aperture mesh. All recovered cultural material will be bagged and labelled according to its recovered location;
- all test pits would be documented using photographic records, written descriptions and scaled drawings;
- soil profiles would be recorded in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010), including scaled drawings, photographs, and written descriptions;
- soil samples may be collected for description, sedimentological and chronological analysis where such analysis is considered likely to contribute significant information. Optically Stimulated Luminescence (OSL) samples would be taken in areas where Aboriginal objects are found, and generally try to bracket the deposit (to provide a maximum and minimum age). Material for radiocarbon analysis may also be undertaken opportunistically if archaeological features containing charcoal or other dateable material are evident;
- reduced levels of the top and bottom of the test pit would be documented using a dumpy level against a known elevation. Other levels may be taken as required; and
- excavation procedures and protocols may be modified at the discretion of the Excavation Director, in consultation with the RAPs and proponent as the conditions in the field and nature of the excavations develop. This includes the movement/discontinuance of test pits to avoid existing obstacles, buried services and disturbances.

4.2 Test pit expansion thresholds

During consultation, Cubbitch Barta Native Title Claimant Aboriginal Corporation requested that the area of excavation be kept to a minimum but acknowledged that the provision for additional test pits was suitable to provide the flexibility to achieve the aims of gathering suitable samples for research purposes. Therefore test pit expansion would *only* be undertaken in areas where the thresholds outlined below are met. The decision of whether to expand any test pits will be at the discretion of the excavation director in the field, and in close collaboration with the registered Aboriginal parties.

The number and locations of any expansion would be determined following the completion of the initial test excavation (phase 1). However, in keeping with the wishes of the Aboriginal community that we minimise unnecessary impacts, and noting that the site is currently at low risk of harm, any proposed expansion would seek

to remain conservative. As such, it would be intended that no more than a maximum of 3 m^2 of additional excavation, representing ~15% of the archaeological deposit within the rockshelter would be recovered.

The thresholds for expansion would include:

- Stone artefact densities greater than 16/m^2, a conservative estimate that takes into account the density of surface artefacts.
- Where evidence of multiple phases of past activity is identified through changing raw material types and/or distinct technological attributes at different depths within the soil profile.
- Where cultural materials considered to reflect use of the site in the early Holocene and/or Pleistocene are encountered.
- Where rare or unique stone artefacts and/or other archaeological material is recovered.
- Where unique and/or rare archaeological features (eg hearths, cooking pits, middens, etc) are identified.
- Other conditions that are considered by the Excavation Director to inform the research questions and/or broader aims of the ARD.

4.3 Post excavation analysis

The post-excavation analysis (incorporating data from the excavations) would be designed to address the research objectives and aims, along with other relevant questions that may arise based on the results of the excavation. These would include, but not be necessarily limited to:

- Stone artefact analysis:
  - initial sorting and cleaning of excavated material;
  - establishment of a computer database to record all provenance information;
  - measuring and recording the attributes of stone artefacts including residue and usewear analysis (if appropriate); and
  - statistical analysis of the data to explore the frequency, distribution, raw material type, implement type and size of the of the artefacts in the assemblage;
- Geochronology, including the processing and analysis of samples to inform the absolute age of the soil profile and/or cultural assemblage recovered. This would include OSL ages, as well as radiocarbon samples were recovered. While large number of these samples are likely to be collected, given the prohibitive cost of processing, it is probable that a small number of ages would be obtained in a small number of master-sequences to inform the broader archaeological program. The samples would be processed by either University of Gloucestershire and/or University of Wollongong.
- Other methods that may be explored if excavation results indicate that they are warranted may include:
  - Geochemistry and soil analysis to further inform and interpret the formation history of the soil profile from which cultural materials are recovered. This would include the use of Itrax X-ray Fluorescence (XRF) core scanning methods at Australia's Nuclear Science and Technology Organisation (ANTSO), as well as particle size analysis to explore changes in the alluvial and colluvial history of the river corridor; and

- Paleo-environmental analysis, including palynology, phytolith analysis and/or charcoal analysis to explore the past vegetation and fire regimes that may have influenced and/or modified by past human activity. These would utilise the same samples collected for geochemistry and/or sampling and sent to a range of university specialists in these fields to process and interpret the results.

4.4 Reporting

Reporting will provide information on the field investigations, compilation and synthesis of the post-excavation analyses, and interpretation of the results to address the research questions and inform the past activity and use of the region.

The subsequent management measures derived from the results will be formulated in consultation with RAPs.

A report will be appended to the Tahmoor South HMP and lodged with the Aboriginal Heritage Information Management System (AHIMS).

An Aboriginal Site Impact Recording Form will be prepared for the rockshelter.

4.5 Artefact storage

Cultural material will be retained temporarily by EMM for the required analysis of technological attributes. Such objects will be stored in a secure location. Soil and cultural materials that are suitable for dating and provenance may be submitted to various specialist laboratories to further inform the post-excavation analysis and reporting.

Following suitable analysis, cultural material recovered during the investigation will be returned to a test pit within the rockshelter from which they were originally removed and reburied in accordance with the request by Glenda Chalker (Cubbitch Barta). Re-burial would be in a suitable container to ensure ease of recovery in the event that subsidence impacts the site.

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Appendix G – Excavations and monitoring reports of rockshelter Teatree Hollow 2013.1

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3 May 2023

April Hudson
Approvals Specialist
SIMEC Mining
2975 Remembrance Drive
Tahmoor NSW 2574

Re: Teatree Hollow rockshelter (#52-2-4471) - archaeological excavations - completion of excavations and results

Dear April,

Background and context

Tahmoor Coal Pty Ltd (Tahmoor Coal) is currently implementing the Tahmoor South Coal Project, near Bargo, which was approved as State Significant Development (SSD-8445) in April 2021. This project includes the southern expansion of underground longwall coal extraction from the existing Tahmoor mine operations, Remembrance Drive, Tahmoor, NSW. Specifically, six longwalls, LWS1A-S6A, are being excavated beneath a relatively unmodified piece of bushland between Remembrance Drive and Charlies Point Road, and within which flows Teatree Hollow Creek. An Extraction Plan for these six longwalls was approved in September 2022.

As part of the Extraction Plan, a heritage management plan (HMP) was developed that provided direction on the management of Aboriginal cultural materials that may interact with the proposed development activities. One of the requirements was the proactive investigation of a documented rockshelter, Teatree Hollow 2013.1 (AHIMS #52-2-4471), situated on the eastern bank of Teatree Hollow Creek. While the site was considered of very low risk of being adversely affected by the under-mining of the locale, discussions with Heritage NSW and the registered Aboriginal parties sought to obtain some archaeological information from the site prior to the development activities should harm and/or destruction ultimately result. An archival recording of the site was completed in May 2022 as one aspect of these proactive works. In addition, the implementation of an archaeological excavation program was also proposed.

The proposed investigations of the rockshelter are outlined within an archaeological research design (ARD) that is appended to the HMP for the project, and which was approved by the NSW Department of Planning and Environment in September 2022. The ARD underwent several iterations during stakeholder engagement in terms of the proposed approach, and ultimately determined a two stage method: i) the initial excavations of up to four 0.25 m^2 test pits within the floor of the rockshelter to identify and recover cultural materials; and ii) in the event of certain archaeological thresholds being reached, an option to expand excavations up to a total of 3 m^3 of the overall deposit. All excavations were to be undertaken carefully, all sediment sieved for cultural materials, and samples collected for palaeoenvironmental and chronological analyses.

During the planning of the fieldwork, Auntie Glenda Chalker (Cubbitch Barta Native Title Claimants Aboriginal Corporation) reiterated their ongoing views of the archaeological program, specifically: i) the project was to be community-led and as a training experience for Tharawal traditional owners; and ii) impacts through the archaeological excavations should be kept to a minimum, and any expansion robustly interrogated before application given the low risk of harm from the development activities. To ensure ongoing Aboriginal community support, these general principles were adopted within the framework of the approved ARD.

This letter report provides a summary of the archaeological program that was conducted within the rockshelter to fulfil the requirements of the HMP.

The Excavations

Dr Alan Williams, with the participation of Rebecca Chalker, Bilyarra Chalker, Kirsty-Lee Chalker, Kiahni Chalker (Cubbitch Barta Native Title Claimants Aboriginal Corporation), and Shazda Brown (Tharawal LALC), undertook the excavations at Teatree Hollow rockshelter 2013.1 on 15 and 16 November 2022.

These excavations only implemented the initial phase ((i) above), which consisted of four 0.25 m^2 test pits situated within the main deposits of the rockshelter. While artefact densities that met the thresholds for expansion were encountered in one test pit (#4), no expansion was undertaken since: i) it was strongly opposed by the Aboriginal participants present to undertake any more impact than was absolutely necessary, and data/samples captured in the four test pits was considered adequate to answer the research aims of the project; and ii) the extent of the archaeological deposits as has been presented in previous documentation was exaggerated, and as such there were few areas where expansion could be achieved. While the original mapping of the archaeological deposit (as presented in the HMP) was broadly accurate, it did not provide detail on the variability of the depth of the deposits, and in several areas under-lying sandstone outcropping – indicative of very shallow deposits – was observed. While the plan suggests an archaeological deposit of ~14 m^2, over half of this may only be a few centimetres in depth (see Plate 1 for an approximate revised deposit curtilage), and as such additional expansion had the risk of entirely removing the deeper portions of the cultural deposit. This was considered an unacceptable level of impact given the low risk of harm to the site.

The excavations initially consisted of three 0.25 m^2 test pits that were spaced broadly every 1.5 m apart through the centre of the archaeological deposits – generally between 1-2 m from the back of the shelter and the same distance from the drip-line (Plates 1-7 inclusive). Following the finding of cultural materials in the northernmost test pits (#1), a fourth test pit (#4) was undertaken in close proximity, but nearer the dripline where a thicker part of the deposit was believed to be present.

All excavations occurred in 2-3 cm spits, with detailed recording being undertaken throughout the excavations. For each spit excavated, a sample of sediment was collected for both archiving and future analysis (as required), with the remainder sieved for cultural materials. The sediment was dry-sieved through a 3mm mesh, with sieving undertaken outside and down-wind of the rockshelter itself. In addition, three Optically Stimulated Luminescence samples were collected from test pit #3, which contained the deepest deposit of ~30 cm; and 18 charcoal samples were collected from across the four test pits, and recovered from the completed vertical sections during recording. Both sample types recovered to provide an absolute chronology of the cultural deposits.

At completion, all test pits were recorded using written description, photographs and scaled drawings. Following recording, geofabric material was placed in the base and sides of the test pits, and they were backfilled with the sieved material from the excavations.

Results and findings

This section presents a summary of the field observations and interrogation of the data. Further details and information are provided in Plates 1-8 and Appendices A-D.

General overview

Overall, the excavations found a relatively shallow archaeological deposit, on average ~28cm thick (Table 1). This consisted primarily of two units: i) an upper compact brown (10YR 5/3) fine sand with frequent charcoal flecks, some 5 cm thick and reflecting the modern, trampled, land surface; over-laying ii) a yellowish brown (10YR 5/4) loose medium to coarse sand, and believed to reflect degrading sandstone either from the under-lying geology and/or from collapsing rockfall (Plates 2-7 inclusive). Of note was a thin very dark grey (10YR 3/1) coarse sand with abundant charcoal found below (ii) in the north-eastern corner of test pit #3, and which has been hypothesised as a possible hearth feature (Plate 6). Charcoal samples were recovered from this feature and will provide a maximum age for the deposits within the site (see below). Artefacts were recovered from this feature, which is located in the deepest and highest part of the rockshelter. It is the only part of the site with a substantive flat surface where a person may sit or lay (Plate 1).

The deposits were situated immediately over undulating sandstone outcropping in all test pits. Test pits #1, #2 and #4 all contained numerous roots of various sizes from established nearby vegetation running along the soil-bedrock interface; and it is probable that these have resulted in some post-taphonomic modifications of the cultural deposits and associated stone artefacts.

Chronology

Of the collected chronological samples, 10 charcoal samples from test pits #3 and #4 were processed by the Chronos laboratory at University of New South Wales (Plate 8; Appendix A). These samples were selected, either being within or associated with the possible hearth feature in test pit #3 and/or where the highest stone artefact densities were recovered.

The samples range in age from 1,700 calibrated years BP (before present) and 301 calibrated years BP (Plate 8). The substantive bioturbation and root intrusions throughout the soil profiles have resulted in numerous reversals and mixing of these ages. For example, the deepest sample recovered (UNSW-2004) provided one of the youngest ages. Conversely, several of the oldest samples were collected from unit (ii) that forms one of the upper units sitting across the cultural deposit.

However, a suite of ages recovered from the possible hearth feature found at the base of test pit 3, all return ages between ~800-1,000 calibrated years BP (including UNSW-1995, -1996, -1997 and -2000). Several of the ages from unit (ii) that overlies the possible hearth feature also return ages between ~800-1,100 calibrated years BP. The only sample collected from unit (i) returned an age of 439-144 calibrated years BP (UNSW-2000), and this aligns with some of the youngest samples recovered from the under-lying unit (ii).

While a comprehensive age-depth model is not feasible given the variability within the samples, a general indication of the age of the site can be determined. Specifically, the majority of the deposits appear to date to between ~450- 1,200 calibrated years BP, with some suggestion of a possible earlier formation as early as ~1,700 years BP. The uppermost units, effectively the current surface of the site, began forming over the last 400 years, and the limited data suggests continually formation up to, and into the post-Contact period.

The majority of the cultural assemblage was recovered from spits 5 and 6 within test pit #4. This is unfortunately one of the most variable cluster of samples collected. However, it appears likely this reflects an occupation focus around 1,000 calibrated years BP.

Stone artefact analysis

A detailed lithic analysis has been undertaken by Dr Trudy Doelman at the University of Sydney, and is presented in Appendices B and C. In summary, a total of 116 artefacts were recovered (Table 2). These were primarily found in test pits #3 and #4 situated in the centre and largest part of the rockshelter. To the north, the site is a steep sandstone slope to a rocky edge on the creek and can be used to access the site, but would be entirely unsuitable for sitting or sleeping; while to the south the roof slopes down dramatically and a person would be unable to stand in this of the site. Despite a narrow piece of deposit being present in the south, no substantive

cultural materials were encountered in test pits #1 and #2, and suggest this was not a well used part of the site in the past.

The artefacts recovered from test pits #3 and #4 are found in close proximity to surface artefact scatters previously recorded (Plate 1), and unit (ii) may be the source of these cultural materials eroding down the face of the rockshelter in the vicinity of the dripline. In contrast to the surface scatter, the recovered assemblage is dominated by very small (<2 cm) artefacts, or micro-debitage, and may reflect the smaller fragments from artefact production occurring within the rockshelter and that have been trampled or bioturbated into the deposits. These were primarily found to depths of ~8-14 cm below surface (spits 4-7), and which would be within a trampling zone, especially during wetter conditions. It is probable that these artefacts may reflect a single occupation event given the potential for movement through the shallow soil profile.

The artefacts recovered were dominated by milky quartz raw materials, with a small number of banded IMTC (indurated mudstone/tuff/chert) and silcrete. Two fragments of basalt were encountered, and which may reflect flaking of a ground implement, such as a hand axe.

The assemblage lacked substantive diagnostic information, but suggests a late Holocene (<5,000 years ago) deposition. The fragments from an edge ground axe also constrain the assemblage to <3,500 years ago when this tool type reached the region. The assemblage therefore aligns well with the radiocarbon data recovered from the site and suggesting visitation in the last <1,500 or so years. The assemblage included the remains of at least 11 cores, and strongly suggests habitation and/or repeated occupation, rather than a brief hunting or re-tooling camp. The use of water-rolled milky quartz pebbles suggest a local source of raw materials, as well as longer transport of some of the other lesser used materials recovered.

Conclusions and next steps

The archaeological excavations were undertaken to ensure a robust sample of the cultural deposits of the Teatree Hollow rockshelter could be recovered in the event of damage or loss of the site. The excavations were Aboriginal community driven – or co-designed – and aimed to reach a balance of obtaining the needed information and cultural material recovery, while not resulting in unnecessary impact by the archaeological work. The proposed activities only considered to have a very low likelihood of resulting in any destabilisation. Overall, 1 m^2 was carefully investigated and recovered, perhaps reflecting ~14% of the cultural deposit. Further, excavations did not have the support of the Aboriginal participants, and there were few areas of the site where additional works would have further informed our understanding of the cultural deposit.

Overall, the excavations recovered 116 stone artefacts from a ~35 cm deposit consisting primarily of degrading sandstone and rockfall. Being shallow and surrounded by large vegetation, the cultural deposit was heavily bioturbated and disturbed by roots, especially to the north. A small open area in the centre of the site was considered more conducive for someone to sit and/or sleep; and this became the focus of the archaeological excavations. Indeed, a potential hearth and dense stone artefactual material were encountered within this part of the shelter. Despite this, a comprehensive understanding of the site can be determined. A suite of radiocarbon ages suggest that the deposits initially began forming ~1,200 years ago (and potentially slightly earlier) and continued into the post-Contact period. While the dates are variable and mixed, they suggest that Aboriginal visitation of the site primarily occurred between ~800-1,200 years ago. This activity may have been a single extended occupation or shorter repeat visits, during which small quartz pebbles were recovered from Teatree Creek and/or nearby outcrops for stone artefact production. The presence of other raw materials not local to the creek suggest that people were moving and/or trading with others in the broader locale. Given this, and the small size of the shelter, it would suggest the site formed one of a number of locales used by a small family group moving through the Tahmoor region.

The Aboriginal participants indicated that this general locale formed a focus of past occupation in the post-Contact period following the Appin massacre in 1826. While the upper unit certainly dates to the post-Contact period, the cultural assemblage cannot validate whether the site was used at this time.

In relation to next steps, EMM will retain the archived samples and cultural assemblage until the proposed development activities have been completed and the site is considered clear from future subsidence risk. At this time, we would liaise with the registered Aboriginal parties on the final repository of the cultural assemblage and/or implement additional mitigation as needed.

If you have any enquiries or questions, please contact me on 0438 104 740.

Yours sincerely

Dr Alan Williams FSA FRSA MAACAI
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Table 1 Radiocarbon samples collected.

Sample #	Test pit #	Spit #	Material type	Lab code	^{14}C age BP	^{14}C error (years)	Calibrated years BP
1	3	1	Charcoal		-	-	-
2	3	10	Charcoal	UNSW-1995	1,005	35	953-792
3	3	6	Charcoal	UNSW-1996	1,013	35	955-795
4	3	8	Charcoal	UNSW-1997	1,070	35	1,049-805
5	3	5	Charcoal	UNSW-1998	1,326	36	1,288-1,086
6	3	7	Charcoal	UNSW-1999	1,102	35	1,058-919
7	1	4	Charcoal		-	-	-
8	1	9	Charcoal		-	-	-
9	4	2	Charcoal		-	-	-
10	4	2	Charcoal		-	-	-
11	4	3	Charcoal	UNSW-2000	269	34	439-144
12	4	6	Charcoal		-	-	-
13	4	2	Charcoal		-	-	-
14	4	2	Charcoal		-	-	-
15	4	4	Charcoal	UNSW-2001	350	34	467-301
16	4	7	Charcoal	UNSW-2002	1,062	34	1,045-801
17	4	8	Charcoal	UNSW-2003	1,731	37	1,700-1,531
18	4	10	Charcoal	UNSW-2004	452	34	523-328

Notes: All calibration was undertaken using Oxcal (Bronk and Lee, 2013), SHCal20 (Hogg et al. 2020) and are presented at 95.4% probability.

This information has been retracted
- For more information contact Tahmoor Coal

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Appendix A
Radiocarbon data

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10 March 2023

Dr Alan Williams
EMM Consulting
20 Chandos Street
St Leonards NSW, 2065

Dear Alan,

Please find below the results of the samples sent for radiocarbon analysis in Table 1**.** All samples have been assigned a unique UNSW Laboratory Code, which should be referenced for publications.

Table 1 indicates the chemical pre-treatment method used for samples and associated matrix matched backgrounds and standards. Additional details of the chemical pre-treatment and duration can be found in Turney et al., 2021 and Haines et al., 2023. Should you have any queries about the pre-treatment and analysis methods please do not hesitate to get in touch.

UNSW Laboratory Code	Sample Label	Pre treatment Code	Age* (^{14}C yr BP)	Age Error ± (^{14}C yr BP)	F^{14}C	F^{14}C ±
UNSW-1995	Sample 2	CP	1,005	35	0.8824	0.0038
UNSW-1996	Sample 3	CP	1,013	35	0.8815	0.0039
UNSW-1997	Sample 4	CP	1,070	35	0.8752	0.0038
UNSW-1998	Sample 5	CP	1,326	36	0.8478	0.0038
UNSW-1999	Sample 6	CP	1,102	35	0.8718	0.0038
UNSW-2000	Sample 11	CP	269	34	0.9670	0.0040
UNSW-2001	Sample 15	CP	350	34	0.9574	0.0040
UNSW-2002	Sample 16	CP	1,062	34	0.8761	0.0038
UNSW-2003	Sample 17	CP	1,731	37	0.8061	0.0037
UNSW-2004	Sample 18	CP	452	34	0.9453	0.0040

Table 1: Radiocarbon Analysis. *Age (^{14}C yr BP) is not reported where F^{14}C is close to or >1.

Pretreatment Code CP:

Pretreatment Code CP denotes an Acid-Base-Acid protocol for charred plant remains.

Table 1 documents the certified laboratory measurement with the corresponding UNSW laboratory code and reported as a conventional uncalibrated ^{14}C age in ^{14}C yr BP or a fractionation-corrected fraction modern ($F^{14}C$).

For publication of these data, the following conventions for the reporting of ^{14}C determinations apply:

- The laboratory measurement should be reported as a conventional ^{14}C age in ^{14}C yr BP or a fractionation-corrected fraction modern ($F^{14}C$), with the corresponding UNSW laboratory code.

- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.

- The sample material dated, and the pretreatment methods applied, should be reported. Please reference our current facility paper (Turney et al., 2021, Haines et al., 2023) as this describes in detail the analytical methods required for chemical pre-treatment and AMS analysis.

- Where data are calibrated, the calibration curve used should be reported.

Please find further detail and first approximations about the results in the appendix below. Please contact us if you have queries about our interpretation of the calibration in the appendix. Thank you for choosing the Chronos ^{14}Carbon-Cycle Facility to process your radiocarbon samples.

With best wishes,

Juee Vohra, Technical Officer j.vohra@unsw.edu.au
Dr William T Hiscock, Technical Officer w.hiscock@unsw.edu.au
Dr Christopher E Marjo, Director c.marjo@unsw.edu.au

P128 – AMS02122022_A

Reference:

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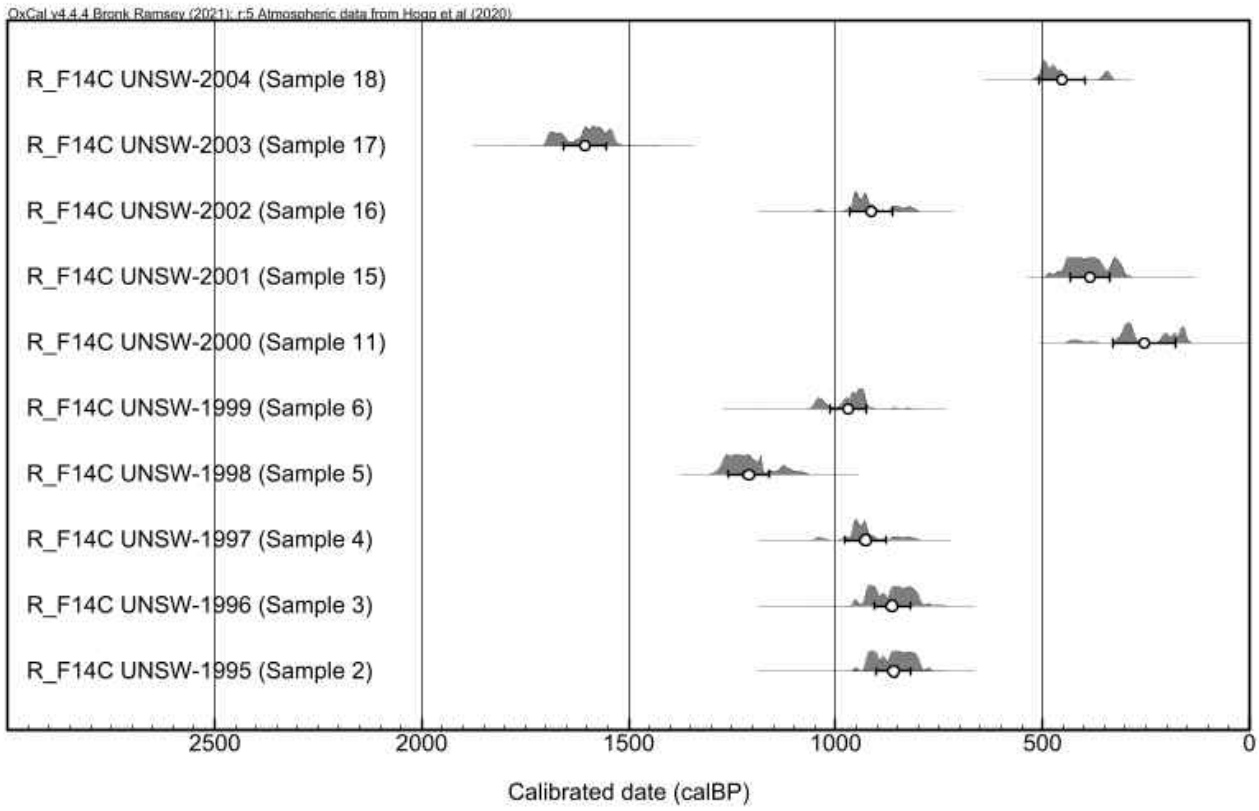
Appendix:

Please use the latest Southern Hemisphere Calibration Curve (SHCal20; Hogg et al., 2020) for the calibration of ^{14}C age determinations from terrestrial Southern Hemisphere samples, the Southern Hemisphere Bomb (region 1,2) Curve (Bomb21 SH1_2; Hua et al., 2021) for the calibration of F^{14}C measurements for 'modern' samples, and the Marine20 calibration curve (Heaton et al., 2020) for marine samples. For marine samples, please note that a local marine reservoir correction (ΔR) should always be applied (see calib.org/marine20 for more details).

Radiocarbon measurements are always reported in terms of years `before present' (BP). This figure is directly based on the proportion of radiocarbon found in the sample. It is calculated on the assumption that the atmospheric radiocarbon concentration has always been the same as it was in 1950 and that the half-life of radiocarbon is 5568 years. For this purpose, `present' refers to 1950.

UNSW Laboratory Code	Sample Label	$F^{14}C$	$F^{14}C$ Error ±	S Hemisphere Calibration Age (cal yr BP)	Age Error ± (cal yr BP)
UNSW-1995	Sample 2	0.8824	0.0038	860	42
UNSW-1996	Sample 3	0.8815	0.0039	864	44
UNSW-1997	Sample 4	0.8752	0.0038	927	50
UNSW-1998	Sample 5	0.8478	0.0038	1210	51
UNSW-1999	Sample 6	0.8718	0.0038	970	45
UNSW-2000	Sample 11	0.9670	0.0040	254	76
UNSW-2001	Sample 15	0.9574	0.0040	386	47
UNSW-2002	Sample 16	0.8761	0.0038	915	51
UNSW-2003	Sample 17	0.8061	0.0037	1605	53
UNSW-2004	Sample 18	0.9453	0.0040	453	56

Table 2: Radiocarbon ages are calibrated using the Southern Hemisphere Calibration Curve (SHCal20; Hogg et al., 2020). Southern Hemisphere Calibration (SHCal20) Age are reported (cal yr BP), `before present' (BP) refers to 1950.



Appendix B
Stone artefact report

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Analysis of Lithic Assemblage from the Teatree Hollow Rockshelter (#52-2-4471)

December 2022

Dr Trudy Doelman

Overview of Assemblage Characteristics

A total of 116 artefacts from four 0.25 cm^2 test pits were found during the excavation (Table 1). The artefact density is high with 29 artefacts per test pit. The highest concentration of artefacts was found in TP4 (n=85, 73.3%). A similar trend is seen in the distribution of the artefact weights, although a higher frequency of artefacts by weight occurs in TP3 (Table 1). Most of the artefacts were found in spit 6 (n=32, 27.6%, Table 2). In three spits (spits 4-5) 62.1% (n=72) of the assemblage was found. In general, below spit 4 the size and weight of artefacts decreases with depth. Smaller artefacts in spits 1-3 may reflect treadage or bioturbation after discard (c.f. Baker 1978, Boot 1987, Richardson 1992). In addition, in previous studies indicate that conjoining artefacts are vertically displaced by more than 40 cm in rockshelters (Richardson 1992). Hence, it is possible that spits 4-7, representing ~10-15 cm of accumulation, reflect a single occupation layer. Charcoal fragments were found in spit 3 of TP4 and spit 2 of TP2.

TP	Count	%	Total Weight (g)	%
1	1	0.9	5.92	8.0
2	12	10.3	5.01	6.8
3	18	15.5	14.02	18.9
4	85	73.3	49.1	66.3
Total	116		74.05	

Table 1. Distribution of artefacts in the assemblage

Spit	Count	%	Mean Maximum Length (mm)	Std Dev.	Total Weight (g)	%
1	1	0.9	12.9		0.44	0.6
2	3	2.6	14.3	6.0	1.7	2.3
3	8	6.9	14.3	4.1	3.84	5.2
4	14	12.1	16.8	7.9	14.42	19.5
5	26	22.4	14.1	4.6	20.58	27.8
6	32	27.6	13.2	4.2	17.51	23.6
7	16	13.8	14.4	6.1	10.08	13.6
8	8	6.9	14.1	3.5	3.53	4.8
9	1	0.9	13.8		0.51	0.7
10	2	1.7	13.9	1.6	0.59	0.8
11	3	2.6	10.8	0.3	0.59	0.8
12	2	1.7	6.5	3.0	0.26	0.4
Total	116				74.05	

Table 2. Distribution of artefacts by depth in the assemblage

The presence of backed artefacts in an assemblage indicates that it can be dated to the mid-late Holocene while an increase in milky quartz artefacts is attributed to the late Holocene (c.f. Attenbrow 2002). However, no backed artefacts were found in the Teatree Hollow Rockshelter assemblage. The assemblage is dominated by milky quartz. This dominance cannot be solely attributed to a late chronology but either the lack of other stone resources in the region and/or the high quality and preference for the locally available milky quartz.

A comparison of the complete and broken flakes by spit shows that higher numbers of broken flakes occur in spits 5 to 7. This trend maybe consistent with an exposed occupation layer with a higher impact from treadage in these spits.

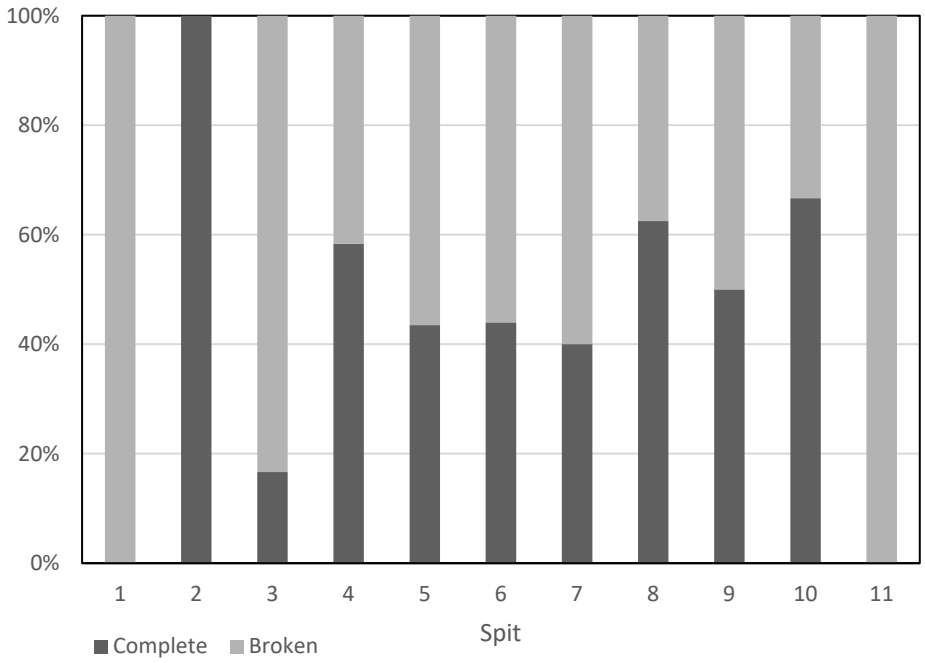

Figure 2. Frequency of complete flakes and broken flakes by splits

Complete flakes (n=45, 38.8%) singularly dominate the assemblage. Broken flakes, including distal, medial and proximal flakes, account for 40.5% (n=47) of the assemblage (Table 3). This result indicates that the assemblage is highly fragmented. Four cores, three core fragments and six split flakes were also found indicating on-site reduction (Table 3). A low frequency of tools was found in the assemblage (n=2, 1.7%).

Artefact Type	**Count**	**%**	**Mean Maximum Length (mm)**	**Std Dev.**	**Total Weight (g)**	**%**
Core	4	3.4	19.1	2.2	9.81	13.2
Core fragment	3	2.6	14.8	4.2	3.56	4.8
Complete Flake	45	38.8	14.5	6.0	30.46	41.1
Complete Split	6	5.2	17.3	5.4	5.06	6.8
Broken Flakes						
Distal Flake	24	20.7	12.4	3.7	8.2	11.1
Proximal Flake	4	3.4	13.6	4.6	2.94	4.0
Medial Flake	19	16.4	12.7	4.9	6.48	8.8
Sub-total	47	40.5	38.8	13.3	17.62	23.8
Tools						
Complete Tool	1	0.9	18.7		0.77	1.0
Proximal tool	1	0.9	16.8		0.46	0.6
Sub-total	2	1.7	35.5		1.23	1.7
Block	9	7.8	13.2	3.6	6.31	8.5

Table 3. Artefact types in the assemblage

A limited variety of raw materials were used at Teatree Hollow Rockshelter (n=5) (Table 4). As noted, most of the artefacts were made from white, milky quartz; a macrocrystalline variety (MCQ) (n=82, 92.1%). Of these, 35 were semi-translucent and 64 were opaque. The formation of the milky quartz in veins influences its flaking properties in several ways. Typically, milky quartz can vary from semi-translucent to opaque depending on the amount of gas and/or liquid inclusions trapped during formation (Knight 2016:37-38). These inclusions impact on the flaking properties of the milky quartz i.e., the whiter, opaque milky quartz has a higher number of inclusions resulting in a less conchoidal fracture and breakage during core reduction. In addition, internal fractures within the material can also create poor flaking quality. The quality of the milky quartz artefacts at Teatree Hollow Rockshelter is generally good due to the lack of internal flaws which results in a more predictable flake manufacture and less breakage during manufacture. It is likely that translucent milky quartz was preferred for artefact manufacture. The milky quartz artefacts were typically made from small water-rolled nodules, locally available, which occur in a variety of colours including grey, white/pink and brown depending on the impurities present.

Eighteen microcrystalline/cryptocrystalline quartz of chert (CCQ) occurs in the assemblage. These are attributed to five cores based on the colour (black, grey, light grey, brown and red) with most grey (n=10). The chert artefacts were only found in TP4. In addition, two silcrete artefacts were also found in TP4 while two basalt artefacts were also found in TP4 and TP3. Based on the colours and raw material types at least 11 cores were used to manufacture the artefacts in the Teatree Hollow Rockshelter assemblage. These raw material types indicate the transportation of artefacts from distant sources.

Material	Count	%	Mean Maximum Length (mm)	Std Dev.	Total Weight (g)	%
Basalt	2	1.7	17.4	8.8	1.58	2.1
Chert	18	15.5	15.7	3.7	8.77	11.8
Crystal Quartz	2	1.7	10.9	1.1	0.42	0.6
Milky Quartz	89	76.7	13.2	4.4	52.87	71.4
Fine Silcrete	1	0.9	19.3		0.39	0.5
Medium Silcrete	1	0.9	20.6		2.2	3.0
Quartzite	1	0.9	24.8		1.78	2.4
Tuff	2	1.7	23.6	21.2	6.04	8.2

Table 4. Raw Material types in the assemblage by size and weight

The cortex (or weathered exterior of the parent rock) provides information about the type of stone sources used (i.e., a primary or secondary source) (c.f. Doelman 2008; Doelman et al. 2015). In general, artefacts with a rough or weathered cortex were acquired from a primary source (or an *in-situ* outcrop). Artefacts with a smooth or water-rolled cortex originate from a secondary source (e.g., a cobble from a waterway). However, small water-rolled quartz pebbles have also been reworked from the Hawksbury sandstone into colluvial deposits. Most of the artefacts, independent of raw material type, have a water-rolled cortex (Table 5). Milky quartz and chert also have a rough or outcrop cortex. Of the milky quartz artefacts four have a rough cortex and it is likely these were obtained from an exposed vein. The artefacts at Teatree Hollow Rockshelter were made from small nodules/pebbles

that were highly rounded. In addition, most of the milky quartz artefacts nearly half have cortex (n=49, 55.1%). This result can be attributed to the small size of the milky/crystal quartz nodules/pebbles that were used as cores. These cores have a maximum length of ~26 mm and a maximum weight of 1.8 g with a mean length of ~20 mm and weight of 7.4 g. A comparison with the total weight of milky quartz (52.9 g) suggests that ~7 nodules/pebbles were worked on-site.

Material	Cortex	Count	%	Polish	Outcrop	Water-Rolled
Basalt				1		
Chert	0%	14	77.8		1	3
Crystal Quartz	0%	2	100.0			
Fine Silcrete	0%	1				
Milky Quartz	0%	49	55.1		4	36
Medium Silcrete	0%	1	100.0			1
Tuff	0%	1	50.0			1

Table 5. Cortex percentage and type on the raw material types in the assemblage

Four cores were found in the assemblage (Figure 2). All cores were made from white, milky quartz. Two cores have a water-rolled cortex and were made on a nodule. All cores were bipolar and anvil rested with elongated flake scars. While there are costs involved in flaking quartz (e.g., hardness and high failure rate) the benefits include a hard and sharp working edge requiring less resharpening (Doelman 2019). These nodules are also locally available requiring less costs in procurement and transportation. The quality of the material if high allows for the manufacture of elongated flakes on suitable pebbles.

Id	TP	Cortex Type	Core Type	Core Body	Scar Form	Core Scars	Length (mm)	Weight (g)
114	4		Bipolar	unknown	Elongated	1-2	16.2	0.55
113	4		Bipolar	unknown	Elongated	3-5	21.5	1.82
27	4	Water-Roll	Bipolar	Nodule	Elongated	1-2	20	4.97
86	3	Water-Roll	Bipolar	Nodule	Elongated	3-5	18.7	2.47

Table 5. Characteristics of the cores in the assemblage

Figure 2. Examples of bipolar cores in the assemblage. Left to right, id=113, id=114. Scale=1cm

Indeterminate and elongated flakes dominant the milky quartz assemblage (Table 6). Bipolar flakes were also identified in the assemblage (n=5). The bipolar technique is used to extend the uselife of a core or is commonly used on small milky quartz pebbles to remove flakes (Holdaway and Stern: 2004: 194). The hardness of milky quartz (mohs scale hardness=7) makes it difficult to flake using a free-hand method. Equally, as the core decreases in size during reduction a bipolar method is used to extend its uselife (Witter 1992: 43-44). The flakes, independent of form, are small (Table 6). The small number and size of expanding flakes indicates they were a by-product core reduction with the primary aim to manufacture elongated flakes.

Form	Count	Mean Axial Length (mm)	Std Dev.
Bipolar	5	12.4	2.9
Block	1	21.4	
Elongated	9	14.9	4.5
Expanding	5	9.1	5.0
Indeterminate	11	10.0	3.0
Split Pebble	1	14.1	

Table 6. Flake forms of milky quartz complete flakes found in the assemblage

Two tools were found during the test pitting (Figure 3). The tools include a burin and a convex scraper (Figure 3). These tools were made from a black or grey chert. Both were found in spit 6 of TP4. Due to the hardness of milky quartz it is difficult to identify tool use and it is often not retouched. The advantage of quartz is that it retains a sharp and strong working edge.

Id	Test Pit	Class	Tool Type	Material	Colour	Form	Maximum Length (Mm)
93	4	Proximal Tool	Burin	Chert	Grey	Elongated	16.8
94	4	Complete Tool	Convex-scraper	Chert	Black	Indeterminate	18.7

Table 7. Tool Types found in the assemblage

Figure 3. Examples of tools found in the assemblage, left id=93; right id=94. Scale=1cm

A further example of tool use is seen in the presence of two basalt flakes of spit 6 in TP3 (ids=32) and spit 4 of TP4 (id=9). These flakes show the reworking of an axe/hatchet. Often during use axes are broken and flaking is undertaken to rework and maintain the tool.

Summary

The raw material types and assemblage characteristics reflect the availability and physical characteristics of the sources in the region. At least 11 cores were worked on site. The milky quartz cores were made on small pebbles obtained from only a secondary source (possibly colluvial) with some use of a primary outcropping vein. The resulting artefacts are small. There are three reasons for this; 1. the small size of the available milky quartz nodules from nearby waterway, 2. a preference for higher quality quartzes, showing greater core reduction and 3., the high failure rate of quartz during reduction creates a high number of broken flakes and a high frequency of cores – as few complete flakes can be manufactured from each core. Although manufacturing quartz artefacts produces as high failure rate (i.e., broken flakes) the higher frequency of broken flakes in spits 5-7 may also indicate treadage and breakage during occupation. It is also likely that flakes of silcrete and chert, rather than cores, were brought to the area and discarded. The tools represent larger flakes of chert transported to the site and used. It is likely that the assemblage is dated to the late-Holocene based on the presence of elongated flakes and scar forms on the cores combined with the use of the bipolar technique.

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Appendix C
Stone artefact catalogue

EMM
creating opportunities

ID	SQ	XY	SPIT	DATA CLASS	MATERIAL	COLOUR	QUARTZ TYPE	DISTIAL END	INITIATION	CORTEX %	CORTEX TYPE	FORM	PLATFORM TYPE	SCAR DIRECTION	TOOL TYPE1	CORE TYPE	CORE BODY	SCAR FORM	CPLATNO	STEP TERMINATIONS	HINGE TERMINATIONS	LENGTH (mm)	AXIAL LENGTH (mm)	WIDTH (mm)	THICKNESS (mm)	PLATFORM WIDTH (mm)	PLATFORM THICKNESS (mm)	CORE SCAR No.	WEIGHT (g)	COMMENTS
1	4		8	BROKFLAKE	MQUART	WHITE	SEMI			0%		INDETER							0			14.4	0	0	0	0	0		0.45	
2	4		8	BROKFLAKE	MQUART	WHITE	SEMI			0%		INDETER							0			13.7	0	0	0	0	0		0.38	
3	4		8	COMPFLAKE	MQUART	CLEAR	SEMI	FEATHER	BIPLOAR	0%		ELONG	CRUSH	0					0			10.5	10.5	6	1.2	0	0		0.09	
4	4		8	COMPFLAKE	MQUART	WHITE	SEMI	CRUSH	BIPLOAR	100%	WATER-ROLL	EXPAND	CRUSH	NA					0			18.8	18	9.1	2.2	0	0		0.6	
5	4		8	COMPFLAKE	MQUART	WHITE	OPAQ	CRUSH	BIPLOAR	0%		ELONG	CRUSH	180					0			12	12	6.3	2.9	0	0		0.26	
6	4		8	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	BIPLOAR	1-25%	ROUGH	INDETER	UNI	0					0			19.5	17.9	13.1	6.2	13.7	6.1		1.39	
7	4		8	BROKFLAKE	CHERT	LGREY	OPAQ			0%		INDETER							0			13.9	0	0	0	0	0		0.14	weathered
8	4		8	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	100%	WATER-ROLL	INDETER	UNI	NA					0			10.1	10.1	7.2	2.2	7.3	1		0.22	
9	4		5	COMPFLAKE	BASALT	BLACK	OPAQ	FEATHER	HERTIZEN	51-99%	POLISH	EXPAND	CRUSH	NA					0			23.6	16.8	21.1	3.1	0	0		1.4	AXE FLAKE
10	4		5	COMPFLAKE	CHERT	BLACK	OPAQ	FEATHER	HERTIZEN	100%	WATER-ROLL	EXPAND	UNI	NA					0			17.1	8.6	17	2.6	8.5	3.2		0.52	
11	4		5	COMPFLAKE	CHERT	LGREY	OPAQ	FEATHER	BENDING	1-25%	WATER-ROLL	EXPAND	CORTICAL	0					0			11	9.9	7.5	3.1	12.3	4.3		0.29	
12	4		5	BROKFLAKE	CHERT	GREY	OPAQ			0%		INDETER							0			15.3	0	0	0	0	0		0.24	
13	4		5	DISTFLAKE	MQUART	WHITE	OPAQ	FEATHER		51-99%	WATER-ROLL	EXPAND							0			15.8	0	0	0	0	0		0.63	
14	4		5	COMPSPLIT	MQUART	WHITE	OPAQ	FEATHER		0%		INDETER							0			14.2	0	0	0	0	0		0.25	
15	4		5	COMPFLAKE	MQUART	WHITE	OPAQ	CRUSH	BIPLOAR	51-99%	WATER-ROLL	BIPOLAR	CRUSH	0					0			18.5	17	12.3	3.8	0	0		1.08	
16	4		5	COMPSPLIT	MQUART	WHITE	SEMI	FEATHER		0%		INDETER							0			11.6	0	0	0	0	0		0.16	
17	4		5	DISTFLAKE	CHERT	BLACK	OPAQ	FEATHER		0%		EXPAND							0			9.2	0	0	0	0	0		0.08	FRACTURED
18	4		5	BROKFLAKE	MQUART	WHITE	SEMI			0%		INDETER							0			12.2	0	0	0	0	0		0.47	
19	4		5	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	BIPLOAR	0%		INDETER	UNI	180					0			10.8	9.1	7.5	3.3	7.6	4.4		0.38	
20	4		5	DISTFLAKE	MQUART	WHITE	OPAQ	FEATHER		0%		INDETER							0			13.7	0	0	0	0	0		0.46	
21	4		5	COMPFLAKE	MSILCRET E	brown	OPAQ	ABRUPT	HERTIZEN	0%		EXPAND	UNI	0					0			20.6	13.2	18.7	5.7	17	7.5		2.2	burnt
22	4		5	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		0%		INDETER							0			10.2	0	0	0	0	0		0.22	
23	4		5	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	0%		INDETER	CRUSH	0					0			10	9.9	7.7	2.5	0	0		0.21	
24	4		5	COMPFLAKE	MQUART	W/P	OPAQ	FEATHER	BIPLOAR	100%	WATER-ROLL	ELONG	CRUSH	NA					0			19.1	19.1	8	4.6	0	0		0.71	
25	4		5	DISTFLAKE	MQUART	WHITE	OPAQ	CORTICAL		100%	WATER-ROLL	EXPAND							0			12.7	0	0	0	0	0		0.58	
26	4		5	BLOCK	MQUART	WHITE	OPAQ			51-99%	WATER-ROLL								0			14.7	0	0	0	0	0		0.89	
27	4		5	CORE	MQUART	WHITE	SEMI			51-99%	WATER-ROLL					BIPOLAR	NODULE	ELONG	1	0	0	20	0	19.8	10.3	0	0	1-2	4.97	size of nodule
28	4	37-31	5	BROKFLAKE	MQUART	WHITE	OPAQ			0%		INDETER							0			6.9	0	0	0	0	0		0.08	
29	4	23-12	5	BROKFLAKE	MQUART	WHITE	OPAQ			100%	WATER-ROLL	EXPAND							0			6.6	0	0	0	0	0		0.06	
30	4	18-12	5	BROKFLAKE	MQUART	WHITE	OPAQ			0%		EXPAND							0			9.4	0	0	0	0	0		0.05	
31	3		6	BLOCK	MQUART	WHITE	OPAQ			26-50%	WATER-ROLL								0			12.4	0	0	0	0	0		0.54	
32	3		6	DISTFLAKE	BASALT	BLACK	OPAQ	CORTICAL		100%	POLISH	EXPAND							0			11.2	0	0	0	0	0		0.18	
33	3	41-14	6	COMPFLAKE	MQUART	WHITE	SEMI	ABRUPT	HERTIZEN	0%		BLOCK	UNI	0					0			23.6	21.4	10.4	8.6	10.3	3		2.62	
34	3	16-45	6	COMPFLAKE	MQUART	WHITE	OPAQ	ABRUPT	BIPLOAR	1-25%	WATER-ROLL	ELONG	CORTICAL	0					0			19.8	17.5	8.7	4.2	6.4	4.4		0.94	
35	3	37-4	7	PROXFLAKE	MQUART	brown	SEMI			26-50%	WATER-ROLL	INDETER	CORTICAL						0			19.8	0	0	0	14.5	6.5		2.11	
36	4		7	BROKFLAKE	MQUART	WHITE	SEMI			26-50%	VEIN	INDETER							0			10.1	0	0	0	0	0		0.26	
37	4		7	COMPFLAKE	MQUART	WHITE	SEMI	CRUSH	BIPLOAR	100%	WATER-ROLL	ELONG	CRUSH	0					0			16.6	16.5	6.4	3.4	0	0		0.48	
38	4		7	PROXFLAKE	MQUART	WHITE	OPAQ			0%		INDETER	CRUSH						0			8.6	0	0	0	0	0		0.06	
39	4		7	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	HERTIZEN	0%		EXPAND	CRUSH	90					0			8.3	6.4	8.4	1.2	3.6	0.8		0.11	
40	4		7	DISTFLAKE	MQUART	WHITE	OPAQ	FEATHER		26-50%	WATER-ROLL	INDETER							0			13	0	0	0	0	0		0.43	
41	4		7	BROKFLAKE	MQUART	WHITE	OPAQ			0%		INDETER							0			11.8	0	0	0	0	0		0.18	
42	4		7	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		0%		EXPAND							0			7.6	0	0	0	0	0		0.1	
43	4		7	COMPFLAKE	MQUART	GREY	SEMI	FEATHER	BIPLOAR	0%		ELONG	UNI	0					0			22.6	22.8	8.9	4.8	3.7	2.2		0.84	
44	4		7	BLOCK	MQUART	WHITE	OPAQ			1-25%	ROUGH								0			13.7	0	0	0	0	0		0.84	
45	4		7	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	HERTIZEN	0%		INDETER	UNI	90					0			18.1	12.3	12.3	4.5	13.3	4.7		1.03	
46	4		7	DISTFLAKE	MQUART	WHITE	OPAQ	FEATHER		0%		INDETER							0			7	0	0	0	0	0		0.13	
47	4		7	COMPFLAKE	QUARTZITE	PINK	OPAQ	FEATHER	BIPLOAR	1-25%	WATER-ROLL	INDETER	CRUSH	0					0			24.8	23	14.3	5.3	0	0		1.78	
48	4	4-26	7	BROKFLAKE	CHERT	GREY	OPAQ			0%		INDETER							0			25.2	0	0	0	0	0		1.28	
49	4	4-26	7	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	0%		INDETER	UNI	0					0			9.9	8.5	7.9	2.1	3.1	1.5		0.18	
50	4	1-12	7	BROKFLAKE	MQUART	WHITE	OPAQ			51-99%	WATER-ROLL	INDETER							0			13.4	0	0	0	0	0		0.27	

ID	SQ	XY	SPIT	DATA CLASS	MATERIAL	COLOUR	QUARTZ TYPE	DISTIAL END	INITIATION	CORTEX %	CORTEX TYPE	FORM	PLATFORM TYPE	SCAR DIRECTION	TOOL TYPE1	CORE TYPE	CORE BODY	SCAR FORM	CPLATNO	STEP TERMINATIONS	HINGE TERMINATIONS	LENGTH (mm)	AXIAL LENGTH (mm)	WIDTH (mm)	THICKNESS (mm)	PLATFORM WIDTH (mm)	PLATFORM THICKNESS (mm)	CORE SCAR No.	WEIGHT (g)	COMMENTS
51	2		5	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	UNCLEAR	0%		EXPAND	CRUSH	0					0			9.7	6.8	9.7	1.4	0	0		0.14	
52	2		1	PROXFLAKE	MQUART	WHITE	OPAQ			0%		INDETER	UNI						0			12.9	0	0	0	7.2	1.6		0.44	
53	4		2	BLOCK	MQUART	WHITE	OPAQ			26-50%	ROUGH								0			20.5	0	0	0	0	0		0.75	
54	2		2	COMPFLAKE	MQUART	WHITE	OPAQ	CRUSH	BIPLOAR	100%	WATER-ROLL	BIPOLAR	CRAZE	NA					0			13.9	13.3	9.2	5.4	0	0		0.78	
55	2		2	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	BIPLOAR	0%		INDETER	CRUSH	90					0			8.5	8.3	7.7	2.3	0	0		0.17	
56	2		3	DISTFLAKE	MQUART	WHITE	OPAQ	FEATHER		0%		ELONG							0			11.2	0	0	0	0	0		0.18	
57	2		3	DISTFLAKE	MQUART	GREY	OPAQ	FEATHER		0%		INDETER							0			9	0	0	0	0	0		0.1	
58	2		3	BLOCK	MQUART	WHITE	SEMI			26-50%	WATER-ROLL								0			9.4	0	0	0	0	0		0.49	
59	2		4	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	BIPLOAR	0%		ELONG	UNI	180					0			8.8	8.6	5.2	1.2	2.8	1.1		0.05	
60	2		4	COMPSPLIT	MQUART	WHITE	OPAQ	CRUSH		1-25%	WATER-ROLL	BIPOLAR							0			26.2	0	0	0	0	0		1.81	
61	4		3	DISTFLAKE	CHERT	GREY	OPAQ	HINGE		0%		EXPAND							0			18.4	0	0	0	0	0		0.66	
62	4		3	COMPFLAKE	CHERT	GREY	OPAQ	FEATHER	HERTIZEN	0%		INDETER	UNI	0					0			14.2	10.9	8.9	3.2	5.6	3.6		0.33	
63	4		3	BROKFLAKE	CHERT	GREY	OPAQ			0%		INDETER							0			14.8	0	0	0	0	0		0.18	
64	4		3	COREFRAG	CHERT	GREY	OPAQ			0%									0			17.9	0	0	0	0	0		1.51	
65	4		3	DISTFLAKE	FSILCRETE	RED	OPAQ	FEATHER		0%		INDETER							0			19.3	0	0	0	0	0		0.39	
66	4		10	BROKFLAKE	MQUART	WHITE	OPAQ			0%		INDETER							0			12.8	0	0	0	0	0		0.2	
67	1		4	COMPFLAKE	TUFF	GREY	OPAQ	FEATHER	UNCLEAR	1-25%	WATER-ROLL	PLATREJOV	CORTICAL	90					0			38.6	23.6	36.8	8.1	10	4.4		5.92	overhang on prj
68	4		4	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		0%		EXPAND							0			14.9	0	0	0	0	0		0.48	
69	4		4	DISTFLAKE	MQUART	WHITE	OPAQ	CRUSH		0%		BIPOLAR							0			15.2	0	0	0	0	0		0.53	
70	4		4	BROKFLAKE	MQUART	WHITE	SEMI			0%		INDETER							0			21.1	0	0	0	0	0		1.55	
71	4		4	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		26-50%	WATER-ROLL	INDETER							0			18.1	0	0	0	0	0		0.8	
72	4		4	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	0%		BIPOLAR	CRUSH	90					0			10.9	10.9	7.3	3.8	0	0		0.33	
73	4		4	COMPSPLIT	CHERT	RED	OPAQ	CORTICAL		100%	ROUGH	INDETER							0			16.6	0	0	0	0	0		0.68	vein
74	4		9	BLOCK	MQUART	WHITE	OPAQ			0%									0			13.8	0	0	0	0	0		0.51	
75	3		4	COMPFLAKE	MQUART	WHITE	OPAQ	CORTICAL	BIPLOAR	100%	WATER-ROLL	SPLITPEB	CRUSH	NA					0			17.4	14.1	15	6.1	0	0		1.46	
76	3		4	COMPFLAKE	CQUART	CLEAR	SEMI	FEATHER	BENDING	0%		INDETER	CRUSH	180					0			10.1	10.1	8.4	2.9	0	0		0.21	
77	3		4	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	1-25%	WATER-ROLL	INDETER	CORTICAL	0					0			10.3	8.2	7.3	3.3	7.3	2.5		0.23	
78	3		4	BROKFLAKE	MQUART	CLEAR	SEMI			0%		INDETER							0			10.5	0	0	0	0	0		0.16	
79	3		4	COMPFLAKE	CHERT	brown	SEMI	FEATHER	UNCLEAR	1-25%	WATER-ROLL	ELONG	MISSING	0					0			17	17	7.5	1.6	0	0		0.21	
80	2		10	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	UNCLEAR	0%		ELONG	UNI	180					0			15	14.1	7.9	3.2	5.8	3.8		0.39	
81	2		6	BLOCK	MQUART	WHITE	OPAQ			0%									0			10.2	0	0	0	0	0		0.23	
82	2		6	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		0%		EXPAND							0			8.2	0	0	0	0	0		0.23	
83	3		12	BLOCK	MQUART	WHITE	SEMI			0%									0			8.7	0	0	0	0	0		0.25	
84	3		12	BROKFLAKE	MQUART	WHITE	OPAQ			0%		INDETER							0			4.4	0	0	0	0	0		0.01	
85	3		5	COMPFLAKE	CHERT	BLACK	OPAQ	FEATHER	HERTIZEN	0%		INDETER	UNI	0					0			13.3	11.1	10.5	3	4.1	2.1		0.32	
86	3		5	CORE	MQUART	WHITE	OPAQ			26-50%	WATER-ROLL					BIPOLAR	NODULE	ELONG	1	0	0	18.7	0	13.9	9.7	0	0	3-5	2.47	
87	3	30-40	5	COMPSPLIT	MQUART	WHITE	OPAQ	FEATHER		100%	WATER-ROLL	BIPOLAR							0			21.2	0	0	0	0	0		1.72	
88	3		11	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	BIPLOAR	1-25%	WATER-ROLL	BIPOLAR	CRUSH	180					0			10.9	10.7	9.1	3.3	0	0		0.26	
89	3		11	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	1-25%	WATER-ROLL	INDETER	CRUSH	180					0			10.5	9.9	7.6	2.1	0	0		0.22	
90	3		11	DISTFLAKE	MQUART	GREY	OPAQ	FEATHER		26-50%	WATER-ROLL	INDETER							0			11	0	0	0	0	0		0.11	
91	4		6	COMPFLAKE	CHERT	GREY	OPAQ	FEATHER	HERTIZEN	0%		INDETER	CRUSH	0					0			13.3	12.9	9.2	1.7	0	0		0.21	
92	4		6	DISTFLAKE	CHERT	GREY	OPAQ	FEATHER		0%		EXPAND							0			10.6	0	0	0	0	0		0.18	
93	4		6	PROXTOOL	CHERT	GREY	OPAQ			0%		ELONG	CRUSH		BURIN				0			16.8	0	0	0	0	0		0.46	
94	4		6	COMPTOOL	CHERT	BLACK	OPAQ	STEP	UNCLEAR	0%		INDETER	MISSING	0	CONSCRAP				0			18.7	18.1	10.1	3.8	0	0		0.77	
95	4		6	BLOCK	MQUART	WHITE	OPAQ			26-50%	WATER-ROLL								0			15.2	0	0	0	0	0		1.81	
96	4		6	BROKFLAKE	MQUART	WHITE	OPAQ			0%		ELONG							0			16.4	0	0	0	0	0		0.41	
97	4		6	PROXFLAKE	MQUART	WHITE	OPAQ			100%	WATER-ROLL	EXPAND	UNI						0			13.3	0	0	0	3.3	1.2		0.33	
98	4		6	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	100%	WATER-ROLL	BIPOLAR	CRUSH	90					0			9.9	9.9	7	3.2	0	0		0.24	
99	4		6	COMPFLAKE	MQUART	WHITE	SEMI	CRUSH	HERTIZEN	0%		EXPAND	UNI	180					0			12.3	8	10.8	3.7	10	5		0.55	
100	4		6	DISTFLAKE	MQUART	WHITE	OPAQ	CRUSH		0%		INDETER							0			8.9	0	0	0	0	0		0.25	

ID	SQ	XY	SPIT	DATA CLASS	MATERIAL	COLOUR	QUARTZ TYPE	DISTIAL END	INITIATION	CORTEX %	CORTEX TYPE	FORM	PLATFORM TYPE	SCAR DIRECTION	TOOL TYPE1	CORE TYPE	CORE BODY	SCAR FORM	CPLATNO	STEP TERMINATIONS	HINGE TERMINATIONS	LENGTH (mm)	AXIAL LENGTH (mm)	WIDTH (mm)	THICKNESS (mm)	PLATFORM WIDTH (mm)	PLATFORM THICKNESS (mm)	CORE SCAR No.	WEIGHT (g)	COMMENTS
101	4		6	COMPSPLIT	MQUART	WHITE	SEMI	CRUSH		100%	WATER-ROLL	BIPOLAR							0			14	0	0	0	0	0		0.44	
102	4		6	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		0%		EXPAND							0			9.9	0	0	0	0	0		0.24	
103	4		6	COMPFLAKE	MQUART	WHITE	SEMI	FEATHER	HERTIZEN	1-25%	WATER-ROLL	EXPAND	CORTICAL	0					0			9.9	6.4	8.9	2.4	4.2	1.6		0.18	
104	4		6	COREFRAG	MQUART	WHITE	OPAQ			26-50%	WATER-ROLL								0			10	0	0	0	0	0		0.6	
105	4		6	COMPFLAKE	CQUART	WHITE	SEMI	FEATHER	UNCLEAR	0%		EXPAND	MISSING	0					0			11.6	10	11.6	1.7	0	0		0.21	
106	4		6	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	HERTIZEN	0%		INDETER	CRUSH	0					0			7.5	7.3	5.9	0.9	0	0		0.05	
107	4		6	DISTFLAKE	MQUART	WHITE	OPAQ	FEATHER		100%	WATER-ROLL	ELONG							0			10	0	0	0	0	0		0.19	
108	4		6	BROKFLAKE	MQUART	WHITE	SEMI	FEATHER	HERTIZEN	0%		EXPAND	UNI	0					0			8.7	5	0	0	0	0		0.11	
109	4		6	COMPFLAKE	MQUART	WHITE	OPAQ	FEATHER	BIPLOAR	1-25%	WATER-ROLL	ELONG	CRUSH	180					0			13.1	13.3	7.5	2.5	0	0		0.31	
110	4		6	COMPFLAKE	MQUART	WHITE	OPAQ	CRUSH	BIPLOAR	51-99%	WATER-ROLL	INDETER	UNI	0					0			10	8.2	6.4	2.9	5.1	3.6		0.24	
111	4		6	DISTFLAKE	MQUART	WHITE	SEMI	FEATHER		0%		EXPAND							0			13.4	0	0	0	0	0		0.34	
112	4		6	COMPFLAKE	TUFF	GREY	OPAQ	HINGE	HERTIZEN	0%		INDETER	UNI	0					0			8.6	7.8	6.5	1.7	3.8	1.6		0.12	
113	4		6	CORE	MQUART	WHITE	OPAQ			0%						BIPOLAR	NONDIAG	ELONG	1	0	0	21.5	0	11.9	7.9	0	0	3-5	1.82	
114	4		6	CORE	MQUART	WHITE	SEMI			0%						BIPOLAR	NONDIAG	ELONG	1	0	0	16.2	0	6.8	5	0	0	1-2	0.55	
115	4		6	DISTFLAKE	CHERT	GREY	OPAQ	FEATHER		0%		EXPAND							0			19.1	0	0	0	0	0		0.71	
116	4		6	COREFRAG	MQUART	WHITE	OPAQ			51-99%	WATER-ROLL								0			16.6	0	0	0	0	0		1.45	test split pebble

Appendix D

Photographic record of the excavations

EMM
creating opportunities

This information has been retracted
- For more information contact Tahmoor Coal

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